FINANCIAL STABILITY REPORT

December 2019

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European Insurance and
Occupational Pensions Authority

FINANCIAL STABILITY REPORT

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PART II
THEMATIC ARTICLES

FOREWORD BY THE CHAIRMAN

Over the past six months, we have seen the risks for a prolonged low yield environment intensify. A combination of a weakening economic outlook, increased downside risks and ongoing uncertainties about trade disputes and Brexit have ushered in a new round of monetary easing by central banks, which has been accompanied by a sharp decline in longer-term yields. Interest rates reached record lows in August 2019 and an increasing number of EU countries now observe negative yields even at longer maturities. Market signals also suggest that interest rates will remain lower for longer than anticipated at the beginning of the year. This low for long environment has significant consequences for the business models of insurers and pension funds, putting pressure on both the capital position and long-term profitability.

On the one hand, the low long-term interest rates directly affect the capital position of insurers and pension funds with nominally guaranteed liabilities and the low yield environment makes it increasingly challenging for insurers and pension funds to meet the promises and guarantees made in the past. In this regard, we continue to see the clear benefits of Solvency II, as the market-consistent and risk-based regulatory framework has helped price in the risk, build resilience and enhance the risk management practices of insurers. At the same time, it is important that the regulatory framework continues to remain robust in the future and adequately reflects the risks faced by insurers in a low for long environment. As such, it is crucial that these elements are addressed in the currently ongoing Solvency II review to ensure that promises can continue to be met in the future.

The low yield environment also has important implications for the business model of insurers and pension funds going forward, as we see a gradual shift away from guaranteed products towards unit-linked and defined contribution products, where the investment risks are borne by the policyholder or beneficiary. While this shift may reduce direct financial risks for insurers and pension funds, it requires increased supervisory attention for potential conduct issues in the provisions of these products, which may carry significant reputational risks.

Finally, cyber and climate change risks continue to demand attention from insurers, pension funds and supervisors alike. Regarding the former, we see that insurers and pension funds are increasingly susceptible to cyber risks as the digital transformation continues, while also bringing new opportunities for insurers in the form of cyber underwriting. In fact, a well developed and mature cyber insurance market can be a crucial enabler of the digital economy and make a valuable contribution to enhancing cyber resilience of individuals, businesses and organisations. However, ensuring the sound provision of cyber insurance in Europe requires good quality data on cyber incidents and appropriate cyber risks management tools. From supervisors, this also requires increased attention for potential non-affirmative coverages, accumulation risk and the potential system-wide impact of cyber incidents.

Regarding climate change risks, insurers and pension funds can play a key role in the transition towards a low carbon economy as major institutional investors, but this transformation carries significant investment risks as well. It is therefore crucial that both insurers and pension funds actively incorporate climate change risks in their own risk

management frameworks. At the same time, climate change can also have a significant impact on the liabilities of non-life insurers and reinsurers, as extreme weather related events become more frequent and severe.

At EIOPA, we have taken several initiatives to pro-actively tackle the climate challenge. We have analysed potential climate-sensitive exposures in insurance investment portfolios in previous Financial Stability Reports, while the stress test for IORPs conducted this year also included an assessment of potential transition risks for pension funds. Furthermore, in September 2019, we published an Opinion on integrating sustainability and climate change risks into the Solvency II framework. Next year, we will build on this work and perform a sensitivity analysis on the investments of European insurers to assess transition risks and potential misalignment with the Paris agreement climate goals and continue to work on methodologies for climate change stress testing to be used in future stress test exercises. Analysing the potential impact of climate change is challenging and requires close cooperation between different fields of academia, economics, policymakers and financial regulators. In this respect, the thematic article on the impact of climate change on the sovereign bonds portfolio of insurers included in this report provides a great example of this cooperation and we look forward to enhancing this cooperation even more going forward to ensure that new emerging risks are incorporated into supervisory frameworks.

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Gabriel Bernardino

EXECUTIVE SUMMARY

The global and European economic outlook has deteriorated in the past months with weakening industrial production and business sentiment and ongoing uncertainties about trade disputes and Brexit. In particular, the "low for long" risk has resurfaced in the EU, as interest rates reached record lows in August 2019 and an increasing number of countries move into negative yield territory for their sovereign bonds even at longer maturities in anticipation of a further round of monetary easing by central banks and a general flight to safety. Bond yields and swap rates have since slightly recovered again, but protracted low interest rates form the key risk for both insurers and pension funds and put pressure on both the capital position and long-term profitability. Large declines in interest rates can also create further incentives for insurers and pension funds to search for yield, which could add to the build-up of vulnerabilities in the financial sector if not properly managed.

Despite the challenging environment, the European insurance sector remains overall well capitalized with a median SCR ratio of 212% as of Q2 2019. However, a slight deterioration could be observed for life insurers in the first half of 2019 and the low interest rate environment is expected to put further pressures on the capital positions of life insurers in the second half of 2019. At the same time, profitability improved in the first half of 2019, mainly due to valuation gains in the equity and bond portfolios of insurers. Nevertheless, the low yield environment is expected to put additional strains on the medium to long term profitability of insurers as higher yielding bonds will have to be replaced by lower yielding bonds, which may make it increasingly difficult for insurers to make investment returns in excess of guaranteed returns issued in the past, which are still prevalent in many countries.

Regarding the reinsurance sector, the first half of 2019 has been marked by relatively benign catastrophe activity, with global insured losses significantly below long-term levels and the record losses observed in the last two years. Coupled with the improved stock market performance in the beginning of 2019, this has benefited the profitability and solvency position of the European reinsurance sector. Growth in global reinsurance capital has been supported mostly by traditional capital, and, to a lesser extent, alternative reinsurance. While outstanding volumes of ILS instruments have continued to increase in 2019, new issuance volumes appear more moderate compared to the previous two years reflecting the impact of recent natural disasters and potential future implications of climate change.

Finally, the European pension fund sector was significantly affected by the worsening economic environment in 2018, taking its toll on both the financial situation of DB pension funds and on the accumulated savings of members and beneficiaries in DC funds. In particular, the persistently low interest rates has kept the market values of DB pension obligations high due to the low discount rates. In almost all Member States cover ratios (ratio of assets covering the pension obligations) decreased and in some cases fell below 100%, with the outlook continuing to look challenging in light of the slowdown in the global economy and the pressure on the interest rates. Asset values were also significantly impaired towards the end of 2018, in particular for investments in equities.

PART I

1. KEY DEVELOPMENTS

The global and European economic outlook has deteriorated in the past months with weakening industrial production and business sentiment in key sectors and increasing uncertainties about trade disputes, political developments and Brexit. Coupled with continued subdued inflation in both the Eurozone and the EU, this has triggered a new round of monetary easening in September 2019 which has been accompanied by a sharp decline in (long-term) interest rates reaching record low levels.

The "low for long" risk has resurfaced in the EU, with an increasing number of countries moving into negative yield territory for their sovereign bonds even at longer maturities. Protracted low interest rates form the key risk for both insurers and pension funds and put pressure on both the capital position and long-term profitability. Large declines in interest rates can also create further incentives for insurers and pension funds to search for yield, which could add to the build-up of vulnerabilities in the financial sector if not properly managed and lead to stretched valuations in asset markets.

Overall, equity markets have rebounded strongly following the correction in the US market in December 2018, albeit with increase volatility in recent months, reflecting the uncertainties on trade negotiations, political developments, Brexit and concerns about the global economy. Credit spreads also remain low by historical standards and increased lending to highly leveraged households, corporates and sovereigns fuels potential financial imbalances. A sudden tightening of financial conditions could therefore trigger substantial investment losses for insurers and pension, especially for exposures to highly indebted corporates and sovereigns. The risk of a sudden reassessment of risk premia therefore remains, despite the intensification of the low for long scenario.

Furthermore, climate risks remain one of the focal points for the insurance industry. Environmental, Social and Governance (ESG) factors are increasingly shaping investment decisions of insurers and pension funds and an alliance of worldwide relevant pension funds and insurers was recently announced at the UN Secretary-General's Climate Action Summit, committing to transition their investment portfolios to net-zero greenhouse gas emissions by 2050. At the same time, transition and physical risks remain

for investments in climate-sensitive sectors, in particular in the case of a disorderly transition to a carbon-neutral economy, whereas increased physical risks could trigger additional underwriting losses for non-life insurers.

Finally, amid increasing frequency and sophistication of cyber-attacks, fast digital transformation and increased use of big data and cloud computing, a sound cyber resilience framework for insurers is crucial to ensure a well-functioning financial system. On top of that, developing a sound, mature European cyber insurance market could enable the transition towards the digital economy and enhance overall cyber resilience in the economy. For that, two elements are essential: the definition of a consistent and harmonised taxonomy that enables the compilation of information on cyber incidents and the associated losses and sound underwriting practices and cyber risk management, including the proper treatment of non-affirmative risks and potential accumulation risk.

1.1. MARKET RISKS

The dynamics of the euro area economy remain challenging amid weakening industrial production and increasing global and domestic uncertainties. GDP growth in the euro area decreased from 0.4% in the first quarter of the year to 0.2% in the second quarter of 2019. In the European Union, GDP growth contracted from 0.5% to 0.2% in the same period, which is the weakest growth rate since the first quarter of 2013 (Figure 1.1). The slowdown in the economy has started already from the beginning of 2018 onwards, when a general trend towards a sluggish economy became more evident across many European countries (Figure 1.2).

Weakening industrial production and business sentiment in key sectors due to lower external demand are important contributing factors to the recent slowdown in the euro area economy, which is exacerbated by increasing uncertainties around trade policies and political developments (Figure 1.3). Despite the challenging overall economic outlook, domestic demand remains resilient and labour market conditions are solid, with overall unemployment rates steadily declining in the euro area and the

Figure 1.1: Real GDP growth (%) QoQ
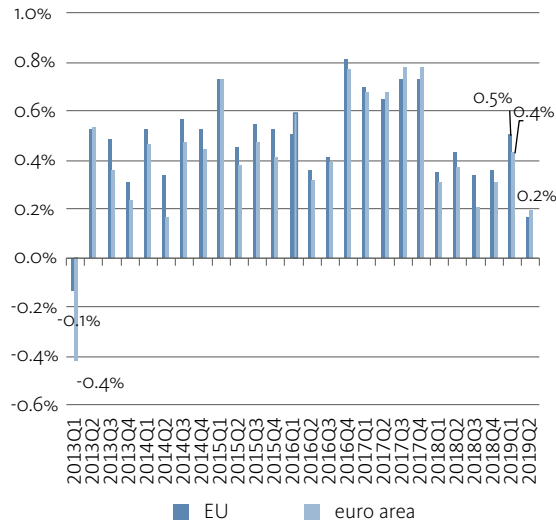
Source: Eurostat
Last observation: October 2019

Figure 1.2: Real GDP growth by country (2007Q1=100)
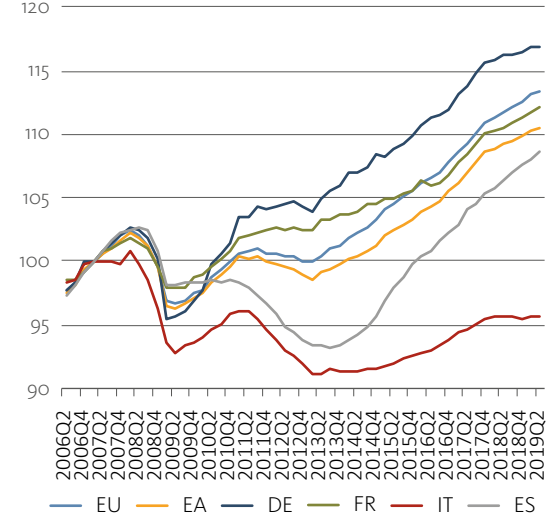
Source: Eurostat
Last observation: October 2019

Figure 1.3: Uncertainty Indexes

Source: "Measuring Economic Policy Uncertainty" by Scott R. Baker, Nicholas Bloom and Steven J. Davis at www.PolicyUncertainty.com.
Last observation: October 2019

Figure 1.4: Unemployment rates (% of labour force)

Source: Eurostat
Last observation: August 2019
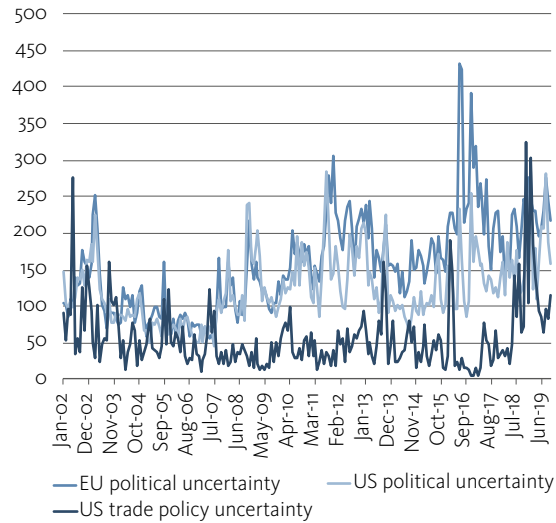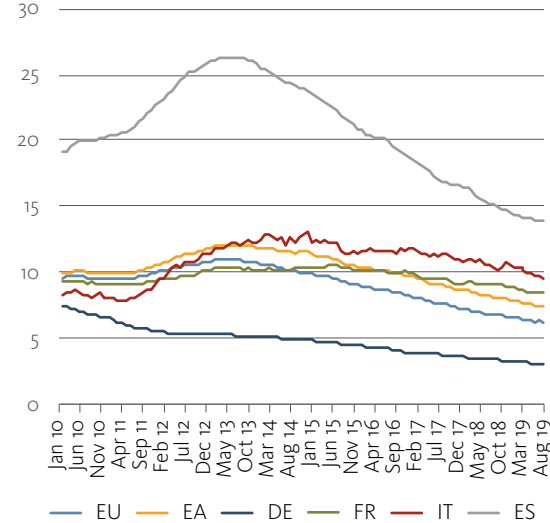
EU. Nonetheless, the level of unemployment is still high in some countries. (Figure 1.4).

Against the backdrop of slowing economic growth and persistently low inflation, the European Central Bank (ECB) has loosened monetary policy again in September 2019. Inflation rates for the EU and for the euro area were similar during 2018 with average rates of 1.8% and 1.9%, respectively (HCIP rates). However, since then, HICP rates have been diverging, as the decrease of the inflation

rate in the euro area has been more prominent. Despite the recent decrease, inflation remained stable at 1.0% in the euro area and at 1.4% in the European Union in July and August (Figure 1.5). In response to the slowing economy and subdued inflation outlook, the ECB announced a new round of policy measures aimed at monetary easening in September 2019 (Box 1.1). The ECB also highlighted the relevance of other economic policies to complement and enhance the effectiveness of monetary policy, in particular fiscal policy and structural reform in EU member states.

Figure 1.5: Average inflation rates: Euro area and EU (in %)
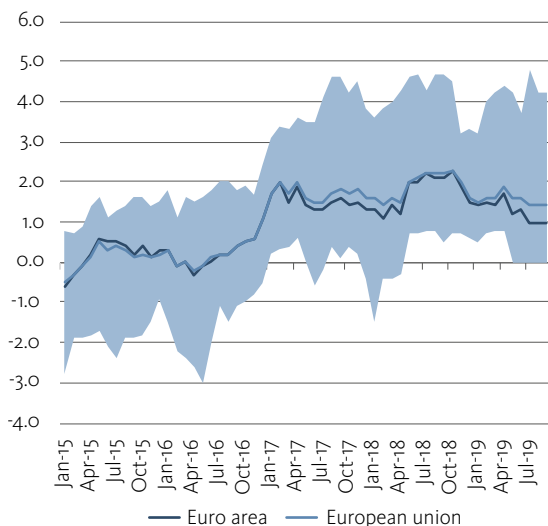
Source: ECB and Eurostat
Last observation: September 2019
Note: The shadow area corresponds to the minimum and the maximum values of annual average inflation (HICP) within the EU.

Figure 1.6: HICP main components (annual % changes)
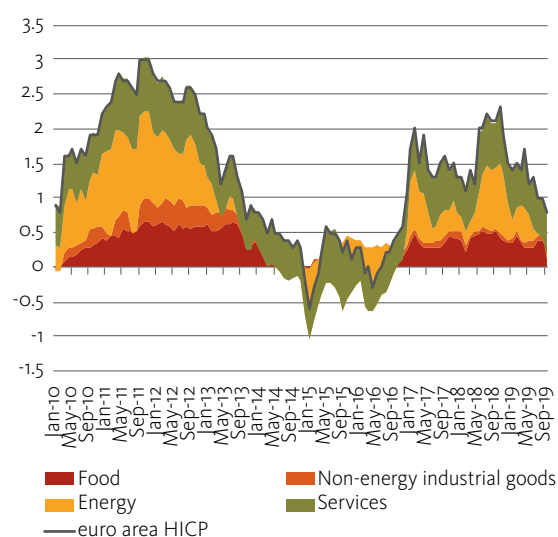
Source: Eurostat
Last observation: September 2019

BOX 1.1: THE ECB PACKAGE OF MONETARY POLICY MEASURES AND ITS TRANSMISSION CHANNELS TO THE ECONOMY

On 12th September 2019, the ECB announced a new stimulus package aiming at maintaining favourable financial conditions and the sustained convergence of inflation towards its medium-term target.

The proposed measures are summarized below:

(1) Decrease of the interest rate on the deposit facility from -0.40% to -0.50%, which is expected to remain at their present or lower levels until inflation outlook converges to the target within its projection horizon and is reflected in underlying inflation dynamics.

(2) Restart of the net purchases under the asset purchase programme (APP) at a monthly pace of €20 billion as from 1 November, which is expected to end shortly before it starts raising the key ECB interest rates.

(3) Continuation of the reinvestments of the principal payments from maturing securities purchased under the asset purchase programme (APP) for an extended period of time after the Governing Council starts raising the key ECB interest rates, and for as long as necessary to maintain favourable liquidity conditions and an ample degree of monetary accommodation. The additional net asset purchases and the revised reinvestment horizon are considered an important complement to interest rate policy. This affects mainly longer-term rates, providing further support to the funding costs to businesses and households. The prolonged reinvestment horizon might also mitigate the passive tightening in the monetary policy stance, which is a natural development as the APP portfolio ages.

(4) The interest rate in each operation of quarterly targeted longer-term refinancing operations[1] (TLTRO III) are now set at the level of the average rate applied in the Eurosystem's main refinancing operations over the life of the respective TLTRO. For banks whose eligible net lending exceeds a benchmark, the rate applied in TLTRO III operations will be lower, and can be as low as the average interest rate on the deposit facility prevailing over the life of the operation. The maturity of the operations will be extended from two to three years.

(5) Introduction of a two-tier system for reserve remuneration, in which part of banks' holdings of excess liquidity will be exempt from the negative deposit facility rate.

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1   TLTRO-III aims at preserving favourable bank lending conditions by providing long-term loans to banks and offering them an incentive to increase their lending to businesses and consumers in the euro area

Figure 1.7: Swap curves

31/12/2015   30/12/2016   29/12/2017   28/12/2018
27/05/2019   30/06/2016   25/11/2019
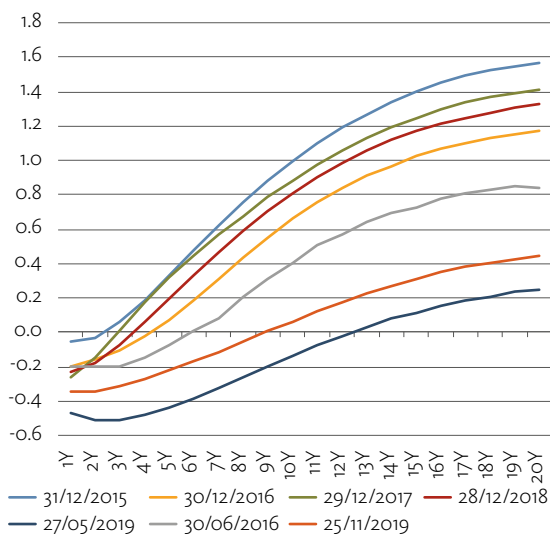
Source: Bloomberg
Last observation: 25 November 2019

Figure 1.8: 10-year government bond yields (in %)

United States   Euro area   United Kingdom
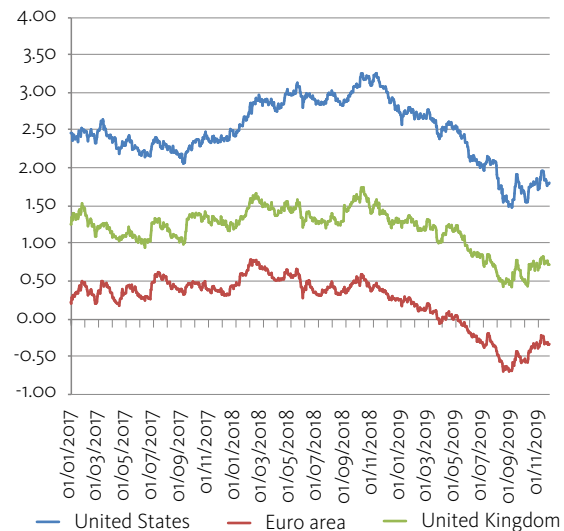
Source: Bloomberg
Last observation: 25 November 2019

The rekindling of accommodative monetary policy has raised the risk of a "low for long"[2] scenario, which has significant impact on insurers and pension funds. Interest rates declined sharply over the summer in anticipation of the new stimulus package and the deteriorating economic outlook. Interest rate swap curves for the euro reached a new low historical level in August, well below the previous lowest level observed in June 2016 (Figure

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2   The "low for long" scenario is defined as a situation when short and long-term nominal interest rates are assumed to remain low over the next decade, combined with a period of low economic growth. The rationale behind this scenario is that structural factors, such as demographic trends, total factor productivity or an increased preference for scarce safe assets, along with cyclical factors, have pushed interest rates down to low levels. See more on Macroprudential policy issues arising from low interest rates and structural changes in the EU financial system, ESRB (2016).

1.7), which significantly affects the values of long-term liabilities of insurers and pension funds using market-based valuation frameworks. Another implication is the increase in the gap between the Solvency II Ultimate Forward Rate (UFR), and the current level of swap rates at 20, 30 or 50 years, resulting in a higher difference between the observed level of swap rates and the extrapolated rates under the Solvency II framework. This fosters the supervisory concern that the technical provisions are underestimated as interest rates for long-term maturities (and thus long-term liabilities) are discounted with too optimistic interest rate assumptions (see Box 1.2).

Government bond yields have also decreasedly substantially over 2019, with borrowing rates moving further into negative territory, before slightly recovering again

following the postponement of Brexit and a slight easing of trade tensions in October (Figure 1.8). Most of the EU area sovereign bond yields are still negative however, even for longer maturities (Table 1.1). The same trend can also be observed for the US, which lowered interest rates by 0.25% for the first time since 2008, amid concerns about the global economy (Figure 1.8). Furthermore, the spread between the yields of countries considered safer and those considered riskier has been narrowing, while sovereign credit default swap remained relatively elevated in countries that face structural fiscal and debt challenges (Figures 1.9 and 1.10).

Table 1.1: Government bond yields for different maturities

|		1Y	2Y	5Y	10Y	15Y	20Y
EU- euro area	Austria	-0.435	-0.644	-0.419	-0.059	0.197	0.356
	Belgium	-0.647	-0.620	-0.401	-0.018	0.309	0.552
	Finland	-0.630	-0.628	-0.453	-0.074	0.164	0.293
	France	-0.612	-0.626	-0.439	-0.046	0.285	0.528
	Germany	-0.656	-0.665	-0.592	-0.355	-0.145	0.008
	Greece	0.130	0.233	0.709	1.530	2.169	2.499
	Ireland	-0.541	-0.488	-0.266	0.127	0.444	0.668
	Italy	-0.175	-0.033	0.596	1.281	1.829	2.193
	Netherlands	-0.658	-0.656	-0.513	-0.196	0.021	0.147
	Portugal	-0.500	-0.401	-0.032	0.447	0.879	1.243
	Slovakia	-0.601	-0.490	-0.356	0.099	0.544	0.732
	Spain	-0.456	-0.376	-0.060	0.442	0.807	1.115
EU-non euro area	United Kingdom	0.648	0.519	0.454	0.700	1.054	1.274
	Bulgaria	-0.381	-0.287	-0.062	0.316	-	-
	Croatia	0.071	0.083	0.243	0.675	1.151	1.559
	Czech Republic	1.471	1.411	1.281	1.471	1.572	1.676
	Denmark	-0.769	-0.726	-0.590	-0.343	-0.162	-0.061
	Hungary	-0.037	0.128	0.816	1.853	2.525	-
	Norway	1.211	1.229	1.245	1.405	-	-
	Poland	1.128	1.420	1.808	2.068	2.398	2.624
	Sweden	-0.423	-0.372	-0.306	-0.031	0.238	0.408
Others	United States	1.660	1.640	1.641	1.775	1.921	2.170
	Japan	-0.191	-0.193	-0.208	-0.084	0.146	0.309
	Switzerland	-0.862	-0.817	-0.744	-0.561	-0.369	-0.284

Source: Refinitiv
Reference date: 25 November 2019

Figure 1.9: 10-year government bond yields (in %)
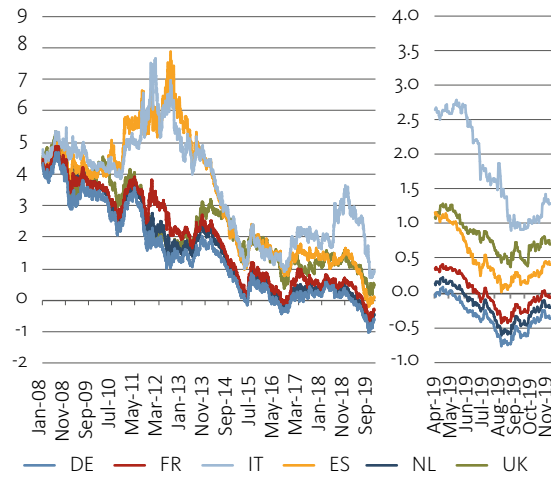
Source: Bloomberg
Last observation: 25 November 2019

Figure 1.10: Sovereign Credit Default Swap
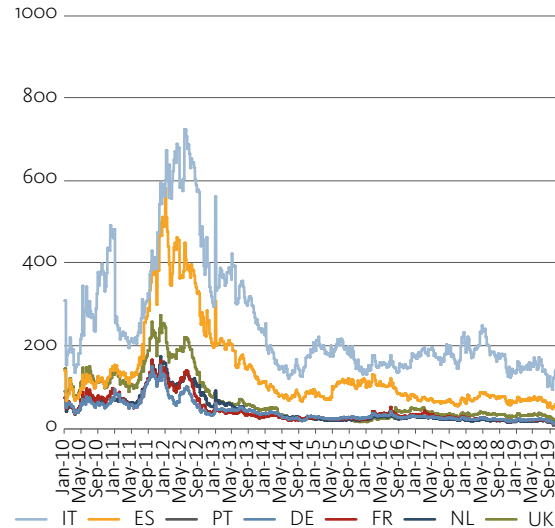
Source: Bloomberg
Last observation: 25 November 2019
Note: the 5 Year CDS (credit default swap) spread implied by the Bloomberg Issuer Default Risk model Likelihood of Default.

BOX 1.2: LOW INTEREST RATES AND THE ULTIMATE FORWARD RATE

The Ultimate Forward Rate (UFR) is a central element in determining the regulatory risk-free rates used to discount insurers' liabilities for horizons beyond the Last Liquid Point (LLP), which is set at the 20-year swap for the euro. As it is essentially the sum of the expected real rate and the expected inflation rate, the UFR is affected by market developments.

Persistent lower interest rates broaden the difference between the level of swap rates at 20, 30 or 50 years and the UFR, which is at 3.9% since the beginning of 2019 for the euro.[3] Large differences between the observed level of swap rates and the extrapolated rates may result in too optimistic interest rate assumptions, which leads to inadequate estimations of liabilities. Critical situations in which for example an undertaking no longer complies with its SCR and/or MCR, a transfer of liabilities to another undertaking might be necessary. Inaccurate estimations might risk that technical provisions may not be sufficient to transfer these liabilities when priced at market values.

The underlying risks of the rates discrepancy would become even more concrete in the near future when undertakings might actually start earning a lower rate than the interest rate used to calculate their technical provisions (which includes the UFR under Solvency II). In that situation, undertakings would incur losses each year that reduce their own funds. Ultimately, persisting losses from inappropriate discounting (where extrapolated rates are persistently higher than market rates) may slowly deteriorate their financial situation and put policyholders and beneficiaries at risk.

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3   The UFR is set each year by EIOPA according to the Methodology found here: https://eiopa.europa.eu/Publications/Standards/20180813_Technical%20Documentation%20(RP%20methodology%20update).pdf

Furthermore, differences between the extrapolated risk-free interest rates and market rates might impact risk management initiatives, as undertakings can choose to hedge the risk as reflected in their solvency balance sheet or the risk that actually exists in the financial markets. If the hedging is based on the extrapolated risk-free interest rates, it may reduce the volatility of Solvency II own funds, at least in the short term, but may leave the insurer exposed to the risks of financial markets in the long run. In contrast, if undertakings decide to hedge the risks of the financial market, it may increase the volatility of their Solvency II own funds. For that reason, the lower LLP may incentivise undertakings to base the hedging on the extrapolated risk-free interest rates instead of hedging the actual risk in financial markets.

Another related issue is the risk of procyclical investment behaviour when interest rates fall. The undertakings could buy long-term swaps in order to improve their matching and reduce their interest risk charge, which could put further pressure on the swap rates. The extent to which the volatility of interest rates translates to a volatility of technical provisions and own funds depends on the specifics of the risk profile of the undertaking concerned, on the term of the liabilities and in particular in the degree of matching between asset and liability cash flows.

The public consultation on the Opinion that sets out technical advice for the 2020 review of Solvency II assesses these issues more in detail.[4] Among the EIOPA proposals are potential changes to the LLP and a recommendation that insurance and reinsurance undertakings should disclose in their Solvency and Financial Condition Report (SFCR) the outcome of a sensitivity analysis for a fixed downward shift of the UFR. This would help increase the transparency of the impact of the extrapolation of risk-free-rates on the financial position of insurers, including on the amount of technical provisions, the SCR, the MCR, the basic own funds and the amounts of own funds eligible to cover the SCR and the MCR.

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4   See the public consultation paper on the Opinion on the 2020 review of Solvency II in the following link: https://eiopa.europa.eu/Pages/News/EIOPA-consults-on-technical-advice-for-the-2020-review-of-Solvency-II.aspx

Protracted low interest rates affect both sides of insurers and pension funds balance sheets, with institutions holding primarily long-term liabilities and shorter-term assets most vulnerable to declining rates. Life insurers and some pension funds discount their long-term financial obligations towards policyholders or pension members based on a market-consistent interest rate term structure.[5] Therefore, the value of liabilities will increase when the interest rates used to discount long-term liabilities decrease. The impact is greater the longer the duration of the liabilities and the bigger the decrease in the long-term interest rates. On the asset side, decreasing interest rates typically lead to an increase in the market value of assets, as insurers and to a lesser extent, pension funds, heavily invest in government and corporate bonds (see Chapter 5). However, as the duration of assets for life insurers and pension funds is typically lower than the

duration of liabilities (negative duration gap), the increase in the value of assets may not fully offset the increase in liabilities, leading to a worsening of the financial position. Ultimately, the overall effect and the magnitude of the impact of declining interest rate will depend on the type of entity, business lines offered, duration of assets and liabilities and the extent to which minimum guarantees are offered. Unless a well-defined hedging strategy has been implemented, a fall on interest rates combined with nominally guaranteed liabilities could lead to a deterioration of the financial position of these entities.

Another aggravating factor for balance sheets in which the duration of liabilities exceeds the duration of the assets in the current low yield environment is the risk that maturing fixed-income securities can only be replaced by lower yielding securities (reinvestment risk). This dynamic might gradually affect profitability and could be particularly worrisome for insurers and pension funds with relatively high nominally guaranteed liabilities and large exposures to fixed-income securities (see also Chapter 2).

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5   While Solvency II prescribes the risk-free-interest rate term structure to be used by EEA insurers for discounting liabilities, the prudential regimes and national valuation frameworks for IORPs and other pension funds diverge significantly within the EEA and do not necessarily require market-consistent valuations, and may allow for discount rates reflecting the expected returns on assets.

BOX 1.3: OVERCOMING PERSISTENT LOW INTEREST RATE CHALLENGES AND ITS IMPLICATIONS FOR FINANCIAL STABILITY

The low interest rate environment exerts pressure on profitability and solvency positions of insurers and pension funds. A natural reaction of the entities is to look for alternatives to mitigate the adverse impact on their balance sheets. However, some market behaviours might introduce risks to overall financial stability, in particular when applied in a large scale by many or large and relevant entities.

The most concerning alternative from a financial stability point of view is when insurers and pension funds try to address the lower yields by diversifying their portfolios with riskier investments, including complex securities with limited liquidity, as entities may have greater incentives to invest in riskier assets leading to "searching for yield" behaviour.

That might occur either because of their business model, for example when offering return guarantees that are dependent on portfolios heavily allocated in fixed-income instruments, or because of the market environment in which they are operating, such as in a competitive context with compressed margins.

The main implication of search for yield for financial stability is the potential growing appetite for risk culminating in an intensification of asset price bubbles, which given the level of interconnectedness across sectors might affect different segments of the financial sector, potentially triggering fire sales and ultimately affecting the real economy.

Another option to hedge the risk of declining interest rates be to increase the duration of assets in order to ensure a better duration match between assets and liabilities. However, if this behaviour is adopted by a large segment of the market, that may trigger a feedback loop in which the high demand for certain types of bonds increase their prices, resulting in further downward pressure on interest rates.[6]

A more gradual solution is the adjustment of new contracts of insurers or pension promises of IORPs, by for example lowering or eliminating guaranteed rates and increasing unit-linked products. Although less risky for insurers from a financial stability point of view, this option would demand time and transfers more risks to policyholders, which may reduce incentives for insurers to properly manage investment risk. This could ultimately give rise to potential conduct and reputational risks to the insurance sector in case returns turn out lower than anticipated. Clear communication towards policyholders and transparency of product features are therefore needed.

6   For empirical evidence of this mechanism, see Domanski, Shin and Sushko (2017): The hunt for duration: not waving but drowning? Available at: https://www.bis.org/publ/work519.htm

Despite the intensification of the low for long scenario, the risk of a sudden reassessment of risk premia remains amid political risks, trade tensions and sovereign debt concerns in some European countries. Overall, asset valuations remain stretched, as investors have been seeking for more rewarding alternatives in an environment where the amount of bonds with negative yields has increased to about $15 trillion globally - including more than $7 trillion in government bonds from large advanced economies.[7] Following the correction in December 2018, equity markets in the US and EA have rebounded strongly, albeit with notable ups and downs. In particular, US equity markets appear to be overvalued (Figure 1.11). The oscillation in equity markets is also reflected in slighly higher volatilities on financial markets, given the rise in equity values since 2009 (Figure 1.12).

7   Source: IMF Global Financial Stability Report - October 2019, available in the following linkl: https://www.imf.org/~/media/Files/Publications/GFSR/2019/October/English/text.ashx?la=en

A weak economic outlook combined with the materialization of key political risks such as the intensification of trade sanctions could trigger a sharp reversal of the risk premia leading to potential downgrades and higher default rates, as the repayment of debts becomes more expensive. This could lead to sudden increases in credit spreads, in particular for lower-quality assets, causing immediate losses in the investment portfolios that are mainly composed of fixed-income instruments. Moreover, as the investments of the insurance sector are characterized by strong home bias and interconnectedness with banks (see Chapter 5), insurers in affected countries are likely to

Figure 1.11: Equity market performance
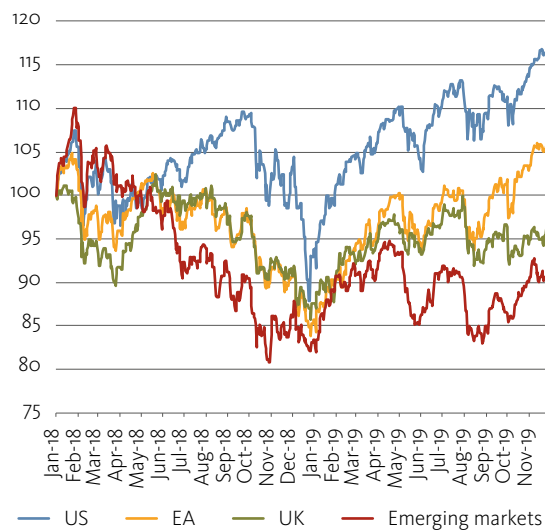
Source: Bloomberg (Index, where 100 corresponds to the values on 01.01.2018)
Last observation: 25 November 2019
Note: US: S&P 500 INDEX, EA: Euro Stoxx 50 Pr, UK: FTSE 100 INDEX, Emerging markets: MSCI EMERGING

Figure 1.12: Market volatilities
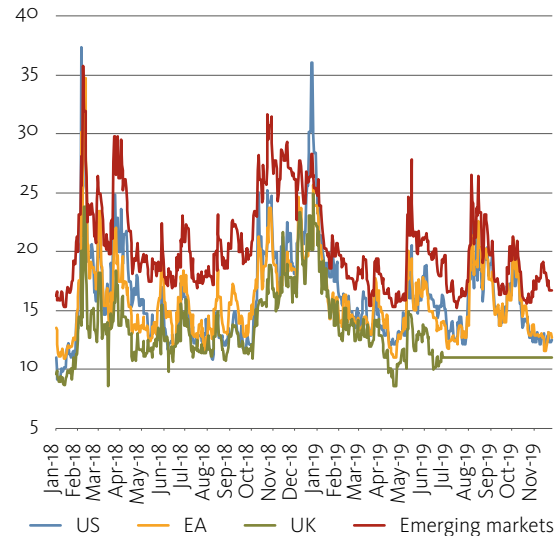
Source: Bloomberg
Last observation: 25 November 2019

Figure 1.13: Selected markets performance (year-to-date)

Market	Performance
SP 500 Banks	30.7%
FTSEMIB Index (IT)	27.8%
DAX Index (DE)	25.2%
CAC Index (FR)	25.1%
SP 500 Insurance	24.4%
SP 500 (US)	24.1%
Euro Stoxx 50	23.4%
AEX Index (NL)	22.2%
Stoxx 600 Insurance	21.2%
MSCI World	20.7%
Euro Stoxx 600	20.5%
Oil price	18.9%
Gold price	11.0%
FTSE (UK)	9.9%
MSCI Emerging	8.6%
MADX Index (ES)	8.0%
Stoxx 600 Banks	5.2%
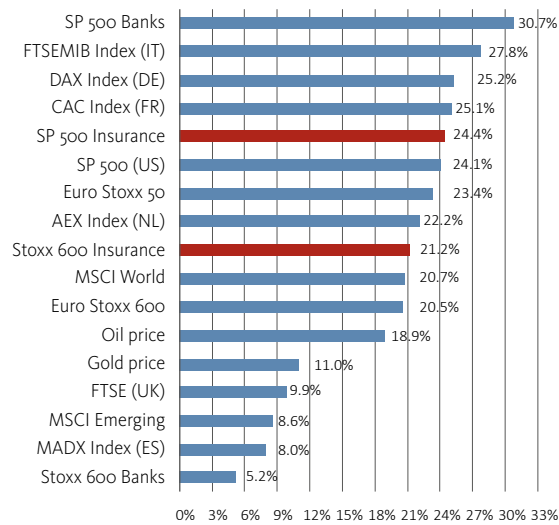
Source: Bloomberg
Last observation: 25 November 2019

Figure 1.14: Insurance CDS spreads
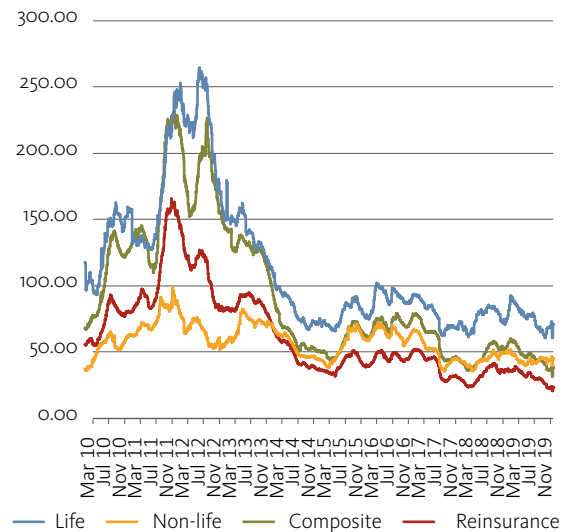
Source: Bloomberg
Last observation: 25 November 2019
Note: the 5 Year CDS (credit default swap) spread implied by the Bloomberg Issuer Default Risk model Likelihood of Default.

suffer more severe losses, with potential spillover effects from the banking sector as well.

Despite the decrease in interest rates and the challenging economic environment, European insurers have so far outperformed the general market in 2019. The market performance of the insurance sector was the slightly ahead of the general market in Europe on a year-to-date period in October (+21.6% versus +20.2%, see Figure 1.13). The positive market performance is in line with the general strong performance of equity markets in 2019. Corporate CDS spreads for insurers have also been decreasing since the beginning 2019, in particular for life insurers (Figure 1.14). That might reflect the fact that certain risks are most likely not yet properly priced by the market.

1.2. CLIMATE RISK AND SUSTAINABLE FINANCE

Preliminary global figures for 2019 show a high concentration of natural disasters in poorer countries, where insurance coverage is very scarce. Total natural catastrophes and weather related losses amounted to approximately USD 42 bn globally in the first half of 2019, from which only USD 15 bn were insured, compared respectively to USD 62 bn and USD 23 bn in the first half of 2018.[8] In Europe, so far, the most costly events were the winter storm Eberhard in March and severe storms and hail in June, which in total caused losses of USD 2.2 bn (see also Chapter 3).

Extreme weather events continue to put significant pressure on non-life insurers and are expected to become more frequent and severe due to climate change. The last European summer was characterized by very high temperatures, with a third of the all-time records of high temperatures happening in Germany, France, Netherlands and UK. The period between June and August was the second warmest period in the 140-year record at 0.93°C above the 20th century average of 15.6°C. This is only behind the same period in 2016 by 0.02°C.[9]

In response to climate related risks, the EU established several targets and actions through a combination of

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8　Source: Munich Re NatCatSERVICE available at https://www.munichre.com/en/media-relations/publications/press-releases/2019/2019-07-30-press-release/index.html

9　Source: NOAA National Centers for Environmenal Information.

financial support and regulation within the EU climate action. This initiative includes packages with sets of binding legislations with climate and energy targets to be met in 2020 and 2030, which are the first steps to achieve the long-term goal of transforming the EU economy towards low carbon utilization by 2050. The key EU targets are in the table below:

Table 1.2: Key EU targets - Climate Action

Key EU Targets	2020	2030
Greenhouse gas emissions (compared to 1990)	-20%	-40%
Energy consumption from renewable energy	20%	32%
Increase in energy efficiency	20%	32.5%

Source: Fourth report on the State of the Energy Union

While the EU is on track to meet its 2020 greenhouse gas emissions reduction target, efforts should be increased to reach both energy efficiency and renewables targets to ensure a smooth transition in line with the Paris Climate Agreement. Regarding emissions, the 2020 target of the reduction of 20% since 1990 was already achieved in 2013. Between 1990 and 2017, emissions decreased by 22% (Figure 1.15). However, the pace of increase in the share of renewable energy has been slowing since 2014, despite the increasing support of Member States in providing incentives to the market. Clearly, more efforts should be done to ensure that the future targets will be met (Figure 1.16). The same holds for the energy efficiency target, as energy consumption has started to increase in recent years after a gradual decrease between 2007 and 2014, mainly due to weather variations and low oil prices. Achieving the goals set in the Paris Climate Agreement in a timely manner would help mitigate the onset of more extreme physical risks, while an orderly transition process would also reduce potential transition risks.

Insurance companies have a high potential to contribute to a substantial acceleration to the transition to a low-carbon economy. As risk managers and investors, they play an essential role in driving investments towards particular sectors and long-term projects. Insurers are increasingly incorporating climate-related risks in their underwriting and investment activities as part of an enhanced approach towards so-called Environmental, Social and Governance (ESG) factors. Another overall growing trend in the market is investments in green bonds, which is estimated to reach USD 250 bn by the end of this year,

Figure 1.15: Greenhouse gas emissions in the EU (index, 1990=100)
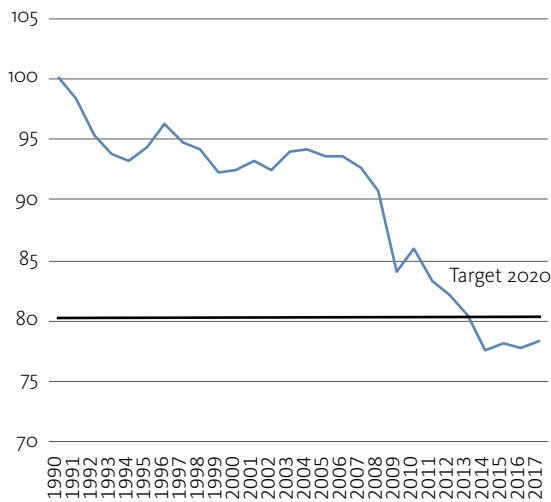
Source: Eurostat
Last observation available: 2017
Note: This indicator shows trends in total man-made emissions (of both the ESD and ETS sectors) of the 'Kyoto basket' of greenhouse gases. It presents annual total emissions in relation to 1990.

Figure 1.16: Renewable energy shares
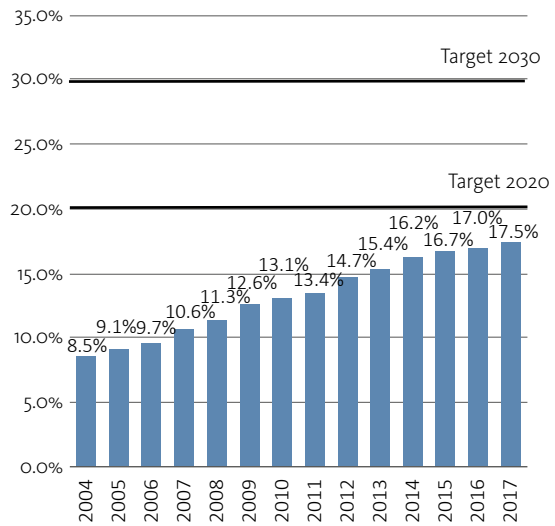
Source: Fourth report on the State of the Energy Union (2019)
Last observation available: 2017

an increase of 46% compared to 2018.[10] These bonds aim to fund projects that have positive environmental and/or climate benefits.

Furthermore, on 23 September, the "Net-Zero Asset Owner Alliance", composed of worldwide relevant pension funds and insurers was announced at the UN Secretary-General's Climate Action Summit. These entities, which together hold approximately USD 2.4 trillion in investments, has committed to transition their investment portfolios to net-zero greenhouse gas emissions by 2050. The members of the Alliance also committed to immediately start to engage with the companies in which they are investing to ensure they decarbonise their business models.

Despite these initiatives, there are still challenges in monitoring and mitigating climate-related risks in both underwriting and investment activities. Overall, insurers and pension funds remain exposed to considerable climate-related transition risk[11] in their investment portfolios, which are still challenging to properly quantify. The industry still lacks a standardized reporting on green

investments, emission metrics and climate impact of exposures which would help to enhance the use of scenario analysis in risk modelling and portfolio management. EIOPA therefore welcomes and actively contributes to the EC Action Plan on Sustainable Finance, which aims at developing a European Taxonomy for green investments, among others. At the same time, EIOPA is currently working on enhancing its insurance stress testing framework to incorporate climate-related risks, while a Thematic Article accompanying this report presents an initial analysis on potential transition risk for government bond holdings (see Part II).

1.3. CYBER RISKS AND THE INSURANCE SECTOR

Amid increasing frequency and sophistication of cyber-attacks, fast digital transformation and increased use of big data and cloud computing, a sound cyber resilience framework for insurers is essential to ensure a well-functioning financial system. According to the Financial Stability Board (FSB)[12], cyber resilience is defined as "the ability of an organisation to continue to

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10   Source: Climate Bonds Initiative, available at: https://www.climate-bonds.net/

11   Transition risks arise in the transition to a more carbon-neutral economy, with potentially significant and disorderly write-downs in certain financial assets, in particular for exposures to carbon-intensive industries.

12   The FSB Lexicon is available at the following link: https://www.fsb.org/2018/11/cyber-lexicon/

carry out its mission by anticipating and adapting to cyber threats and other relevant changes in the environment and by withstanding, containing and rapidly recovering from cyber incidents." Therefore, the primary idea behind of a cyber-resilient entity is that it has the competences to continue providing their services and deliverables despite adverse cyber risks.

Two aspects of cyber resilience are relevant in the context of the insurance sector: insurance companies as a target of cyber-attacks insurance companies as providers of cyber insurance. The connection between the first aspect and cyber resilience is straightforward. Insurance companies possess a large amount of sensitive data, which is naturally appealing for hackers. If a major cyber incident happens to an insurance company that is unprepared operationally, that could immediately prevent the continuation of their activities. Indeed, according to a new report "Cyber risk for insurers: challenges and opportunities" published by EIOPA[13] in September, business interruption is the most frequent consequence of cyber incidents, followed by material costs for policyholders and third parties. Ultimately, the company might face not only revenue losses but also reputational damages and consequently might not be able to continue providing their services. Furthermore, the report shows that there is a lack of harmonization in many dimensions, from the definition of cyber risks itself to what characterizes a cyber event and a cyber incident.

The second aspect, which concerns insurance companies as providers of cyber insurance, has a more indirect but still relevant link with cyber resilience. In this case, the insurance company does not necessarily have to suffer a direct cyber incident to have the continuation of its business threatened. Instead, accumulation risk in cyber coverages is the key factor for potential disruptions. For example, it could be that many policyholders of cyber insurance demand claims for the same cyber incident at the same time. Depending on the scale of the incident and on the extent to which these policies are relevant for the company, this incident might cause a substantial financial impact. This scenario can become even more alarming when consider-

ing non-affirmative risks. In that case, if some cyber perils are not explicitly excluded from traditional policies, a cyber incident that is large enough can trigger unexpected accumulation of losses within other policies.

Therefore, considering these two aspects discussed and based on new evidence discussed in the EIOPA report, two key elements are fundamental to enhance of the cyber insurance underwriting market in the EU.

The first element is the definition of a consistent and harmonised taxonomy that enables a compilation of information on cyber incidents and the associated losses. Providing a consistent terminology would be the first step to enable a better assessment of the risks and exchange of information based on harmonized data cyber incidents. Such a taxonomy could also facilitate the creation of an anonymized cyber incident database. In particular, a cross-sectoral approach would be beneficial not only for insurance underwriting practices, but also to increase awareness of the whole financial system regarding cyber threats.

The second element concerns the need for sound cyber underwriting and risk management practices, in particular to address non-affirmative cyber risks and potential accumulation risk. While there are common efforts under way, evidence suggests that many insurers are not fully aware of their exposure to cyber risks. In that regard, there is not only a lack of explicit cyber exclusions, but also a lack of quantitative approaches to estimate potential impacts of non-affirmative risks. Indeed, EIOPA found that a significant number of insurance groups currently have no action plan in place to review the portfolios in the context of cyber exposures and rewording of contracts.[14] Some groups reported that they have adopted a 'wait-and-see' approach to address non-affirmative cyber risk, where the implementation of actions plans to address non-affirmative exposure depends on materialization of future events. Therefore, addressing non-affirmative risks would also be very beneficial to fight against accumulation risk and therefore increase the resilience of the sector as a whole.

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13   The report Cyber risk for insurers: challenges and opportunities is available in the following link: https://eiopa.europa.eu/Pages/News/EIOPA-calls-for-a-sound-cyber-resilience-framework.aspx

14   See EIOPA report Cyber risk for insurers: challenges and opportunities available in the following link: https://eiopa.europa.eu/Pages/News/EIOPA-calls-for-a-sound-cyber-resilience-framework.aspx

2. THE EUROPEAN INSURANCE SECTOR

The challenging macroeconomic environment described in Chapter 1 is leading insurance undertakings to further adapt their business models. In order to address the challenges associated with the low yield environment and improve profitability, life insurers are lowering guaranteed rates in traditional products and are increasingly focusing on unit-linked products. On the investment side, insurers are slowly moving towards more alternative investments and illiquid assets, such as unlisted equity, mortgages & loans, infrastructure and property. For non-life insurers, the challenge is mostly focused on managing increasing losses stemming from climate-related risks and cyber events, which may not be adequately reflected in risk models based on historical data, and continued competitive pressures.

2.1. MARKET SHARE AND GROWTH

Despite the challenging environment, the European insurance sector overall gross written premiums slightly grew by 1.6% on an annual basis in Q2 2019. This growth is particularly driven by the increase in non-life GWP (3.7%), in comparison to a slightly decrease in life (-0.5%). This reduction growth rate in life GWP is associated to the slowdown in the economic growth; however this does not seem to have affected the growth of non-life GWP to the same extent. Overall GWP as a percentage of GDP slightly increased from 9% to 11% for the European insurance market, likewise total assets as a share of GDP improved from 70% to 74%.

On a country level, the highest GWP growth in Q2 2019 (y-o-y) considering both life and non-life business was recorded in Luxembourg (68% and 27% – see Figure 2.1). A significant increase in Non-life GWP can be observed in Belgium and Malta (48% and 37%). The growth in non-life GWP for the two major insurance markets has declined instead.

The share of unit-linked business has slightly declined notwithstanding the growth expectations. Even though insurers are increasingly trying to shift towards unit-linked business in the current low yield environment, the total share of unit-linked business in life GWP has slightly decreased from 42% in Q2 2018 to 40% in Q2 2019, likewise the share for the median insurance company declined from 34% in Q2 2018 to 31% in Q2 2019

Figure 2.1: Total Life and Non-Life GWP growth in H2 2019 (in %, year-on-year)
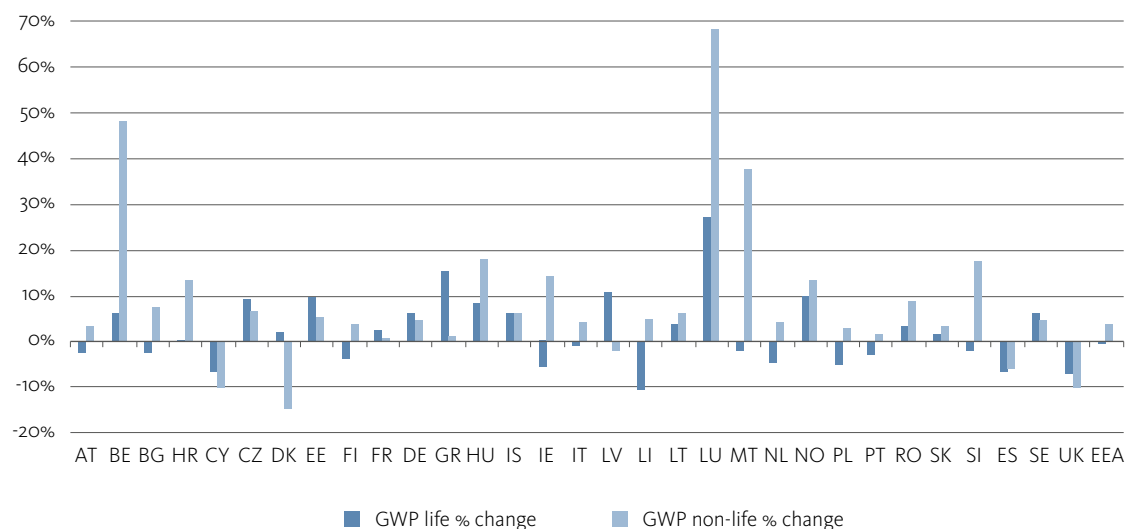
Source: EIOPA QRS
Reporting reference date: Q2 2018 and Q2 2019
Note: Growth rates calculated as difference between Q2 2018 and Q2 2019 GWP and based on local/reporting currency.

(Figure 2.2). This is in line with the general decline seen in the country analysis, particulary for (Figure 2.3) for UK, CZ & LU, with some exceptions for BG, RO & LV. Moroever, considerable differences remain across countries, with some countries still being plagued by low trust due to misselling issues in the past. Overall, the trend towards unit-lead business means that investment risks are increasingly transferred to policyholders with potential reputational risks to the insurance sector in case investment returns turn out lower than anticipated.

The liquid asset ratio slightly deteriorated in the first half of 2019. The median value for liquid asset increased by 1.5% from 63.3% in 2018 Q2 to 64.8% in 2018 Q4, and after slightly decreased to 63.8% in Q2 2019. Furthermore,

the distribution moved down (10th percentile reduced in the past year by 6 p.p. to 47.9%). Liquid assets are necessary in order to meet payment obligations when they are due. Furthermore, a potential increase in interest rate yields might directly impact the liquidity needs of insurers due to a significant increase in the lapse rate as policyholders might look for more attractive alternative investments.

The liquid asset ratio varies considerable across EEA countries. Malta, Finland and Cyprus have liquidity asset ratio below 50%, while Lithuania, Hungary and Croatia have high liquidity asset ratios in comparison with the median, 57% (Figure 2.5).

Figure 2.2: GWP-Life business: Unit-linked share (in %; median, interquartile range and 10th and 90th percentile)
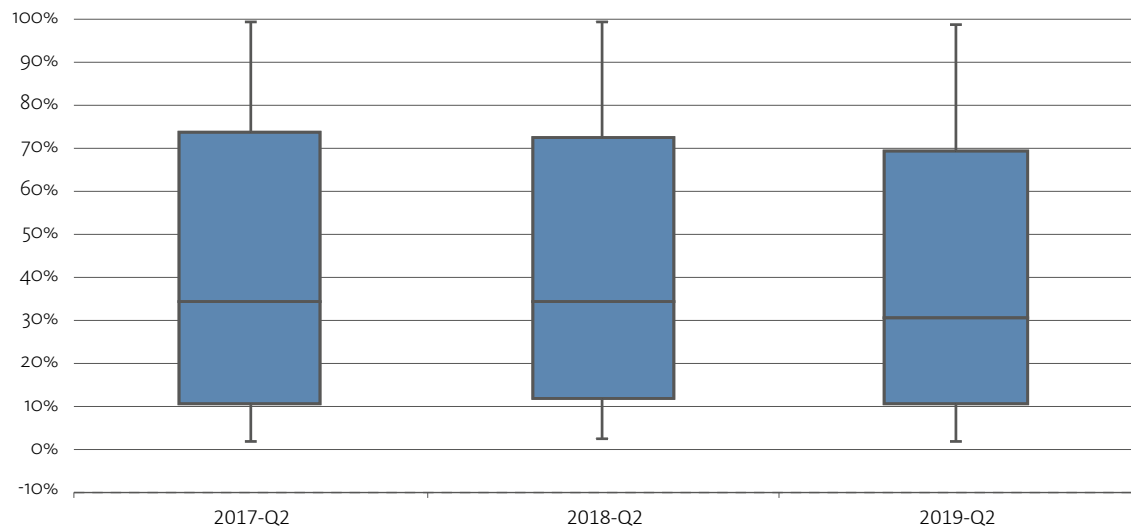
Source: EIOPA QRS
Note: Sample sized on insurance companies which have reported unit-linked business (life and life part of composite insurance companies)

Figure 2.3: GWP-Life business: Unit-linked share across countries (in %)
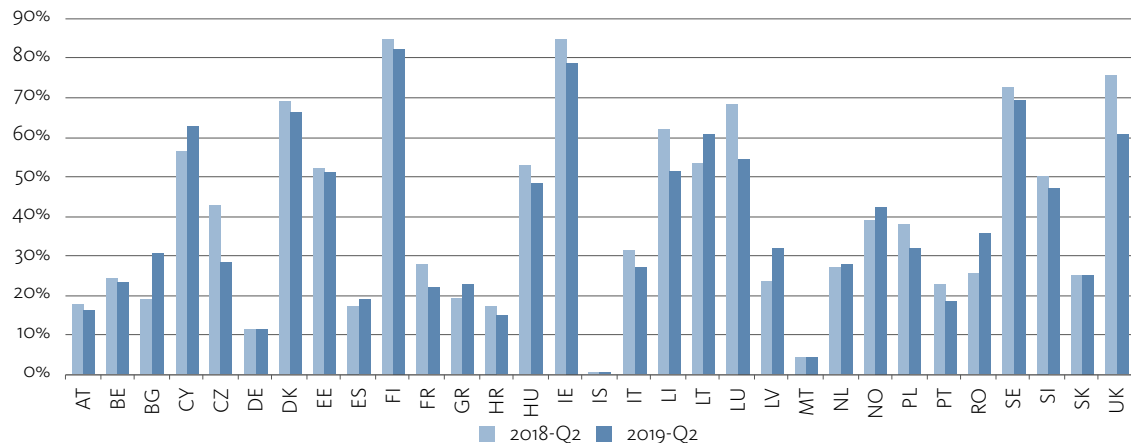
Source: EIOPA QRS

Figure 2.4: Liquid assets ratio (in %; median, interquartile range and 10th and 90th percentile)

Source: EIOPA QRS
Note: The liquid assets ratio shows the proportion of liquid assets on total assets (excluding assets held for unit-linked). The ratio is calculated by applying different we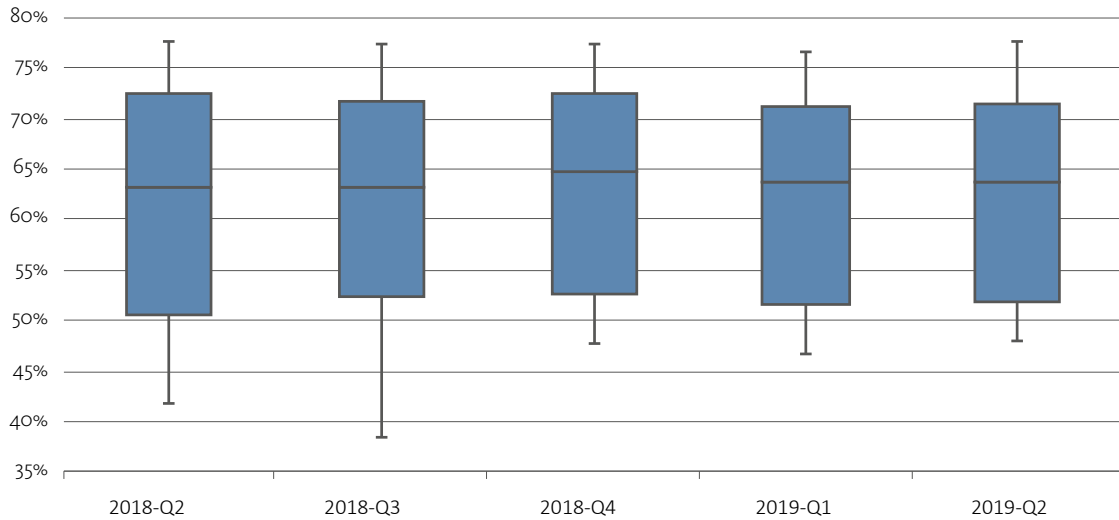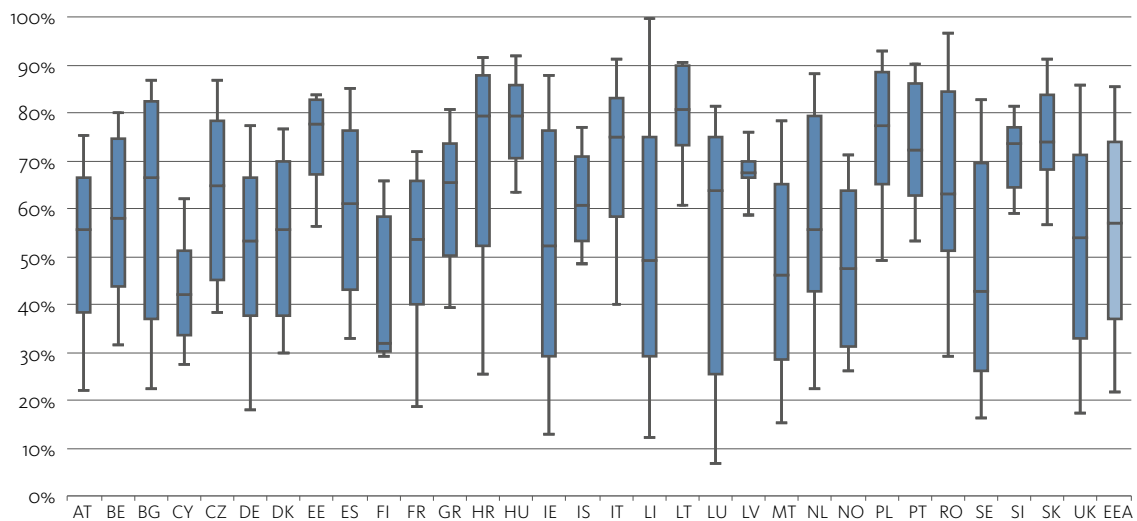ights (ranging from 100% for cash to 0% for intangible assets) to different assets, according to the liquidity profile).

Figure 2.5: Liquid assets ratio by country (in %; median, interquartile range and 10th and 90th percentile)

Source: EIOPA QRS
Note: The liquid assets ratio shows the proportion of liquid assets on total assets (excluding assets held for unit-linked). The ratio is calculated by applying different weights (ranging from 100% for cash to 0% for intangible assets) to different assets, according to the liquidity profile).

Lapse rates in the life business remained stable slightly increased in the first half of 2019. The median value increased from 1.34% in Q2 2018 to 1.38% in Q2 2019. Moreover, a potential sudden reversal of risk premia and abruptly rising yields could trigger an increase in lapse rates and surrender ratios as policyholders might look for more attractive investments. Although several contractual and fiscal implications could limit the impact of lapses and surrenders in some countries, potential lapses by policyholders could add additional strains on insurers' financial position once yields start increasing.

Figure 2.6: Lapse rates (in %)
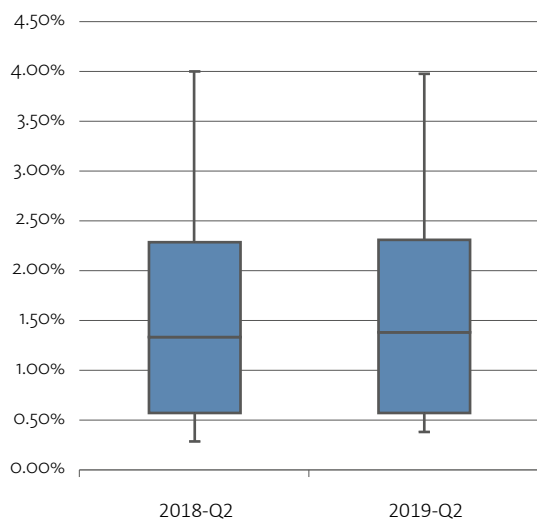
Source: EIOPA QFG

Figure 2.7: Return on Investments (in %; median, inter-quartile range and 10th and 90th percentile)

Source: EIOPA ARS
Reference date: 31/12/2018
Note: Investment returns are taken from template s.09.01 and incude dividends, interest, rent, net gains and losses and unrealized gains and losses.

2.2. PROFITABILITY

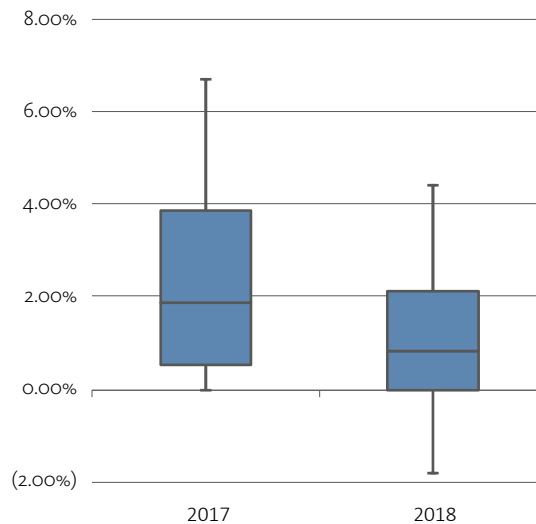**The return on investment has substantially declined further over 2018.** The investment returns have significantly deteriorated for the main investment classes (bonds, equity and collective instruments). The median return on investment decreased to only 0.31% in 2018, compared to 2.83% in 2016 and 1.95% in 2017 (Figure 2.7). In particular the four main investment options (government and corporate bonds, equity instruments and collective investment undertakings) – which approximately account for two-thirds of insurers' total investment portfolios – have generated considerably lower or even negative returns in 2018 (Figure 2.8). As a consequence, insurers may increasingly look for alternative investments, such as unlisted equities, mortgages and infrastructure to improve investment returns. This potential search for yield behaviour might differ per country and warrants close monitoring by supervisory authorities as insurers may suffer substantial losses on these more illiquid investments when markets turn sour (see Chapter 5 for further analysis on the impact of low yield environment).

Despite the challenging investment climate, overall insurer profitability improved in the first half of 2019. The median return on assets (ROA) increased from 0.24% in Q2 2018 to 0.32% in Q2 2019, whereas the median return on excess of assets over liabilities (used as a proxy of

return on equity), increased from 2.8% in Q2 2018 to 4.9 % in Q2 2019 (Figure 2.9 and Figure 2.10). The improvement in overall profitability seems to stem mainly from valuation gains in the investment portolio of insurers driven by a strong rebound in equity prices and declining yields (and hence increasing values of bond holdings) throughout the first half of 2019, while profitability could be further supported by strong underwriting results and insurers' continued focus on cost optimisation. However, decreased expected profits in future premiums (EPIFP) from 11% in Q1 2019 to 10.3% in Q2 2019 suggest expectations of deteriorating profitability looking ahead.

Figure 2.8: Return on Investments per asset class (in %)

Source: EIOPA ARS
Reference date: 31/12/2018
Note: Investment returns are taken from template s.09.01 and incude dividends, interest, rent, net gains
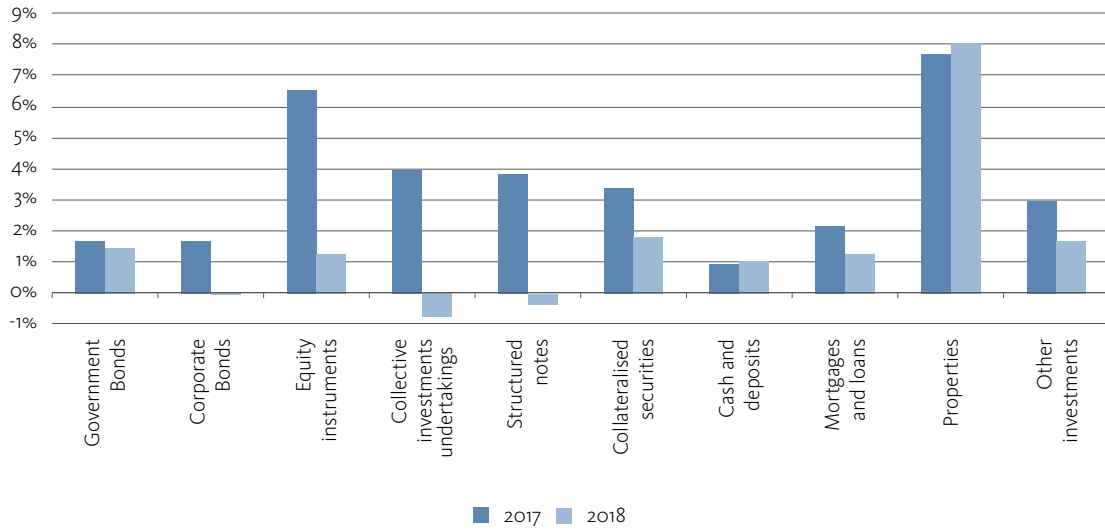and losses and unrealized gains and losses.

Figure 2.9: Return on Assets (in %; median, interquartile range and 10th and 90th percentile)
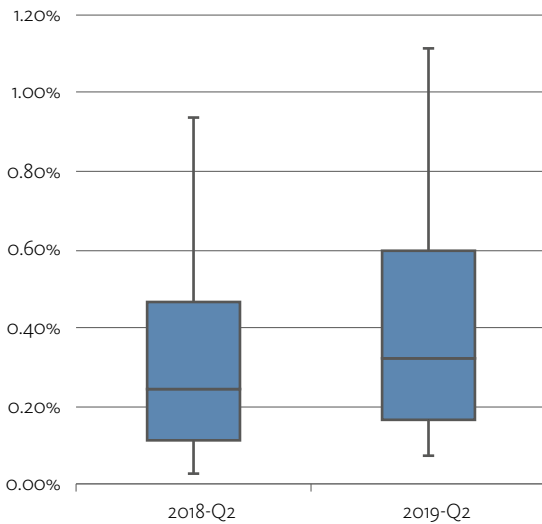
Source: EIOPA QFG (templates S.39.01.11 and S.02.01.02)
Note: Data is cumulative

Figure 2.10: Return on Excess of Assets over Liabilities (in %; median, interquartile range and 10th and 90th percentile)
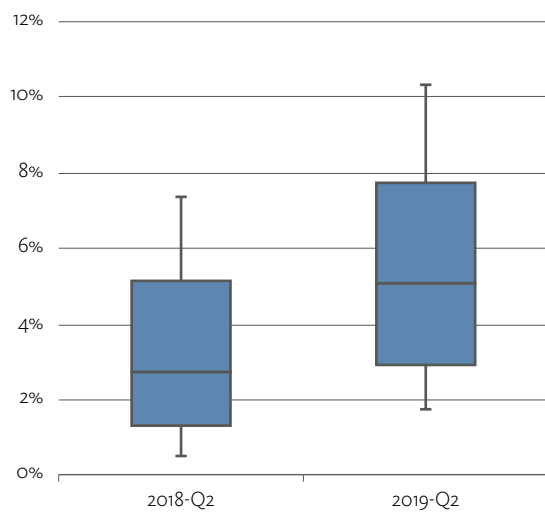
Source: EIOPA QFG (templates S.39.01.11 and S.02.01.02)
Note: Data is cumulative

The low yield environment also makes it increasingly hard for insurers to make investment returns in excess of guaranteed returns issued in the past, which are still prevalent in many countries. Many insurers, especially in the life segment, have offered guaranteed returns on their insurance policies in the past. These investment guarantees have become comparatively high in

the current low yield environment and it is increasingly difficult for insurers to cover the offered guaranteed rates in certain countries (Figure 2.11). While most insurance undertakings have stopped offering investment guarantees on new insurance policies and increasingly focus on unit-linked products, the legacy products with investment guarantees still make up the majority of technical provi-

Figure 2.11: Spread of investment return over guaranteed interest rate for life insurers (in %; median, interquartile range and 25th and 75th percentile)
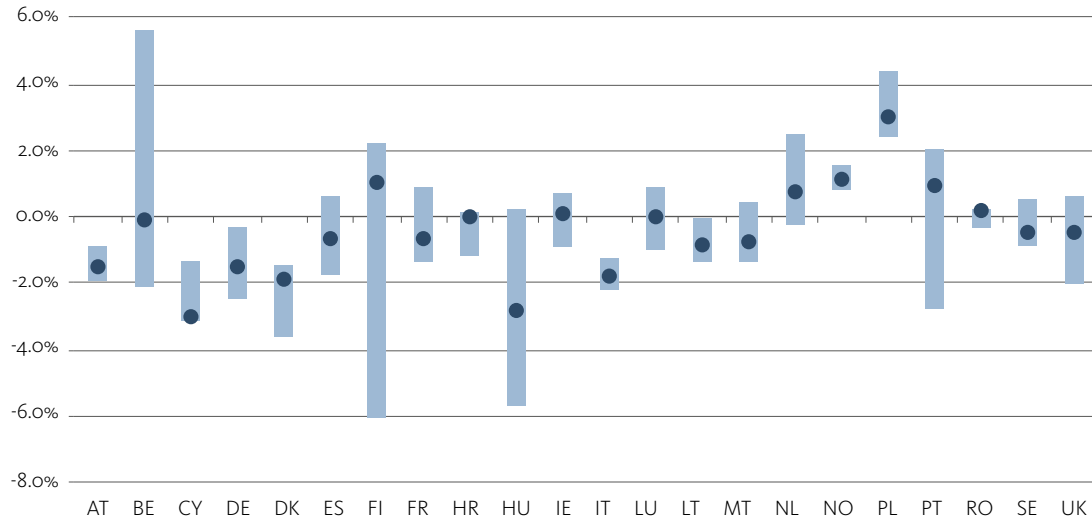
Source: EIOPA ARS
Reference date: 31/12/2018
Note: Only countries with a combination of material guaranteed rates and sufficient observations are shown. Weighted average guaranteed rate (using the best estimate at homogeneous risk group as weight) and investment return for solo life insurers are based on Solvency II reporting (s.14.01 and s.09.01) and may differ from statutory accounts. Life business from composite insurers is not considered in this figure, which may be relevant in some Member States, in particular in Italy and France.

Figure 2.12: Gross Combined Ratio across lines of business (in %; median, interquartile range and 10th and 90th percentile) as of Q2 2019
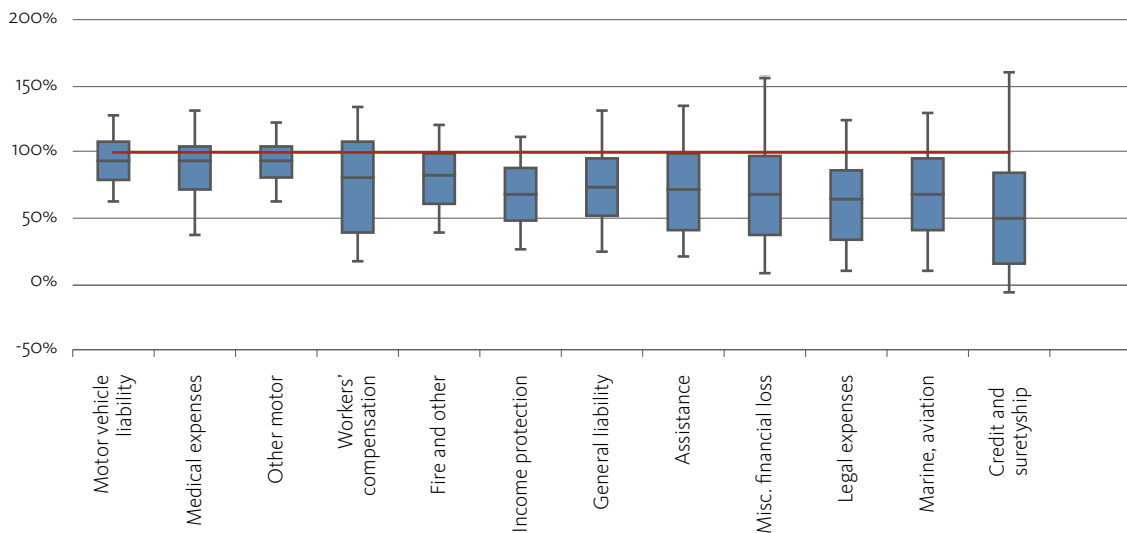
Source: EIOPA Quarterly Solo
Reference date: Q2 2019
Note: Premiums, claims and expenses by line of business (Claims Incurred Gross Direct Business + Expenses incurred by line of business divided by Gross Earned Premiums)[15]

sions in the EEA (approximately two-thirds of the total life best estimate in the EEA have some form of guaranteed rate). This continues to put a significant strain on the profitability of insurers.

15   Nominator S.05.01.02 ([R0310+ R0550, C0010-C0160]); Denominator S.05.01.02 [R0210, C0010-C0160]

Underwriting profitability remained stable and overall positive in the first half of 2019. The median Gross Combined Ratio for non-life business remained below 100% in the first half of 2019 across all lines of business, indicating that most EEA insurers were able to generate positive underwriting results (excluding profits from in-

vestments (Figure 2.12).[16] However, significant outliers can still be observed across lines of business, in particular for credit and suretyship insurance, indicating that several insurers have experienced substantial underwriting losses in this line of business. Furthermore, concerns of underpricing and underreserving remain in the highly competitive motor insurance markets.

2.3. SOLVENCY

Solvency positions slightly deteriorated in the first half of 2019 and the low interest rate environment is expected to put further pressures on the capital positions in the second half of the year, especially for life insurers (Figures 2.13 – 2.15). Furthermore, the number of life insurance undertakings with SCR ratios below the 100% threshold increased in comparison with the previous year from 1 in Q2 2018 to 4 in Q2 2019 mainly due to the low interest rate environment, while the number of non-life insurance undertakings with SCR ratios below 100% threshold decreased from 9 in Q2 2018 to 7 in Q2

2019 (Figure 2.14). The median SCR ratio for life insurers is still the highest compared to non-life insurers and composite undertakings. However, the SCR ratio differs substantially among countries (Figure 2.15).

The impact of the LTG and transitional measures varies considerably across insurers and countries. The long term guarantees (LTG) and transitional measures were introduced in the Solvency II Directive to ensure an appropriate treatment of insurance products that include long-term guarantees and facilitate a smooth transition of the new regime.[17] These measures can have a significant impact on the SCR ratio by allowing insurance undertakings, among others, to apply a premium to the risk free interest rate used for discounting technical provions. The impact of applying these measures is highest in DE and the UK, where the distribution of SCR ratios is signicantly lower without LTG and transitional measures (Figure 2.16). While it is important to take the effect of LTG measures and transitional measures into account when comparing across insurers and countries, the LTG measures do provide a potential financial stability cushion by reducing overall volatility.

Figure 2.13: SCR ratio (in %; median, interquartile range and 10th and 90th percentile) in 2018
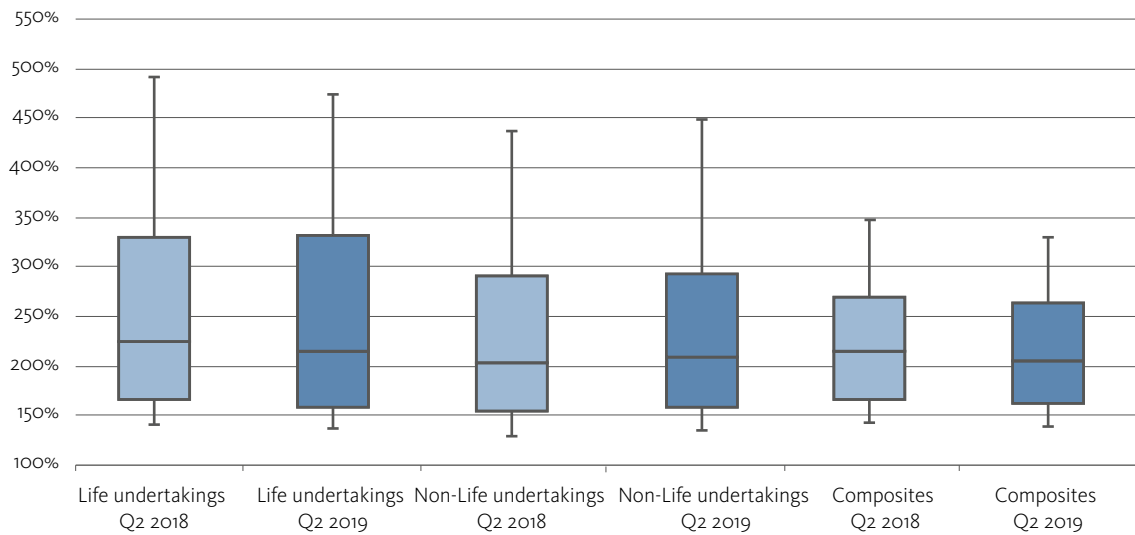
Source: EIOPA QRS

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16 The Gross Combined Ratio is the gross loss ratio plus the gross expense ratio.

17 Please refer to the annual LTG report for more information on the LTG and transitional measures.

Figure 2.14: Intervals of SCR ratios for solo undertakings as of Q2 2019 by type of undertakings
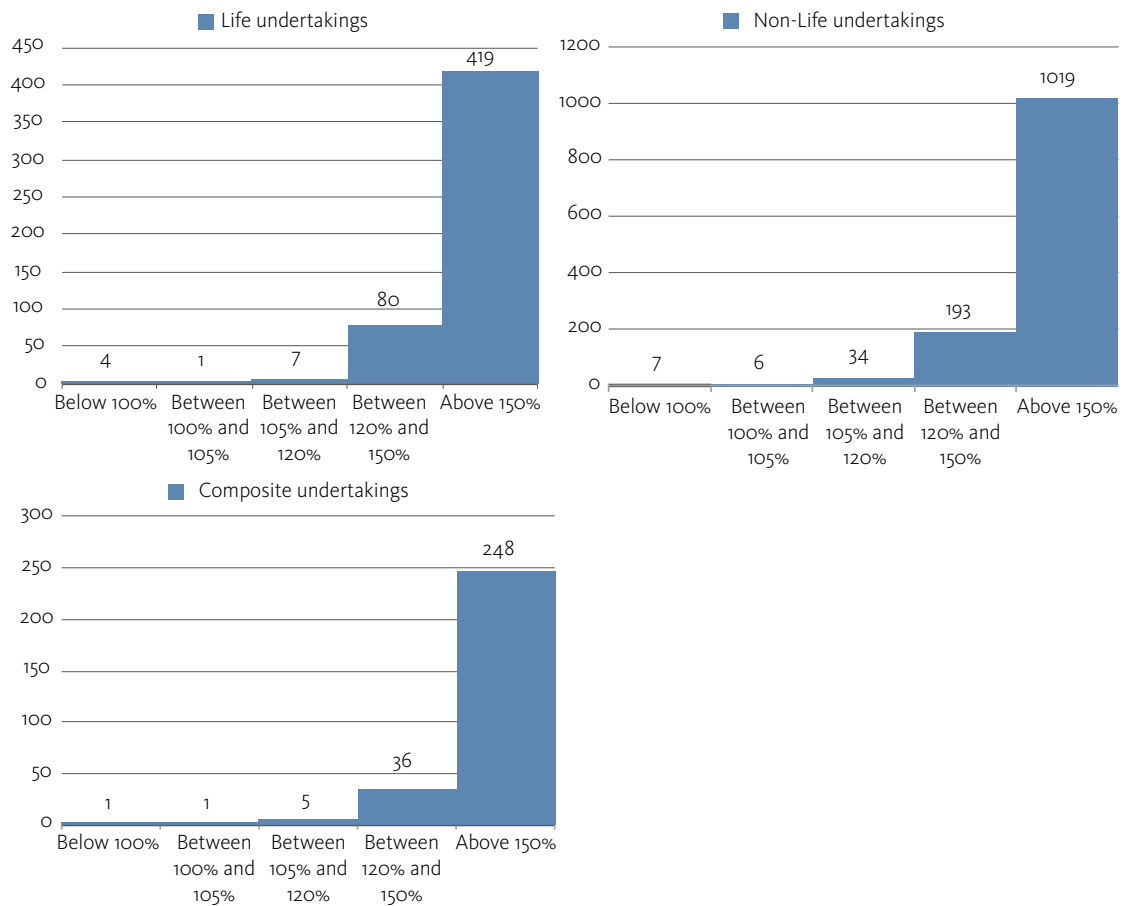
Source: EIOPA QRS
Reference Date: Q2 2019

Figure 2.15: SCR ratio by country (in %; median, interquartile range and 10th and 90th percentile)
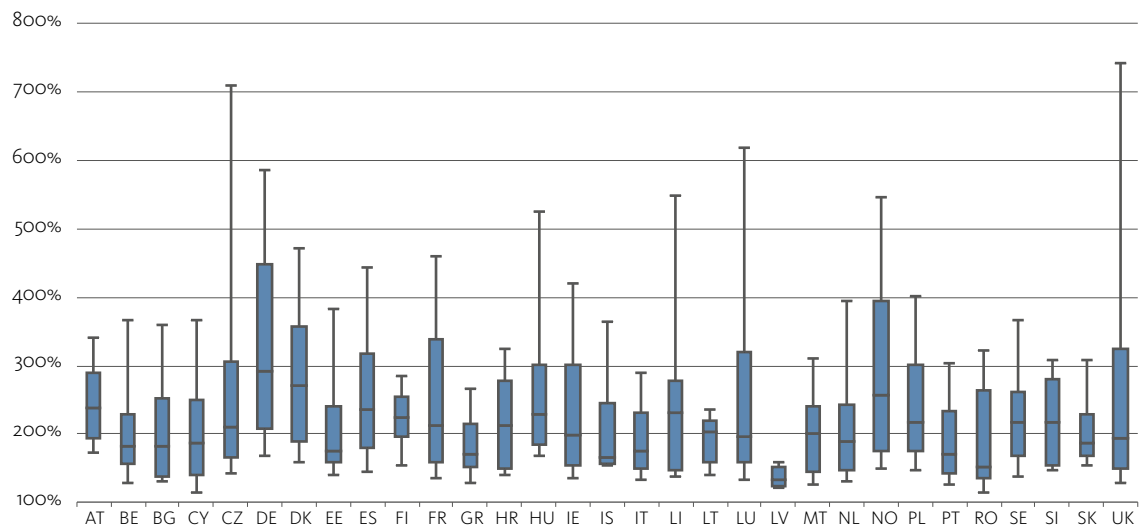
Source: EIOPA QRS
Reference date: Q2 2019

Figure 2.16: SCR ratio by country with and without LTG and transitional measures (in %; median, interquartile range and 10th and 90th percentile)

■ SCR ratio with LTG and transitional measures impact   ■ SCR ratio without LTG and transitional measures impact
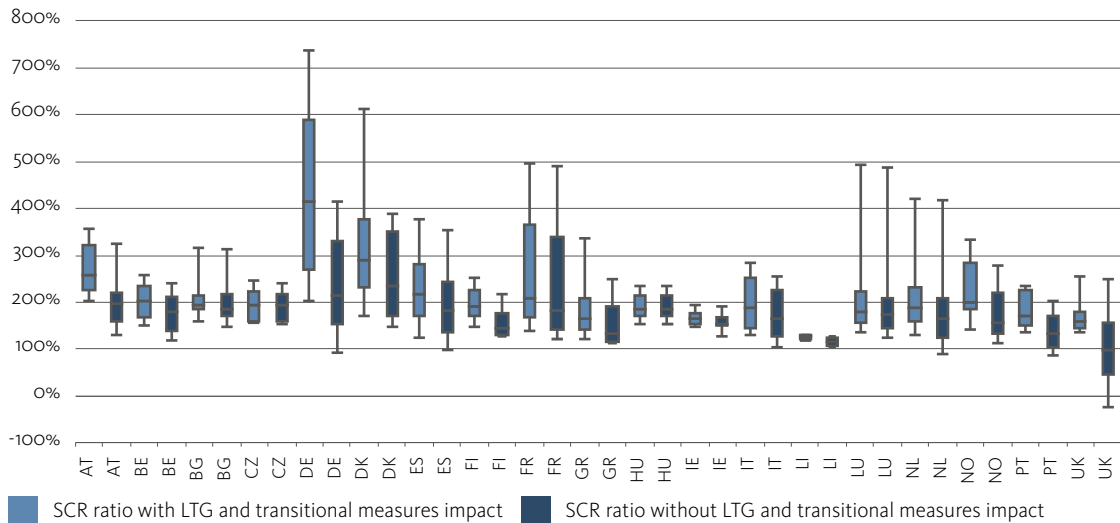
Source: EIOPA ARS
Reference date: 31/12/2018
Note: Sample based on 694 solo insurance undertakings in EEA that use transitional and/or LTG measures.

2.4. REGULATORY DEVELOPMENTS

On October 15th 2019, EIOPA launched a public consultation on an Opinion that sets out technical advice for the 2020 review of Solvency II. The Opinion will respond to the call for advice of the European Commission of 11 February 2019 on the 2020 review of Solvency II.[18] The call for advice comprises 19 separate topics. Broadly speaking, these can be divided into three parts.

›   The review of the LTG measures, where a number of different options are being consulted on, notably on extrapolation and on the volatility adjustment.

›   The potential introduction of new regulatory tools in the Solvency II framework, notably on macro-prudential issues, recovery and resolution, and insurance guarantee schemes. These new regulatory tools are considered thoroughly in the consultation.

›   Revisions to the existing Solvency II framework including in relation to freedom of services and establishment; reporting and disclosure; and the solvency capital requirement.

The main specific considerations and proposals of this consultation are as follows:

›   Considerations to choose a later starting point for the extrapolation of risk-free interest rates for the euro or to change the extrapolation method to take into account market information beyond the starting point.

›   Considerations to change the calculation of the volatility adjustment to risk-free interest rates, in particular to address overshooting effects and to reflect the illiquidity of insurance liabilities.

›   The proposal to increase the calibration of the interest rate risk sub-module in line with empirical evidence, in particular the existence of negative interest rates. The proposal is consistent with the technical advice EIOPA provided on the Solvency Capital Requirement standard formula in 2018.

›   The proposal to include macro-prudential tools in the Solvency II Directive.

›   The proposal to establish a minimum harmonised and comprehensive recovery and resolution framework for insurance.

The European Supervisory Authorities (ESAs) published on the 4th October 2019 a Joint Opinion on the risks of money laundering and terrorist financing affecting the European Union's financial sector. In this Joint Opinion, the ESAs identify and analyse current and

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18   The consultation covers all areas of the call for advice except insurance guarantee schemes and most topics on reporting and disclosure, which have been consulted upon at an earlier stage.

emerging money laundering and terrorist financing (ML/TF) risks to which the EU's financial sector is exposed. In particular, the ESAs have identified that the main cross-cutting risks arise from the withdrawal of the United Kingdom (UK) from the EU, new technologies, virtual currencies, legislative divergence and divergent supervisory practices, weaknesses in internal controls, terrorist financing and de-risking; in order to mitigate these risks, the ESAs have proposed a number of potential actions for the Competent Authorities.

Following its advice to the European Commission on the integration of sustainability risks in Solvency II and the Insurance Distribution Directive on April 2019, EIOPA has published on 30th September 2019 an Opinion on Sustainability within Solvency II, which addresses the integration of climate-related risks in Solvency II Pillar I requirements. EIOPA found no current evidence to support a change in the calibration of capital requirements for "green" or "brown" assets. In the opinion, EIOPA calls insurance and reinsurance undertakings to implement measures linked with climate change-related risks, especially in view of a substantial impact to their business strategy; in that respect, the importance of scenario analysis in the undertakings' risk management is highlighted. To increase the European market and citizens' resilience to climate change, undertakings are called to consider the impact of their underwriting practices on the environment. EIOPA also supports the development of new insurance products, adjustments in the design and pricing of the products and the engagement with public authorities, as part of the industry's stewardship activity.

On the 15th July 2019 EIOPA submitted to the European Commission draft amendments to the Implementing technical standards (ITS) on reporting and the ITS on public disclosure. The proposed amendments are mainly intended to reflect the changes in the Solvency II Delegated Regulation by the Commission Delegated Regulation (EU) 2019/981 and the Commission Delegated Regulation 2018/1221 as regards the calculation of regulatory capital requirements for securitisations and simple, transparent and standardised securitisations held by insurance and reinsurance undertakings. A more detailed review of the reporting and disclosure requirements will be part of the 2020 review of Solvency II.

On 18th June 2019 the Commission Delegated Regulation (EU) 2019/981 amending the Solvency II Delegated Regulation with respect to the calculation of the SCR for standard formula users was published. The new regulation includes the majority of the changes proposed by EIOPA in its advice to the Commission in February 2018 with the exception of the proposed change regarding interest rate risk[19]. Most of the changes are applicable since July 2019, although changes to the calculation of the loss-absorbing capacity of deferred taxes and non-life and health premium and reserve risk will apply from 1 January 2020.

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19   See "Regulatory developments" in pages 33-34 of EIOPA's Financial Stability Report – June 2018

3. THE EUROPEAN REINSURANCE SECTOR

The first half of 2019 has been marked by very benign catastrophe activity, with global insurance losses significantly below long-term levels and the record losses observed in 2017 and 2018. Coupled with the overall positive stock market developments, this has benefited the profitability and solvency position of the reinsurance sector, including in the EEA. Growth in global reinsurance capital has been supported mostly by traditional capital, although outstanding alternative reinsurance capital has also continued to grow despite concerns related to the potential effect of climate change on the occurrence of natural disasters. The issuance of new ILS instruments appears to be more moderate in 2019 compared to the previous two years however.

3.1. MARKET SHARE AND GROWTH

The overall share of reinsurance gross written premiums (GWP) in total GWP in the EEA remains at 15% (Figure 3.1). Non-life reinsurance accepted represented 10% of total GWP in the first half of 2019, while life reinsurance obligations accounted for only 5%. In terms of year-on-year developments, overall reinsurance premiums increased by a mere 2 percentage points to EUR 121 bn, owing mostly to an increase in non-life proportional reinsurance. The latter increased from EUR 54 bn in the first half of 2018 to EUR 59 bn in the same period of 2019 (Figure 3.2). This was driven primarily by higher premiums written for the motor liability, general liability and medical expense insurance lines of business (Figure 3.3).

The importance of the reinsurance business varies both at the EEA level and within each Member State. In some Member States reinsurance premiums account for a higher share of total premiums written in the country, but only for a smaller share of total reinsurance premiums written in the EEA. Reinsurance premiums written in Malta and Bulgaria, for example, account for between 40% to 50% of total premiums written in those countries, but for less than 5% of total reinsurance premiums written in the EEA (Figure 3.4). The same holds for Luxembourg and Liechtenstein, though the importance of reinsurance at national level is lower than in the two countries mentioned before (around 25%). The share of reinsurance

Figure 3.1: Gross Written Premiums in the EEA (in EUR billion and %)
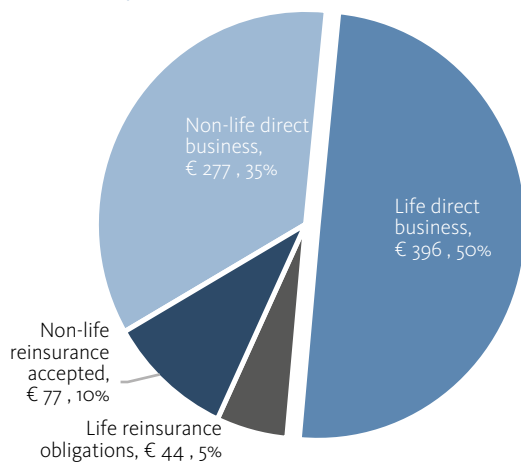
Figure 3.2: Reinsurance Gross Written Premiums in the EEA (in EUR billion)
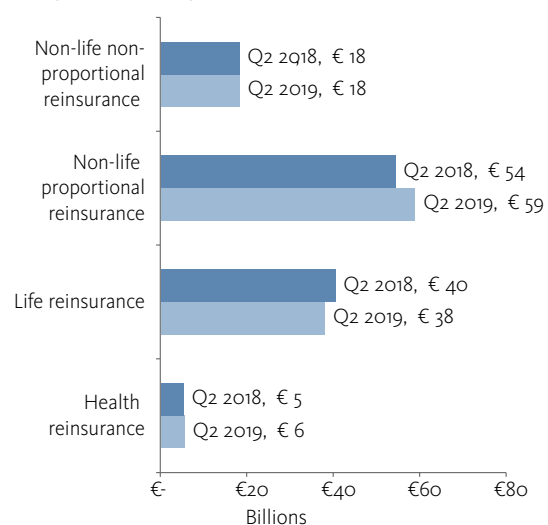
Source: EIOPA QRS
Reference date: Q2 2019
Note: Year-to-date amounts. Non-life reinsurance accepted includes proportional and non-proportional reinsurance. Life reinsurance obligations include life reinsurance and health reinsurance.

Figure 3.3: Gross Written Premiums for non-life proportional reinsurance by Line of Business (in EUR billion)
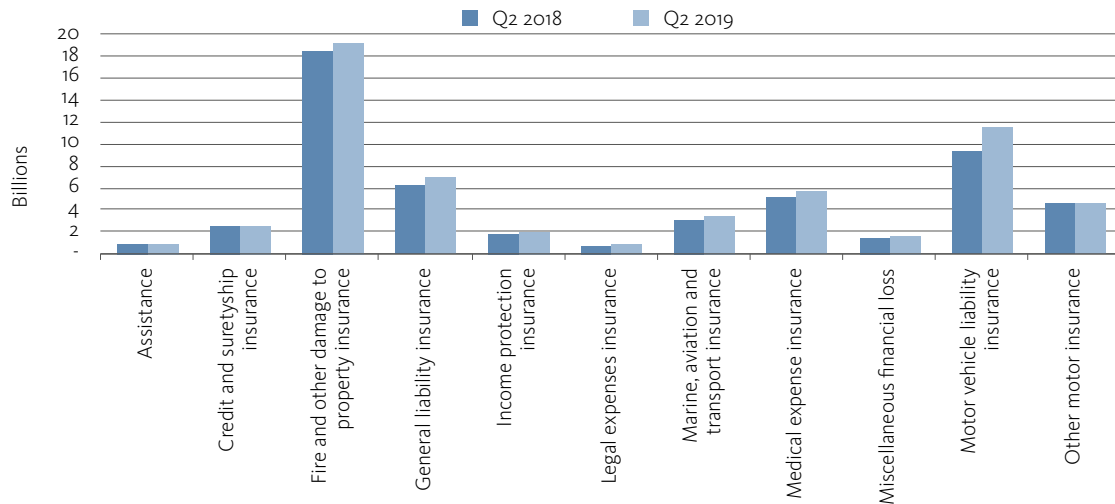
Source: EIOPA QRS

Figure 3.4: Reinsurance gross written premiums by EEA Member State
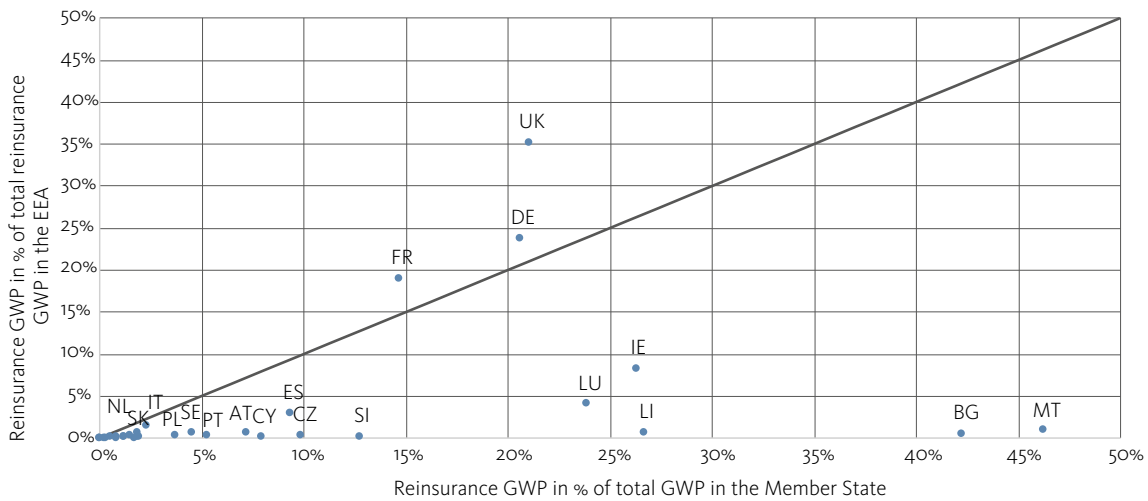
Source: EIOPA QRS
Reference date: Q4 2018
Note: Labels are not shown for all Member States with reinsurance shares below 5% for readability.

premiums written in Member States such as the United Kingdom, Germany and France, is very high when considering the whole EEA reinsurance market (between 20% and 35%), but relatively smaller at national level.

Globally, total reinsurance capital increased since the end of last year, driven mostly by traditional reinsurance.[20] Accordingly, global reinsurance capital reached USD 610 bn by June 2019, an increase of 4% since end-

2018. Traditional reinsurance capital rose by 6% impelled mainly by strong earnings, reaching USD 517 bn. Alternative capital declined by 4% to USD 93 bn, reflecting the payment of losses and investor redemptions. While significant capital, especially regarding collateralised reinsurance, remains confined because of prior losses, new capital continues to flow into the industry. Total outstanding insurance-linked securities (ILS) amounted to USD 41 bn by mid-November 2019, an all-time high in comparison with the prior full-year totals (Box 3.1). The amount of ILS issued until mid-November 2019 reached USD 8.5 bn, still lower than the last two years' totals, but a high level in

historical terms. Nevertheless, collateralised reinsurance transactions still represent the bulk of alternative capital in the market.

Despite the losses related to the natural disasters of autumn 2017, capital flows into the ILS-market continued in 2018 and 2019. On one hand, the relatively high yields, as well as the diversifying nature of the catastrophe-exposed business, might continue to attract investors. On the other hand, concerns such as the potential impact of climate change on the frequency of natural catastrophes might hold back the development of the ILS-market via reduced demand from investors or pressures for higher returns in compensation for the perceived increase in risk.[21]

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21 "Global Reinsurance Guide 2020", Fitch Ratings, September 2019.

BOX 3.1: CATASTROPHE BONDS AND INSURANCE-LINKED SECURITIES[22]

Catastrophe bonds (cat-bonds) are a type of insurance-linked security (ILS) that transfers catastrophe and natural disaster risks from a sponsor to capital market investors. Since first issued in the mid 1990's, issued volumes of cat-bonds and ILS have been on a rise, from roughly USD 786 million in 1997 to USD 14 billion in 2018 (Figure B3.1). In November 2019, outstanding volumes of ILS, including cat-bonds, reached approximately USD 41 billion.

Figure B3.1 - Issued and outstanding volumes of cat-bonds and ILS risk capital (in USD)
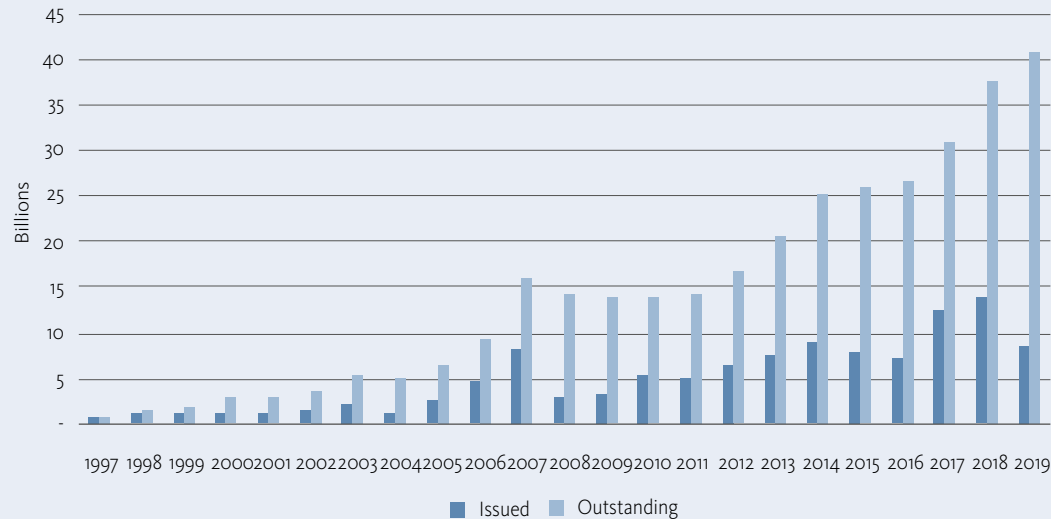
Source: www.Artemis.bm Deal Directory.
Note: Data for 2019 includes catastrophe bond issuance up to mid-November.

Three main parties are involved in the issuance of a cat-bond:

Sponsors

Sponsors include (re)insurance companies, large multinational corporations and even governments looking to spread the risk of loss from natural disasters. For sponsors, cat-bonds are a complement to traditional reinsur-

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22 References for the content of this box include: www.Artemis.bm and "Catastrophe Bonds: Investing with Impact", Man Institute, Rzym A. and Abou Zeid T., October 2018.

ance. The bonds function similarly to a reinsurance contract structured over several years or a single year: when the natural catastrophe occurs and specific pre-defined conditions are met, the bond kicks in to absorb the financial impact up to a stated limit.

Triggers and perils

Some bonds are pegged to parametric triggers such as an index of weather or disaster conditions (e.g. earthquake magnitude or wind speed) under which catastrophe events above a certain severity trigger a payment to the sponsor. Other bonds use indemnity triggers, which specify a sliding scale of actual losses experienced by the sponsor, or industry loss triggers, which are activated when industry wide losses from an event breach a certain threshold. Indemnity triggers are by far the most common, accounting for 68% of outstanding cat-bonds and ILS (Figure B3.2). Industry loss triggers and parametric triggers account for 17% and 4% of all outstanding deals, respectively. A cat-bond may provide coverage for exposures to single events or multiple events over the course of a pre-defined period. Also, it can cover losses originating in single or multiple geographical locations (Figure B3.2).

Figure B3.2 – Outstanding cat-bonds and ILS by type of trigger and peril
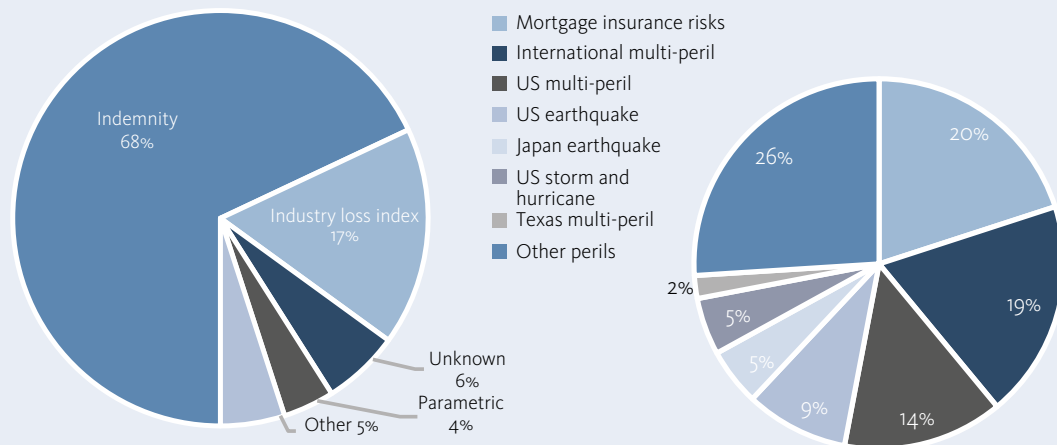
Sources: www.Artemis.bm Deal Directory and EIOPA calculations.
Note: Outstanding volume as of mid-November 2019.

Investors

Generally, investors are pension funds, hedge funds and other private investors. Typically, interest in this type of financial instrument is due to its portfolio diversification benefits and attractive rates of return. First, non-financial risks covered by cat-bonds are generally thought to be highly uncorrelated with broader financial markets. Second, cat-bond yields are usually higher than more traditional investments – the annualised rate of return for cat-bonds since 2002 was 7.1%, which compares to 6.6% for equity and 4.7% for fixed income securities (Figure B3.3). Investors face a loss on their investment when a natural disaster occurs or the trigger conditions are met. In this situation, sponsors use that amount to cover their losses.

Figure B3.3 - Relative performance of cat-bonds

— Swiss Re Global Cat Bond Performance Index   — MSCI World Net Total Return Index
— Bloomberg Barclays Global-Aggregate Total Return Index
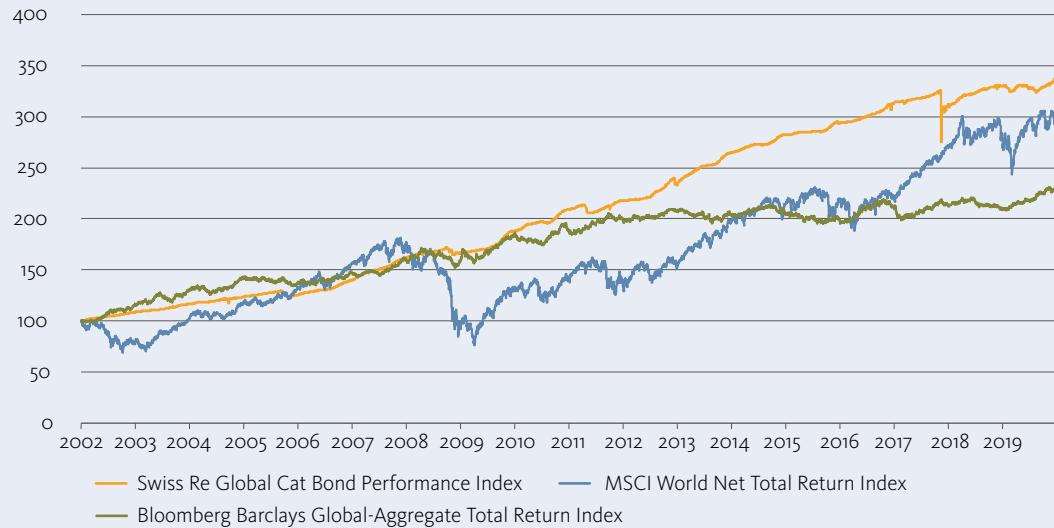
Sources: Man Institute, Bloomberg and EIOPA calculations.
Notes: Equity performance measured by MSCI World Net Total Return Index (M1WO Index) and fixed income market performance measured by Bloomberg Barclays Global Aggregate Total Return Index (LEGATRUU Index). Cat bond performance index calculated by Swiss Re (SRGLTRR Index). Reference date is 11 November 2019 and 5 January 2002=100.

Special Purpose Vehicle (SPV)

Cat-bonds are issued through securitisation. A SPV enters into an agreement with a sponsor, receiving premiums in exchange for providing coverage in case a predefined event happens. The coverage is ensured via the issuance of cat-bonds, which are bought by investors for a principal amount. The SPV can then invest the proceeds of the sale into the financial markets, with the returns being used to pay the investors' coupon in combination with the premiums received from the sponsor. Upon the occurrence of a qualifying event, the SPV uses the invested amount to pay the sponsor under the terms of the reinsurance agreement and the investors may lose the entire principal amount. When no qualifying event occurs, the investors are repaid upon the term of the bond.

Figure B3.4 - Illustration of a possible set-up
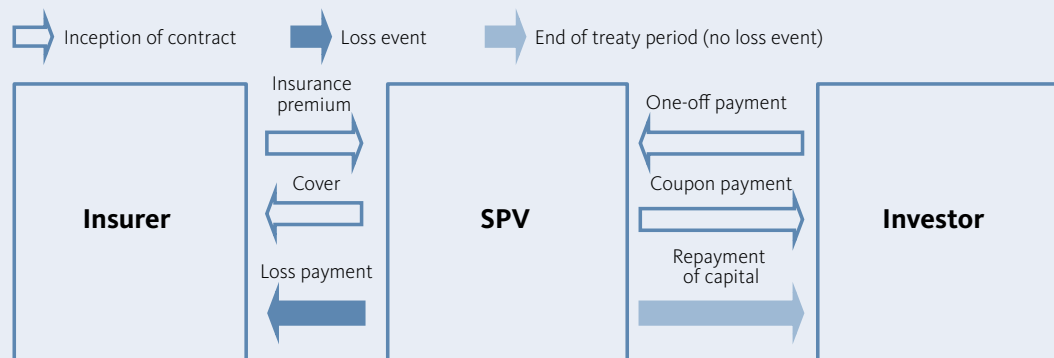
Pricing

The pricing of cat-bonds is not different from other financial instruments as it should take into consideration the projected cash flow. As each individual cat-bond holds its own features, they are subject to pricing resembling its individual characteristics.

3.2. PROFITABILITY

**In the first half of 2019, the global insurance indus-
try catastrophe losses were considerably below the
long-term average.** Insured losses decreased to USD 15
bn, from USD 23 bn in the same period of the previous
year, and fell below the 30-year average (USD 18 bn). The
overall economic losses fell from USD 62 bn in the first
half of 2018 to USD 42 bn in the same period of 2019 and
are considerably lower than the 30-year average (USD 69
bn).[23]

**Stormy weather was most prominent in terms of both
economic and insured losses.** The costliest natural di-
saster event was a series of tornados and thunderstorms
in the USA, which took place in the second half of May.
The overall economic losses from this event amounted to
USD 3.3 bn, of which USD 2.5 bn was insured (Table 3.1).
Despite a very active stormy weather season in the USA,
losses during the first half of 2019 amounted to nearly
USD 7.5 bn, well below the USD 10 bn average over the
past decade.

**In comparison with 2017, the hurricane season has
been relatively benign during the first half of 2019.**
This is despite hurricane Dorian in September, whose
losses are estimated to range from USD 4 bn to USD 8.5
bn, including also the impact to the Caribbean, the USA
and Canada. In Europe, winter storm Eberhard was the
most damaging event, causing overall economic losses
around USD 1.2 bn and insured losses of USD 0.9 bn.

**After severe losses in 2017 and 2018, reinsurance rates
increased only moderately, mostly in the regions and**
lines of business affected by catastrophe events. In-
vestors have continued to show appetite for insurance
risk, leading to a still considerable capital supply in the
reinsurance market, especially for alternative reinsurance.
Therefore, stable or slightly increasing prices are expected
in the renewals ahead.

**The combination of the continued capital-inflows,
lack of catastrophe losses affecting the market and
the sustained low interest rate environment is likely
to increase the pressure on the profitability of the EEA
reinsurance sector.** The last renewals revealed that the
competitive pressure in the reinsurance sector remains
high. Moreover, the ability to release reserve from previ-
ous years appears to have been diminished, whereas the
long-term business is getting less profitable or even un-
profitable, as the high interest rates calculated in previous
rates are difficult to earn. Against this background, getting
risk-adequate prices at the upcoming renewals is crucial
for the reinsurance companies.

**The return on investments of EEA reinsurance under-
takings has declined in 2018.** The return on investments
has decreased across the whole distiribution with the
median ratio reaching 0.2% in 2018 after 0.6% in the pre-
vious year (Figure 3.5). Moreover, more negative returns
were observed for the lower tail of the distribution, with
the 10th percentile dropping from -0.1% in 2017 to -1.6%
in 2018.

**There has been an improvement in the combined ra-
tio for non-life non-proportional reinsurance, possibly
reflecting the lower catastrophe losses in the first half
of the year.** Median gross combined ratios for EEA rein-
surers across all lines of business have remained broadly

Table 3.1: The five largest natural catastrophes in the first half of 2019, ranked by insured losses

Date	Event	Region	Overall losses (USD bn)	Insured losses (USD bn)
17-31.5.2019	Tornado, severe storm	USA	3.3	2.5
23-26.2.2019	Severe storm, Tornado	USA, Canada	1.6	1.1
23-25.3.2019	Severe storm	USA	1.3	1.0
26.1-10.2.2019	Flood	Australia	1.9	0.9
9-11.3.2019	Winter Storm Eberhard	Europe	1.2	0.9

Source: Munich Re, NatCatSERVICE.

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23   Munich Re, NatCatSERVICE.

Figure 3.5: Return on investments of EEA reinsurance undertakings (in %; median, interquartile range and 10th and 90th percentile)
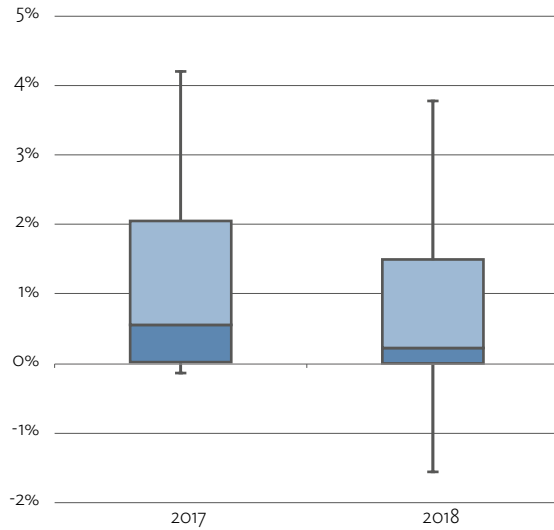
Source: EIOPA ARS

Figure 3.6: Gross Combined Ratio for non-life direct business and accepted proportional reinsurance of EEA reinsurance undertakings (in %; median, interquartile range and 10th and 90th percentile)
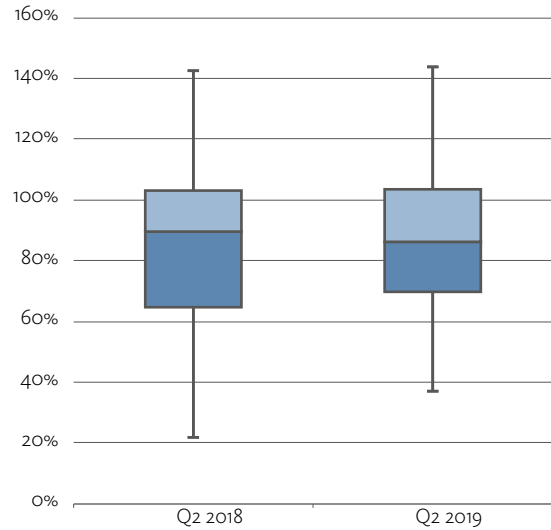
Source: EIOPA QRS

Figure 3.7: Gross Combined Ratio for accepted non-proportional reinsurance of EEA reinsurance undertakings (in %; median, interquartile range and 10th and 90th percentile)
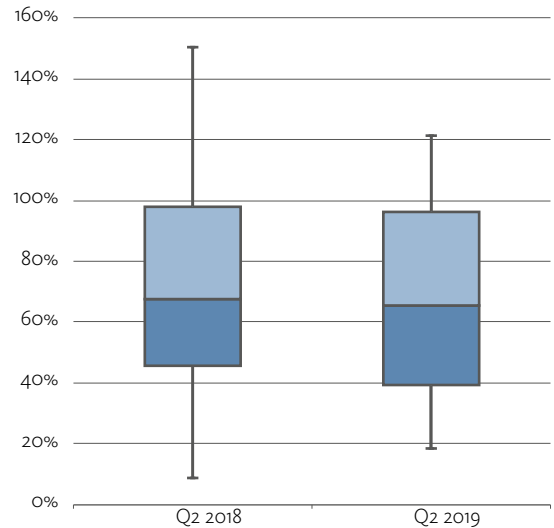
Source: EIOPA QRS

Figure 3.8: Gross Combined Ratio for life reinsurance obligations of EEA reinsurance undertakings (in %; median, interquartile range and 10th and 90th percentile)
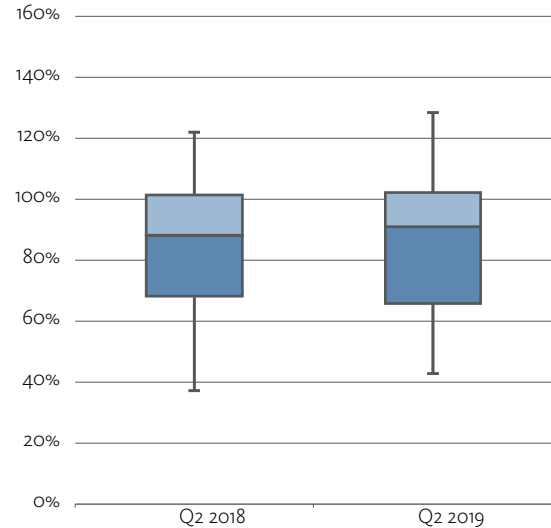
Source: EIOPA QRS

stable, but the upper tail of the distribution of the combined ratio for non-proportional reinsurance declined by roughly 30 percentage points, to 121% (Figures 3.6 to 3.8). This potentially reflects the lower amount of insured losses from natural catastrophes in the first half of 2019 compared to the same period of 2018.

3.3. SOLVENCY

Median solvency positions of the reinsurance undertakings operating in the EEA improved during the first half of 2019, standing at the highest level since

Figure 3.9: Solvency ratio of EEA reinsurance undertakings (in %; median, interquartile range and 10th and 90th percentile)
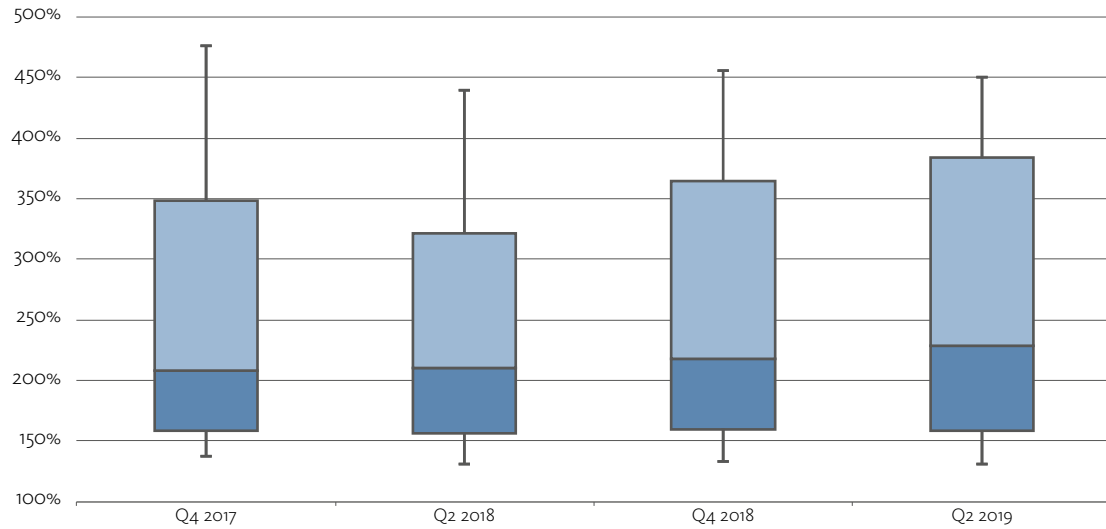
Source: EIOPA QRS

end-2017. The median solvency ratio increased by 20 percentage points since Q4 2017 and by 10 percentage points since Q4 2018, to 229% in Q2 2019 (Figure 3.9). Overall, reinsurance companies seem to have remained resilient to the significant catastrophe losses observed in the last two years. Moreover, the interquartile range of the distribution has expanded upwards, indicating a larger proportion of reinsurance undertakings with higher SCR ratios. The lower level of catastrophe losses in the first half of the year coupled with positive developments in the stock markets should have contributed to the improvement in reinsurers' capital positions.[24]

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24   "Global Reinsurance Guide 2020", Fitch Ratings, September 2019.

4. THE EUROPEAN PRIVATE PENSION FUNDS SECTOR

In 2018, the private pension fund sector experienced a constantly worsening economic environment, taking its toll on both the financial situation of DB pension funds and on the accumulated savings of members and beneficiaries in DC funds. The persistently low interest environment affects the current values of DB pension obligations due to low discount rates. In almost all Member States, cover ratios (ratio of assets covering the pension obligations) decreased and in UK, IS and PT fell below the 100%, with the outlook continuing to look challenging in light of the slowdown in the global economy and the pressure on the interest rates.

Asset values impaired significantly towards the end of 2018, wiping off substantial values in equity investments. Depending on the investment allocation, which has remained relatively stable over the last couple of years, Member States' private pension funds were affected in different ways: in some Member States almost one third of the investments are in equity, whereas in aggregate EEA terms 52% of the investments are made in bonds – of which the vast majority is in sovereign bonds. An increase in asset values by +1.5% can be observed at aggregate EEA level. However, severe losses of -6%, -8% and up to one third of the total asset values can be seen in some Member States in 2018.

EIOPA can start to better monitor and more deeply assess potential negative impacts of macroeconomic developments on the IORP sector and financial stability through its improved reporting data from 2020. In order to improve its capabilities to analyse the European private pension fund sector, in 2018 EIOPA decided on an improved, common set of reporting requirements.[25] The new framework will allow EIOPA to effectively monitor market developments in the area of occupational pension funds as well as to undertake in-depth economic analyses.

4.1. MARKET GROWTH OF THE OCCUPATIONAL PRIVATE PENSION FUND SECTOR

The UK[26] and the Netherlands continue to be the largest European private pension sectors with IORPs holding more than 80% of the assets under management (EUR 3,141 bn) in the European occupational private pensions sector. (Table 4.1). The size of the national private pension sector is primarily determined by its relative role in the national social security and pension framework.

Table 4.1: Total assets per country as a share of total assets reported for 2018

UK	NL	DE	IT	IE	NO	ES	BE	IS	AT	SE	PT	RO
46.2%	35.4%	6.3%	3.5%	2.7%	0.91%	0.90%	0.82%	0.74%	0.57%	0.49%	0.47%	0,28%

DK	LI	FI	SI	LU	SK	GR	LV	PL	HR	MT	BG	Total
0.21%	0,17%	0.11%	0.07%	0.05%	0.05%	0.04%	0,01	0.01%	0.003%	0.0005%	0.0002%	100%

Source: EIOPA
Note: Figure for UK excludes DC schemes

25 In April 2018, EIOPA published its decision at: (https://eiopa.europa.eu/Pages/News/EIOPA-is-significantly-enhancing-European-pensions-statistics.aspx)

26 This covers only the DB sector of the UK IORPs, the percentage would be significantly higher if the DC sector could have been included.

Figure 4.1: Total Assets (in EUR bn)

■ 2016   ■ 2017   ■ 2018
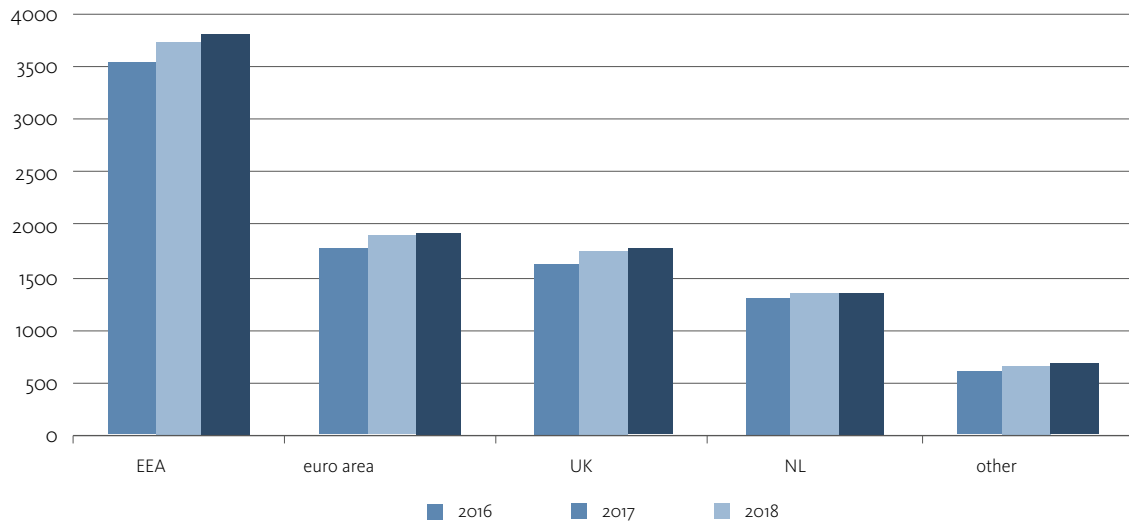
Figure 4.2: Penetration rates (total assets as % of GDP)
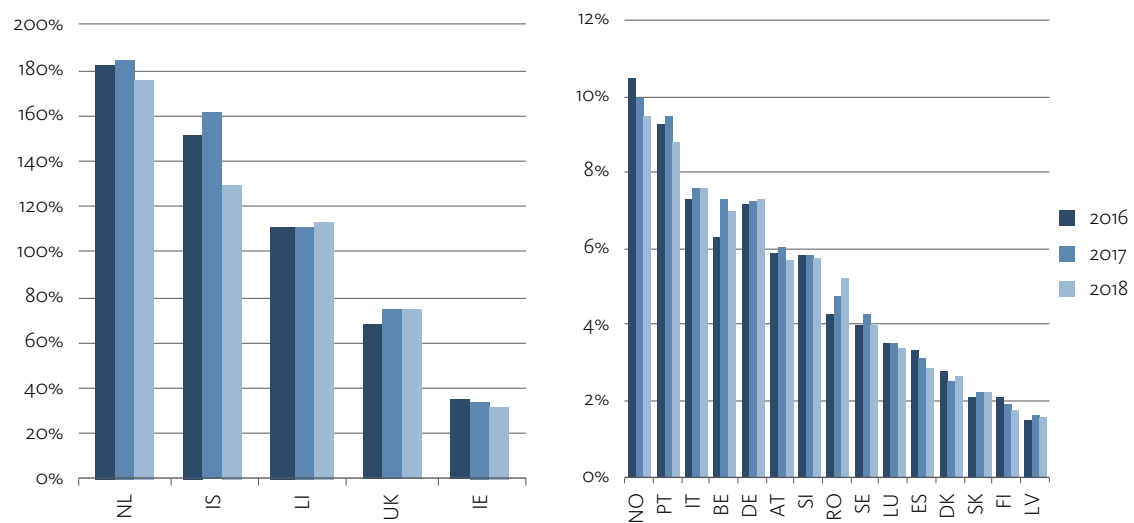
Source: EIOPA
Note: For the UK data refer only to DB and HY schemes.
Figure 4.1 is based on data received by 25 countries (EEA) and 15 countries (euro area) which provided total assets for 2017. The category "other" includes all countries except UK and NL.
Figure 4.2 Penetration rate for GR, HR, PL, MT and BG is lower than 1 per cent. For RO, the data refers to 1st Pillar bis and 3rd Pillar private pension schemes only
Source: EIOPA QRS

With in total EUR 3,848 bn of assets under manage-ment in the European private pension funds, total assets increased by only +1,5 per cent for the EEA in 2018 – compared to an increase of +6 per cent in 2017 (Figure 4.1). Whereas in most countries the increase was relatively moderate, for example: IT +2%, DE +4% or low: NL +0.2%, some were also very negative: IE -34.

The penetration rate[27] remained broadly unchanged in 2018, both for the EEA (23%) and the euro area (17%). This ratio gives an indication of the relative wealth ac-cumulated by the sector. It has to be noted that there is large heterogeneity across countries (Figure 4.2), which is determined by the diverse size of private pension funds and corresponding savings in the Member States.

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27 The size of the occupational pension fund sector with respect to the GDP

4.2. INVESTMENT ALLOCATION AND PERFORMANCE

In aggregate terms, the investment allocation of private pension funds remained almost unchanged in recent years (Figure 4.3). Debt instruments account for the biggest aggregate share (52% in 2018) in private pension funds' investment assets. This share has further increased in 2018 compared to 2017 (50% in 2018), arguably due to the significantly lower market values of equity investments experienced at the end of 2018. Looking at the types of debt investments of private pension funds in the EEA, the significant portion of 64% in sovereign bonds remained unchanged since 2016. The rest of 36% is almost equally split between corporate and other bonds. The aggregate equity exposure in the private pension sector is relatively high in some Member States, amounting to around one third of the investment portfolio (UK: 27%, NL: 34%, AT: 32%, SE: 34%; Figure 4.5). Impairments in the equity investments have brought down the relative share in equity investments by 2% in the EEA.

Investment allocations across countries remained very heterogeneous in 2018 (Figure 4.5). Whilst direct investments in bonds and equity cover almost 80% of the private pension funds' investments on aggregate, the shares within the individual countries vary substantially across the countries of the sample. Interesting is the relative share of 'other assets' in the sample (around 20% in DE, IE, AT, DK; over 30% in IT, LU and MT). Within the category 'other assets' the highest proportions of investments can be found in loans and real estate as well as unallocated assets. The investments in derivatives is relatively low in market values.[28]

The asset-weighted ROA for the EEA decreased significantly in 2018 compared to the previous year. The average ROA (Figure 4.7) in 2018 (un-weighted -1.0%, weighted 0.22%) substantially decreased compared to 2017 (un-weighted 4.9%, weighted 3.4%). The ROA went negative in most countries, in particular those with relatively high equity exposures, either directly or through UCITS (NL -1.22%, BE -2.7%, AT -5%, SK -4.7%).

Figure 4.3: Investment Allocation for 2016 to 2018 (in %)
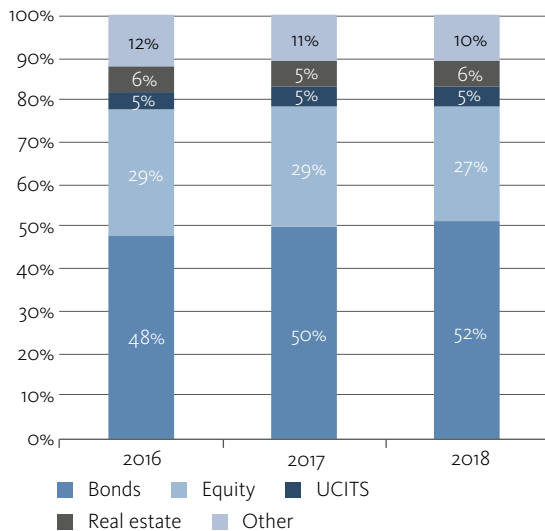
Figure 4.4: Bond investments breakdown for 2016 to 2018 (in %)
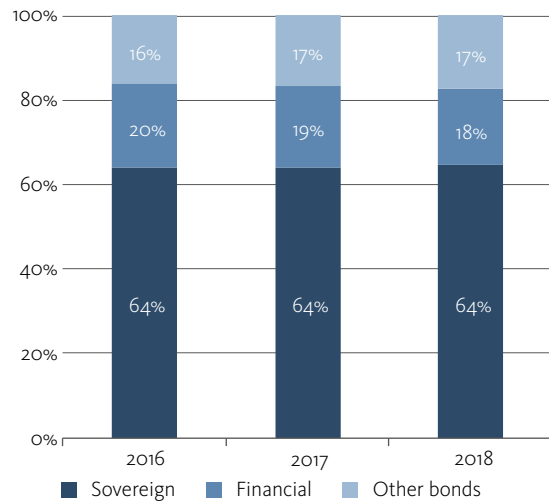
Source: EIOPA
Note: UCITS stands for Undertakings for Collective Investment in Transferable Securities. For all variable definitions, please refer to the statistical annex published at: https://eiopa.europa.eu/financial-stability-crisis-prevention/financial-stability/statistics.

[28] It should be noted that the market value of derivatives is typically zero when the contract is entered into and changes in responses to changes in the underlying over time. EIOPA currently does not receive data on the notional amounts outstanding.

Figure 4.5: Investment Allocation per country for 2018 (in %)
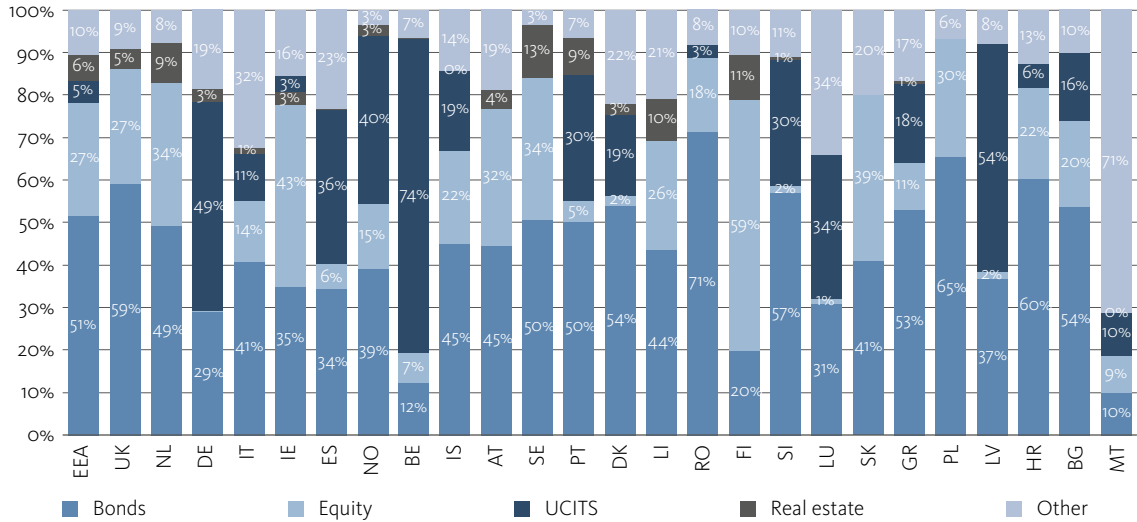
Source: EIOPA
Note: "Other" includes: Derivatives, loans, reinsured technical provisions, other investments and other assets. For all variable definitions please refer to the statistical annex published at: https://eiopa.europa.eu/financial-stability-crisis-prevention/financial-stability/statistics. The UK figure used for the calculations of these figures relates to DB and HY schemes only. Finally, please note that the information on investments in UCITS is not available for all countries

Figure 4.6: Other investments breakdown per country for 2018 (in %)
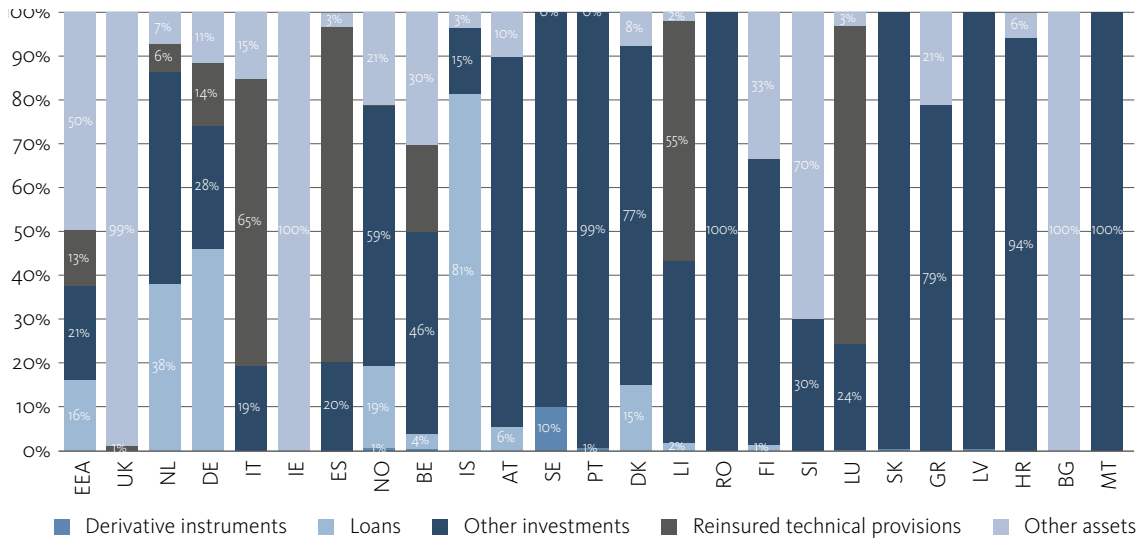
Source: EIOPA; Notes:
(1) "Other investments" includes: Deposits with credit institutions, cash, other short term investments or derivatives. "Other assets" includes the assets that are not shown under investments.
(2) Figure 4.6 does not include PL.

Figure 4.7: Rate of return on assets (ROA) in %
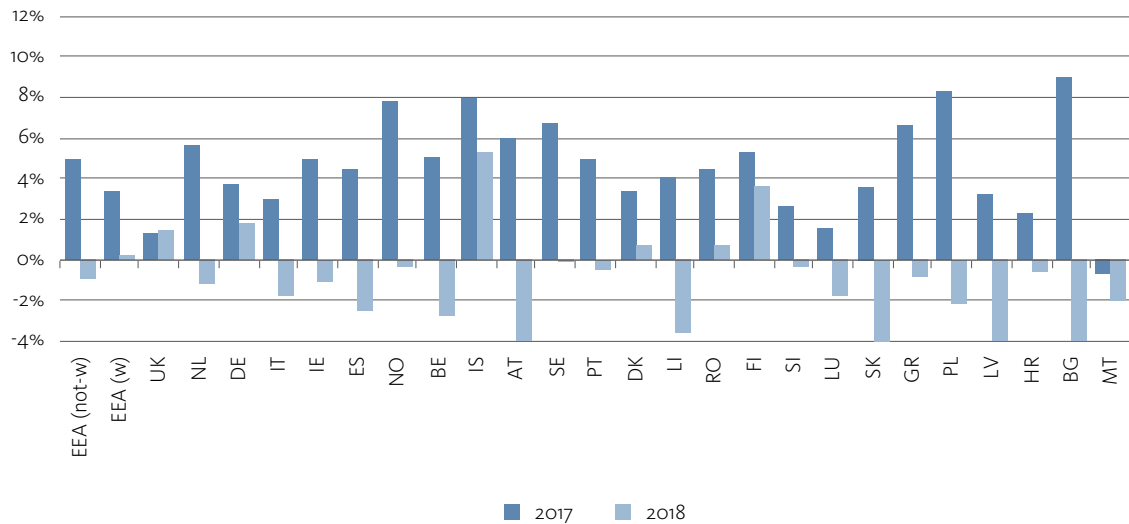
Source: EIOPA; Notes:
(1) Figure 4.7 does not include HU.
(2) Both the weighted and un-weighted averages for ROA were calculated on the basis of the countries that are depicted in the chart. The weighting is based on total assets.

4.3. FUNDING RATIOS AND MEMBERSHIP DEVELOPMENTS

The asset-weighted cover ratio for DB schemes slightly increased in 2018.[29] Overall, the asset-weighted average cover ratio increased from 101% in 2017 to 102% in 2018, whereas the un-weighted average coverage ratio decreased from 113% in 2017 to 111% in 2018. The cover ratio shows to which extent the private pension funds' technical provisions are covered by investment assets. The cover ratio can be based on market consistent valuations – and thus change in response to changes in the economic environment - or other valuation metrics depending on the national valuation framework and pruden-

tial regime for private pension funds in each country. The cover ratio is also not a measure of national prudential regimes or required funding ratios, and hence, do not necessarily require direct supervisory intervention when breached. Cover ratios close to or below 100 per cent remain a concern for the sectors, as the 'buffer' for crisis or continued poor asset performance is small. If private pension funds reach the point of underfunding, there are national-specific mitigating tools. In some countries, for example the UK, the sponsoring undertaking will have to finance the shortfall and if that is insufficient, there are pension protection schemes. In other countries, the private pension funds can cut their obligations by cutting the benefit payments to beneficiaries.

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29   Cover ratio (%) is defined as net assets covering technical provisions divided by technical provisions.

Figure 4.8: Cover ratios (in %)
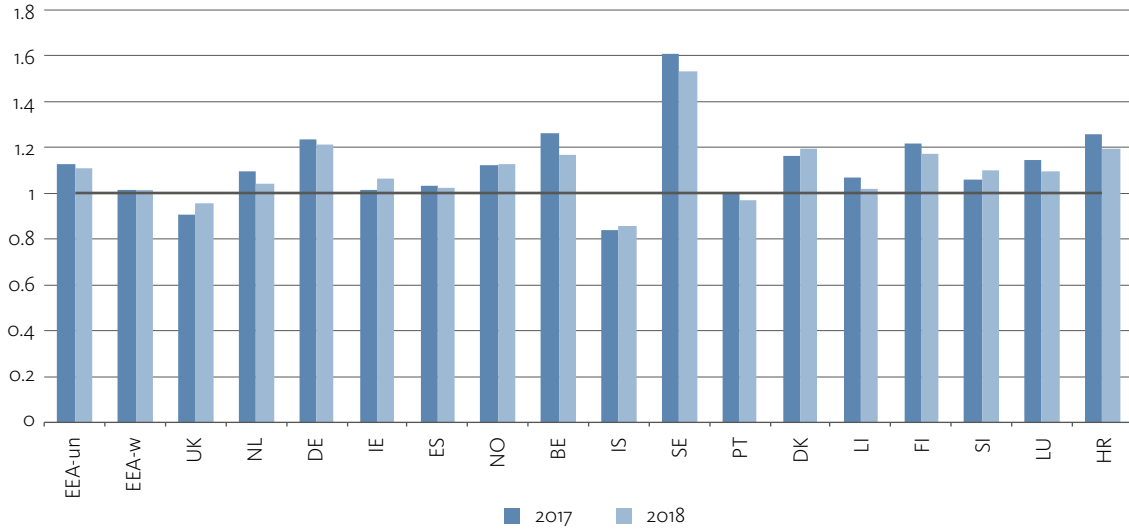
Source: EIOPA; Notes:
(1) Cover ratios refer to DB schemes. Countries with predominant pure DC schemes are not included in the chart and in the average calculations.
(2) Both the weighted and un-weighted averages for the cover ratio were calculated on the basis of the 16 countries depicted in the chart. The weighting was based on total assets.
(3) Due to different calculation methods and legislation, the reported cover ratios are not comparable across jurisdictions.

The total population of members of private pension funds in the EEA increased by 6 per cent, driven by a strong increase in active membership in DC schemes by in total 11%. (Figure 4.10) In terms of number of persons contributing and covered by private pension funds in the EEA, the shift in significance from DB to DC pensions can be clearly evidenced. The overall increase in active membership in EEA DC pension funds is 11% compared to 2017, which is reflected in very high growth rates in some countries +18% for UK, +44% for SI and +33% for HR. At the same time, active membership in the DB sector slightly increased in 2018 (by 2% compared to 2017), which can be linked to a stable, small increase in NL and IS. For most other EEA countries, the overall membership and in particular the active membership in DB pension funds decreased significantly, due to DB schemes being closed to new members and/or new contributions: compared to 2017 the active membership in DB schemes decreased, for example, in UK by -18%, DK by -11% and FI by -10%. Whilst the DC sectors in most Member States are still relatively young with still limited values of assets under management, the direct exposure of members of DC funds to investment risks will increasingly require monitoring to understand better the effects of DC funds' investment allocations and investment behaviour on financial markets and financial stability.

Figure 4.9: Active members (in thousands)
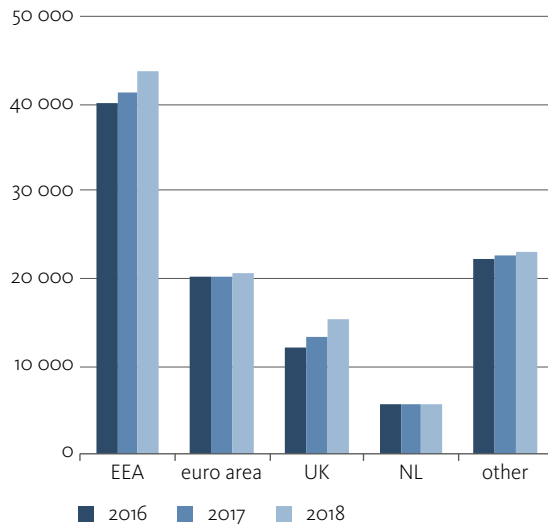
Figure 4.10: DB/HY and DC breakdown of active members (in per cent)
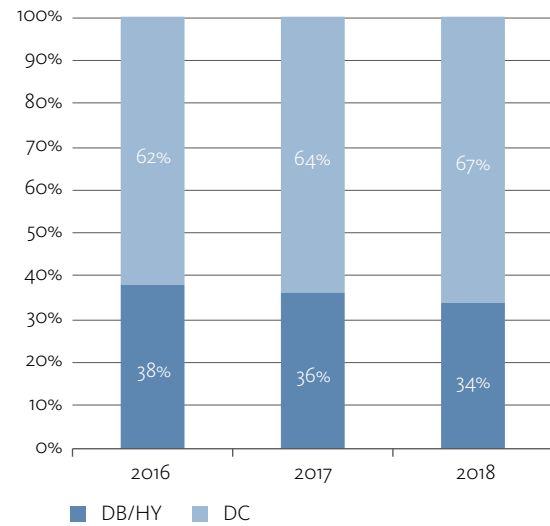
Source: EIOPA

Note: Figure 4.10 does not include SE and IS. BG, DK, FI, GR, HR, HU, LI, LU, MT and PL have below 100 thousand active members. Figure 4.9 does not include AT, IS, and SE.

BOX 4.1: DEVELOPMENTS IN CROSS-BORDER IOPRS

Directive 2003/41/EC (IORP Directive) has enabled IORPs to take advantage of the internal market by accepting sponsorship and managing an occupational pension scheme from a company located in another Member State since 2005. In absence of a fully harmonised framework, such cross-border activities follow the Social and Labour Law (SLL) of the "host Member States" and the prudential rules of the "Home Member State" in which the IORP is established. Operating a cross-border activity may lead to achieve economies of scale by centralising the management of, for example, various occupational pension schemes of a company operating in several Member States in a single IORP (i.e. cross-border IORP). Prior to the IORP Directive, IORPs would tend to operate exclusively in the Member State in which they were established.

In line with the status quo over the last years[30], one could not observe any significant changes in the number of active or authorised cross-border IORPs in 2018. Cross-border IORPs continue to remain clustered geographically, carrying out cross-border activities from eight[31] home Member States to a total of 16[32] host Member States.

Cross-border activities have to be fully funded at all times, see Article 16(3) of the IORP Directive[33]. EIOPA observed that in the vast majority of Member States the fully funded requirement applies to the whole IORP rath-

30   Eiopa Market Development Report 2017 p.19

31   AT, BE, DE, IE, LU, LI, MT, UK

32   UK, IE, NL, DE, LU, BE, AT, CY, LI, ES, HU, LT, MT, PT, GR, and PL

33   Article 16 (3) of the IORP Directive requires that the technical provisions of a cross-border IORP to be fully funded at all times in respect of the total range of pension schemes operated. If these conditions are not met, the competent authorities of the home Member State shall intervene in accordance with Article 14 of the IORP Directive. Furthermore, to comply with the requirement of "fully funded at all times", the home Member State may require ring-fencing of the assets and liabilities.

er than specifically to the cross-border activity. Further, in the majority of home Member States, a recovery plan for the cross-border IORP may be set up if the IORP does not meet the requirement of fully-funded at all times. Subject to the Member States' specificities, the recovery period may range between 3 months and 10 years. Recovery measures to mitigate underfunding may include increasing contributions or reduction of benefits.

Overall cross-border DB assets over liabilities have remained relatively stable, although a significant decrease can be observed LI and LU in 2018. By contrast, a substantial increase can been seen for UK, in line with the drop in the cross border IORPs number of members (Table B.4.1.).

Figure B.4.1: Cross border DB assets over liabilities (in %)
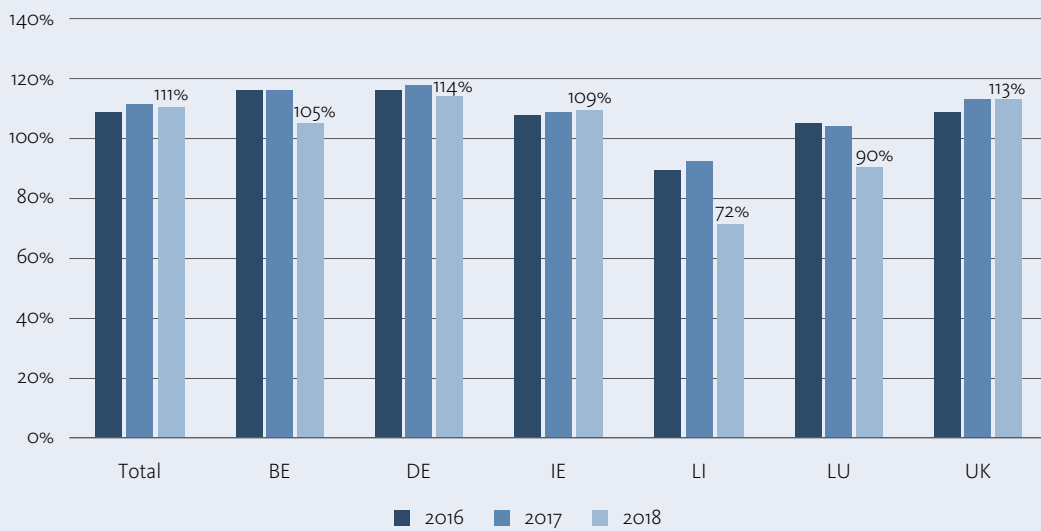
Source: EIOPA

Table B.4.1: Cross border IORPs - Total assets per country (in EUR mil)

	2016	2017	2018
BE	5,080	8,865	8,902
DE	34,564	36,010	36,215
IE	13,969	14,567	14,443
LI	479	507	636
LU	815	856	849
MT	2.00	2.60	2.90
UK	10,263	8,770	8,175
Total	65,171	69,578	69,223

Source: EIOPA
Note: For BE, DE, LI and UK assets include domestic activities.

Table B.4.2: Cross border IORPs - Nr. of members

	2016	2017	2018
BE	20,198	25,045	25,455
DE	448,884	447,819	447,779
IE	56,360	56,360	56,360
LI	1,624	1,653	2,102
LU	10,041	11,202	11,477
MT	158.00	193.00	241.00
UK	120,278	61,559	55,520
Total	624,511	602,508	592,080

Source: EIOPA
Note: LU includes total number of members and beneficiaries & UK total scheme membership.

5. RISK ASSESSMENT

5.1. QUALITATIVE RISK ASSESSMENT

EIOPA conducts twice a year a bottom-up survey among national supervisors to determine the key risks and challenges for the European insurance and pension fund sectors, based on their probability and potential impact.

The EIOPA qualitative Autumn 2019 Survey[34] **reveals that low interest rates remain the main risks for both** the insurance and pension fund sectors (Figure 5.1 and Figure 5.2). Equity risks also remain prevalent, ranking as the 3rd and 2nd biggest risk for the insurance and pension funds sectors respectively. The cyber risk category is now rank as the 2nd biggest risk for the insurance sector, as insurers need to adapt their business models to this new type of risk both from an operational risk perspective and an underwriting perspective. Geopolitical risks have become more significant for both markets, along with Macro risks, which continue to be present in the insurance and pension fund sectors, partially due to concerns over

Figure 5.1: Risk assessment for the insurance sector

Insurance 2019 Autumn ▪ Insurance 2019 Spring
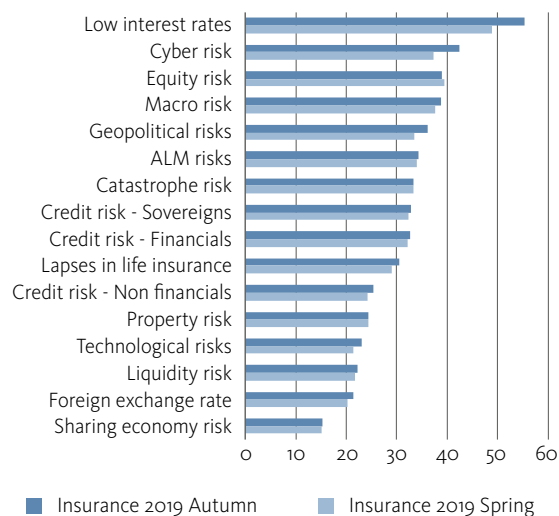
Figure 5.2: Risk assessment for the pension funds sector

PF 2019 Spring ▪ PF 2018 Autumn
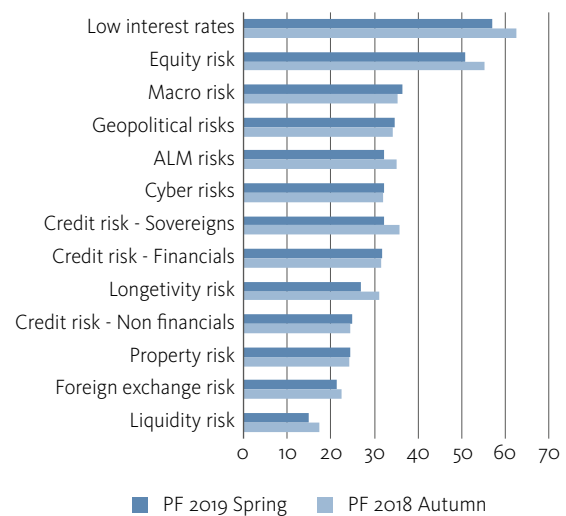
Source: Qualitative EIOPA Autumn 2019 Survey
Note: Based on the responses received. Risks are ranked according to probability of materialisation (from 1 indicating low probability to 4 indicating high probability) and the impact (1 indicating low impact and 4 indicating high impact). The figure shows the aggregation (i.e. probability times impact) of the average scores assigned to each risk. The results were subsequently normalised on a scale from 0 to 100.

34 The survey was carried out in August 2019 and only reflects market developments until then. Therefore, the survey does not reflect concerns over the recent market developments such as sovereign spreads widening for some countries.

protectionism, trade tensions, debt sustainability, sudden increase in risk premia and uncertainty relating to the potential future post-Brexit landscape.

For the pension fund sector, ALM risks have remained unchanged compared to Spring 2019. Cyber risks have risen to the 6th biggest risk facing pension funds now, while credit risk (for both sovereigns and financials) and longevity risk are ranked in lower positions compared to Spring 2019.

The survey further suggests that all the risks are expected to increase over the coming year (Figure 5.3). The increased risk of the low for long interest rate environment is in line with the observed market developments, particulary after the ECB's announcement of renewed monetary easing in September 2019. The significant expected raise of cyber, property, equity, macro and geopolitical risks in the following year is also in line with the observed market developments highlighted in Chapter 1, indicating increased geopolitical uncertainty, trade tensions, stretched valuations in equity and real estate markets and more frequent and sophisticated cyber attacks which could all potentially affect the financial position of insurers and pension funds. On the other hand, ALM risks and Credit risk for financials are expected to increase in the coming year, while in the last survey in Spring 2019 the expectations were following the opposite direction.

Although cyber risk is ranking as one of the top risks and expected to increase in the following year, many jurisdictions also see cyber-related insurance activities as a growth opportunity. The rapid pace of techno-

logical innovation and digitalisation is a challenge for the insurance market and insurers need to be able to adapt their business models to this challenging environment, nonetheless from a profitability perspective, increased digitalisation may offer significant cost-saving and revenue-increasing opportunities for insurance companies. The increase of awareness of cyber-risk and higher vulnerability to cyber threats among undertakings due to the increased adoption of digital technologies could drive a growth in cyber insurance underwriting.

The survey shows the exposure of an sudden correction of the risk premia significantly differs across EU countries. In the event of a sudden correction in the risk premia, insurance undertakings and pension funds with ample exposure to bonds and real estate, could suffer significant asset value variations that could lead to forced asset sales and potentially amplify the original shock to asset prices in less liquid markets. Some juridictions, however, confirm the limited exposure to this risk due to the low holding of fixed income instruments and well diversified portfolios.

The survey further indicates that national authorities expect the increase of investments in alternative asset classes and more illiquid assets. Conversely, holdings of governement bonds are expected to decrease in favour of corporate bonds within the next 12 months. Overall this might indicate potential search for yield behaviour and a shift towards more illiquid assets continues throughout numerous EU jurisdictions (Figure 5.4). Property investments – through for instance mortgages and

Figure 5.3. Supervisory risk assessment for insurance and pension funds - expected future development
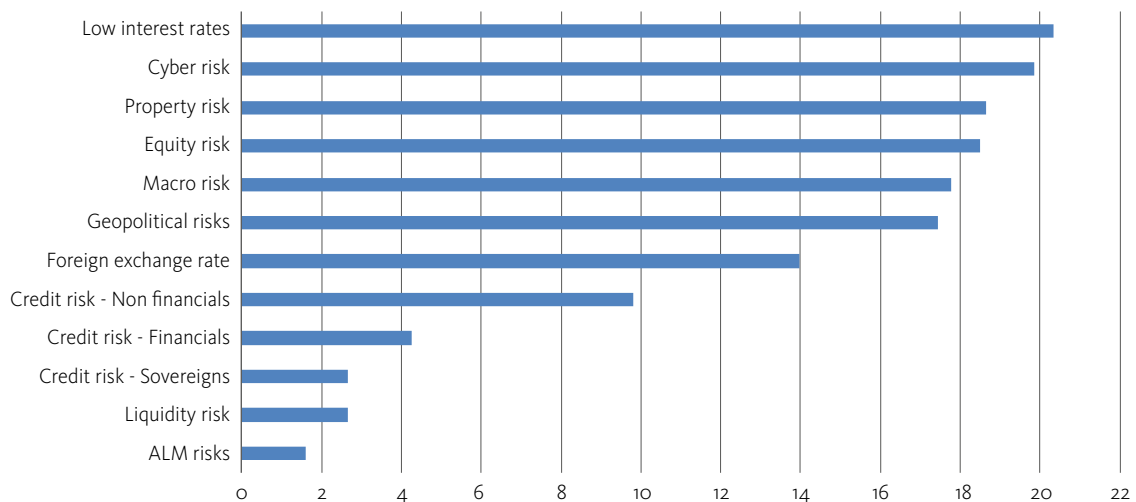
Source: Qualitative EIOPA Autumn 2019 Survey
Note: Based on the responses received. EIOPA members indicated their expectation for the future development of these risks. Scores were provided in the range -2 indicating considerable decrease and +2 indicating considerable increase.

Figure 5.4. Supervisory assessment on expected change on investment exposures in the coming 12 months
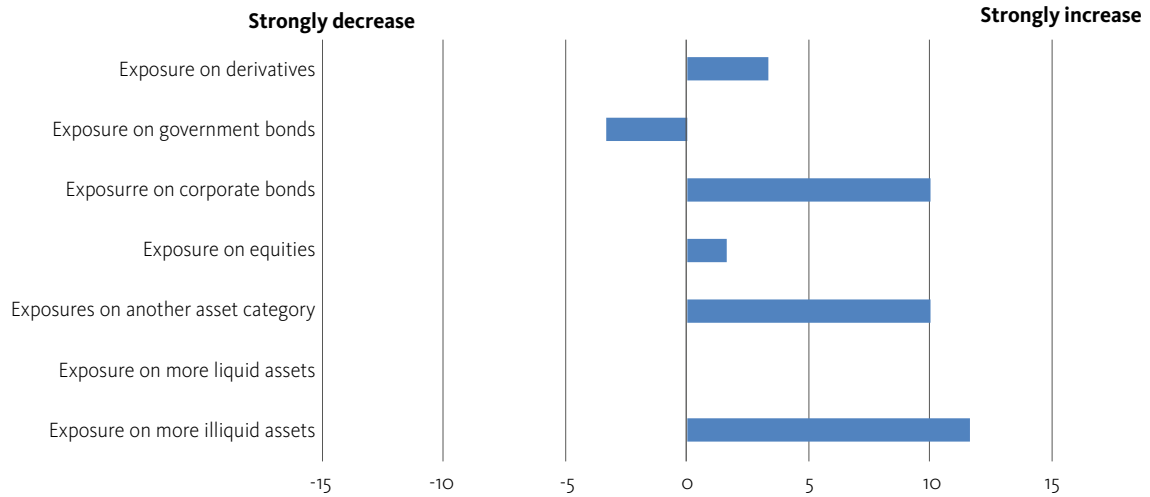
Source: Qualitative EIOPA Autumn 2019 Survey
Note: Based on the responses received. EIOPA members indicated their expectation for the future movements of each exposure. The aggregate level is ranked from 0 indicating considerable decrease to 100 indicating considerable increase.

infrastructure investment - are also expected to increase in some jurisdictions, for both insurers and pension funds. A potential downturn of real estate markets could therefore also affect the soundness of the insurance and pension fund sectors.

5.2. QUANTITATIVE RISK ASSESSMENT EUROPEAN INSURANCE SECTOR

This section further assesses the key risks and vulnerabilities for the European insurance sector identified in this report. A detailed breakdown of the investment portfolio and asset allocation is provided with a focus on specific country exposures and interconnectedness with the banking sector. The chapter also analyses in more detail the implications of the current low yield environment for insurers.

INVESTMENTS

Insurance companies' investments remain broadly stable, with a slight move towards less liquid investment. Government and corporate bonds continue to make up the majority of the investment portfolio, with only a slight movement towards more non-traditional investment instruments such as unlisted equity and mort-

gage and loans (Figure 5.5). Life insurers in particular rely on fixed-income assets, due to the importance of asset-liability matching of their long-term obligations (Figure 5.5 and 5.6). At the same time, the high shares of fixed-income investments could give rise to significant reinvestment risk in the current low yield environment, in case the maturing fixed-income securities can only be replaced by lower yielding fixed-income securities for the same credit quality.

Insurers' investment portfolios at country level continue to be heterogeneous across countries (Figure 5.7). Insurers from HU, LT and RO invest more than two thirds of their portfolio in government bonds while insurers from IS, NO and SE hold other types of investments, such as equity and corporate bonds. SE insurers are the largest investors in equity, closely followed by IE and DK insurers, whereas NL insurers invest more than a quarter of their assets in mortgages and loans. Even though the total investment to corporate bonds have remained constant over the last year, the three largest investors, EE, LU & NO have significantly increased their exposures to corporate bonds.

The overall credit quality of the bond portfolio is broadly satisfactory, although slight changes are observed in 2018 (Figure 5.8). The vast majority of bonds held by European insurers are investment grade, with most rated as CQS1 (AA). However, the share of CQS2 has increased in the first half of 2019, and significant differences can be observed for insurers across countries (Figure 5.9).

Figure 5.5: Investment split in Q2 2019 compared to Q4 2018, Q4 2017 and Q4 2016
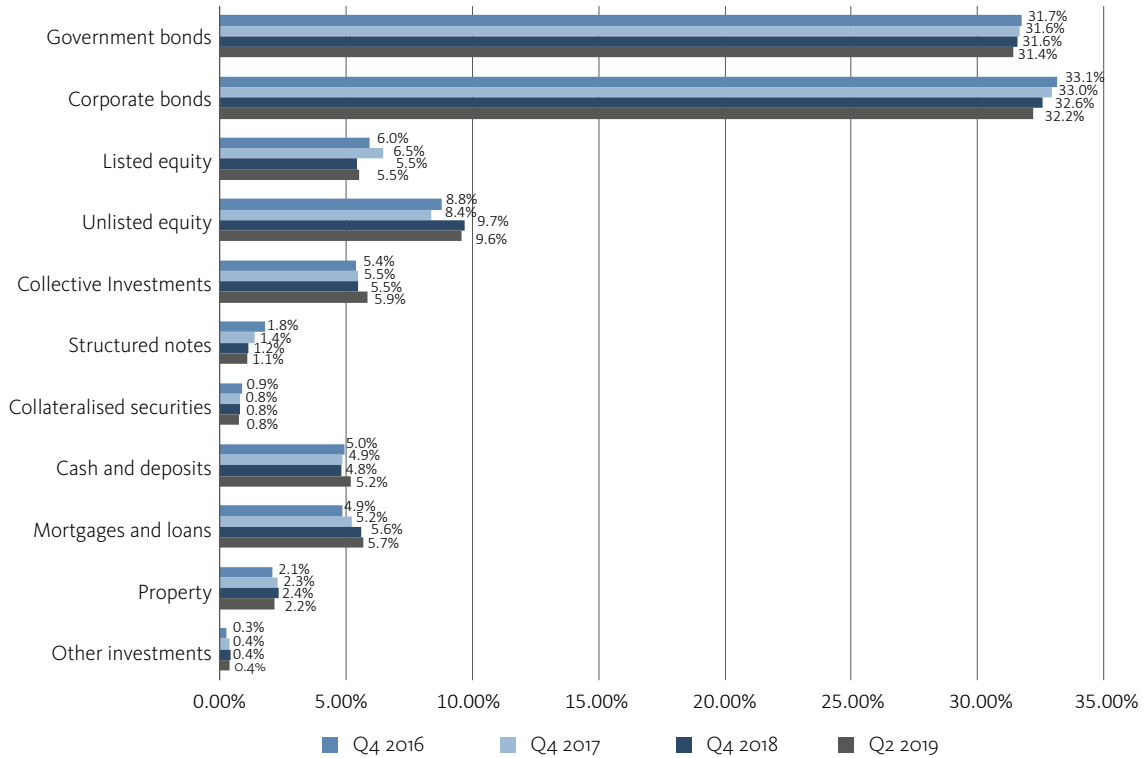
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019
Note: Look-through approach applied. Assets held for unit-linked business are excluded. Equities include holdings in related undertakings.

Figure 5.6: Investment split in Q2 2019 by type of undertaking
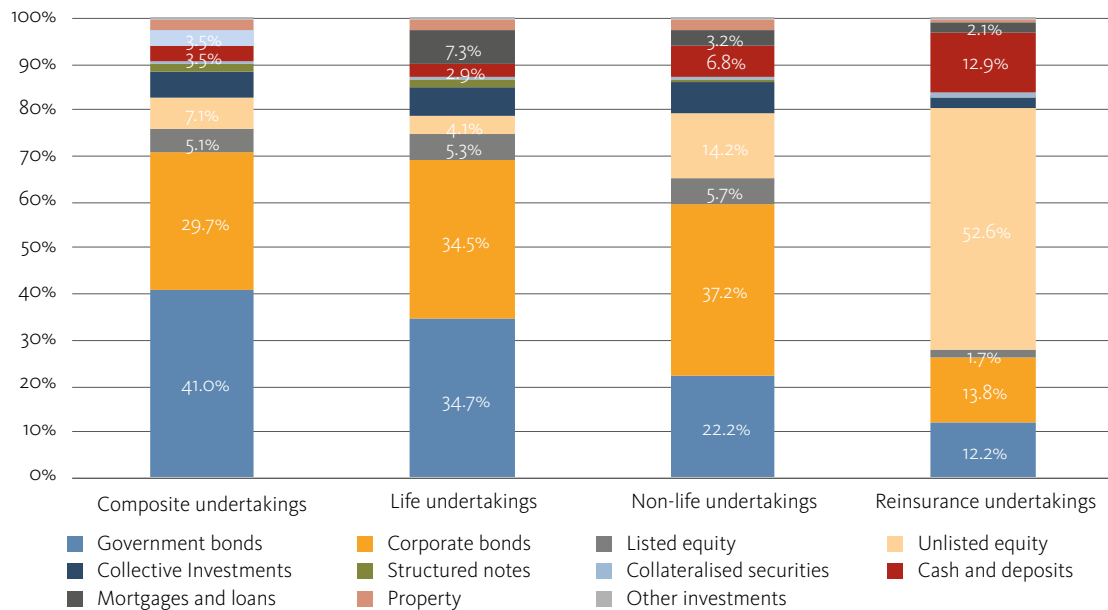
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019
Note: Look-through approach applied. Equities include holdings in related undertakings, which account for most equities held by reinsurers. Assets held for unit-linked business are excluded.

Figure 5.7: Investment split at country level

	Government bonds	Corporate bonds	Equity	Cash and deposits	Mortgages and loans	Property	Other
EU/EEA	31.4%	32.2%	15.1%	5.2%	5.7%	2.2%	8.2%
AUSTRIA	25.0%	31.3%	20.0%	4.1%	3.9%	7.1%	8.7%
BELGIUM	48.1%	22.3%	8.1%	2.7%	12.2%	2.7%	4.0%
BULGARIA	50.2%	15.3%	11.2%	10.8%	6.5%	2.5%	3.6%
CROATIA	64.1%	4.5%	8.3%	5.6%	7.2%	7.8%	2.5%
CYPRUS	18.5%	36.1%	11.8%	15.6%	2.9%	6.0%	9.1%
CZECH REPUBLIC	50.8%	17.6%	8.5%	7.6%	8.5%	0.4%	6.6%
DENMARK	18.0%	39.7%	27.0%	3.1%	3.8%	2.7%	5.6%
ESTONIA	27.0%	53.1%	1.5%	14.0%	0.7%	0.0%	3.7%
FINLAND	9.6%	33.3%	6.9%	7.5%	4.5%	5.6%	32.5%
FRANCE	33.4%	35.1%	12.3%	3.4%	1.9%	2.3%	11.6%
GERMANY	25.3%	35.8%	21.5%	4.1%	5.5%	2.1%	5.8%
GREECE	61.8%	20.6%	4.7%	6.6%	0.8%	1.9%	3.6%
HUNGARY	81.2%	3.0%	4.7%	4.8%	0.4%	0.1%	5.8%
ICELAND	26.2%	19.3%	28.8%	6.0%	2.7%	1.5%	15.4%
IRELAND	27.7%	32.6%	7.1%	19.3%	5.0%	1.3%	6.9%
ITALY	52.6%	21.1%	12.5%	2.1%	1.3%	1.0%	9.4%
LATVIA	59.9%	17.5%	2.5%	13.5%	2.1%	0.9%	3.5%
LIECHTENSTEIN	26.2%	39.5%	7.4%	19.3%	2.4%	0.1%	5.0%
LITHUANIA	70.8%	14.8%	1.6%	6.5%	1.1%	0.8%	4.2%
LUXEMBOURG	28.4%	41.5%	8.0%	11.8%	4.8%	0.8%	4.7%
MALTA	33.6%	20.9%	8.9%	18.5%	5.3%	1.8%	11.0%
NETHERLANDS	35.2%	17.2%	6.1%	4.5%	26.1%	1.8%	9.1%
NORWAY	13.0%	46.5%	22.9%	2.6%	10.2%	0.5%	4.3%
POLAND	56.6%	7.6%	20.9%	3.7%	3.9%	0.3%	7.1%
PORTUGAL	44.9%	27.7%	8.8%	11.9%	1.1%	2.2%	3.4%
ROMANIA	68.2%	7.7%	5.8%	14.7%	1.0%	1.8%	0.8%
SLOVAKIA	45.3%	35.9%	5.6%	6.9%	1.7%	0.5%	4.0%
SLOVENIA	37.5%	33.7%	18.2%	5.3%	0.9%	1.4%	3.0%
SPAIN	58.6%	20.7%	5.7%	7.7%	0.8%	2.4%	4.0%
SWEDEN	14.5%	31.9%	33.2%	4.3%	3.8%	3.1%	9.1%
UNITED KINGDOM	19.2%	36.0%	12.9%	10.4%	10.8%	2.3%	8.5%

Source: EIOPA Quarterly Solo
Reference date: Q2 2019
Note: Red - above 90th percentile, Blue - below 10th percentile; look-through approach applied, except for FI. Other investments include collective investment undertakings, structured notes, collateralised securities and other investments not classified in the mentioned categories. Assets held for unit-linked business are excluded. The high share of Other investments for FI is mainly driven by investments in collective investment undertakings for which look-through was not possible.

Figure 5.8: Credit quality of bond portfolio

Credit quality step 0 | Credit quality step 1 | Credit quality step 2 | Credit quality step 3
Not rated | NIG | Not reported
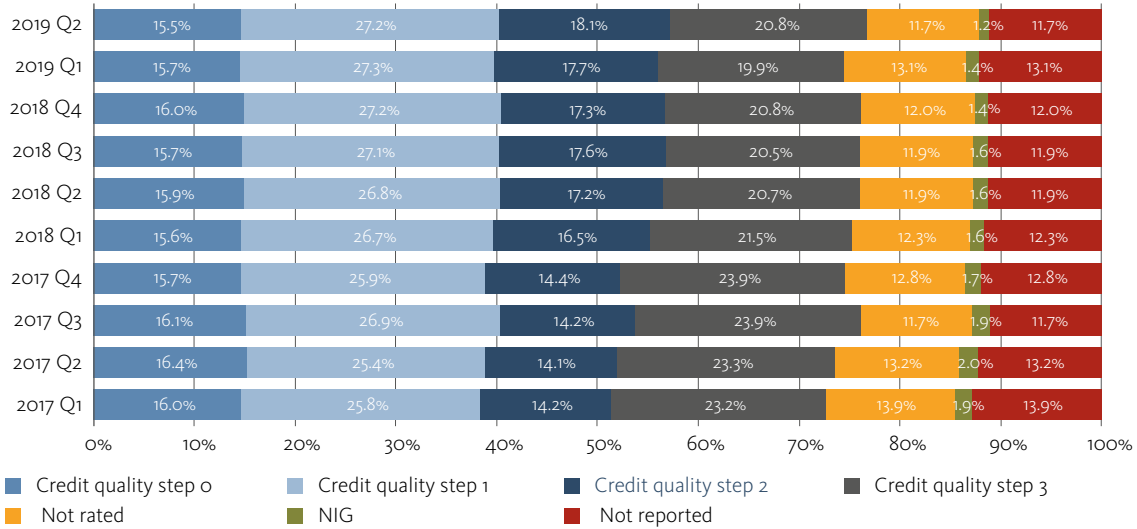
Source: EIOPA Quarterly Solo
Note: Government and corporate bond portfolios combined. Assets held for unit-linked are included. NIG stands for Non-Investment Grade.

Figure 5.9: Credit quality of bond portfolio across countries

Credit quality step 0 | Credit quality step 1 | Credit quality step 2 | Credit quality step 3
NIG | Not rated | Not reported
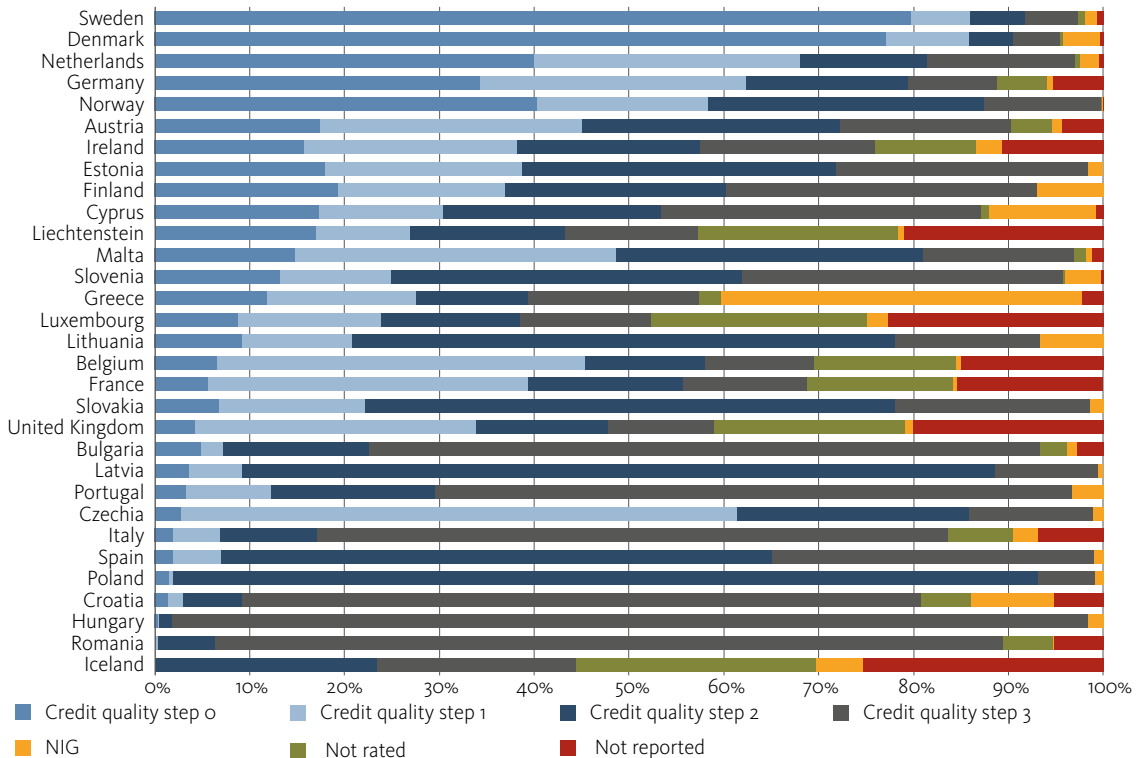
Source: EIOPA Quarterly Solo
Reference date: Q2 2019
Note: Government and corporate bond portfolios combined. Assets held for unit-linked are included. NIG stands for Non-Investment Grade.

Insurers also continue to show significant home bias for government bonds investments, while direct exposures of the European insurance sector towards emerging markets are limited. In order to assess the risk of a sudden reassessment of risk premia, it is important to analyse investment exposures from a geographical point

of view. In particular, the government bonds holdings of insurers continue to show significant home bias and has slightly increased in the first half of 2019, which is particularly relevant should concerns over debt sustainability resurface in the EU (Figure 5.10-5.11). A significant home bias poses a higher concentration risk in affected countries, but could also help to contain potential contagion at EU level.

Additionally, insurers' exposures towards emerging markets that are currently one of sources of a potential instability are relatively limited for most countries. However, the exposure to emerging markets has increased in the first half of 2019 and insurers from CY, NO and DK seem to have larger investments in this markets compared to insurers from other EU/EEA countries. In addition, interconnectedness with banks exposed to emerging markets and second-round effects could still have an impact on insurers with limited direct exposure towards emerging markets, in case of economic distress.

The overall corporate bonds exposures of the European insurers seems to be also oriented towards home bias be-

haviour but to a lesser extent when comparing to government bonds (Figure 5.12 - 5.13). In this case, the exposures towards emerging markets is higher, with insurers from PT allocating almost a quarter of their corporates bonds portfolio to companies from emerging markets. On average, EU/EEA insurers have 6% of their corporate bonds portfolio allocated in emerging markets' firms.

Despite limited exposures of European insurers towards equity emerging markets (4.8%), the insurance sector may still be vulnerable to a potential pronounced equity market distress. Concerns of a global economic slowdown following trade tensions between the US and China remain. This could serve as an additional transmission channel of risks from emerging markets to the European insurance sector. Again, while direct exposures toward emerging markets are very limited for most countries as well as at a European level (Figure 5.14 and 5.15), uncertainty, political instability and interconnectedness could have negative effects on equity prices. This would have a noteworthy impact on insurance sectors in countries with substantial exposures to equities (Figure 5.7).

Figure 5.10: Home biased behaviour for insurers' holdings of government bonds
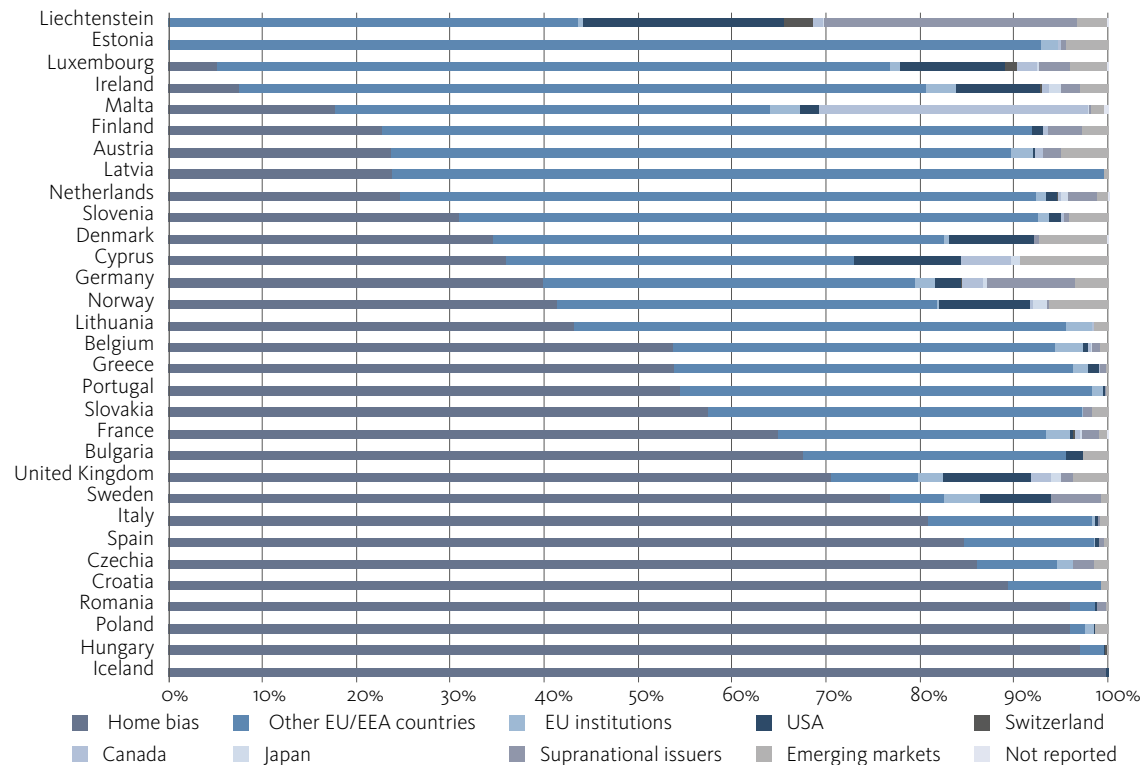
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019
Note: Look-through approach applied. Assets held for unit-linked business are included.

Figure 5.11: Overall government bonds exposures of the European insurers to different countries
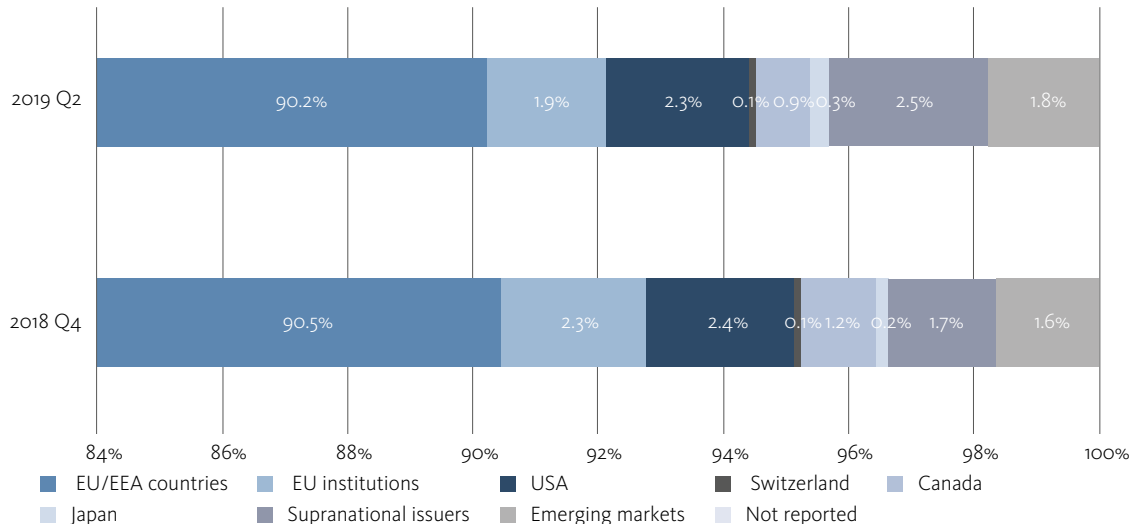
Source: EIOPA Quarterly Solo
Note: Look-through approach applied. Assets held for unit-linked business are included.

Figure 5.12: Home biased behaviour for insurers' holdings of corporate bonds
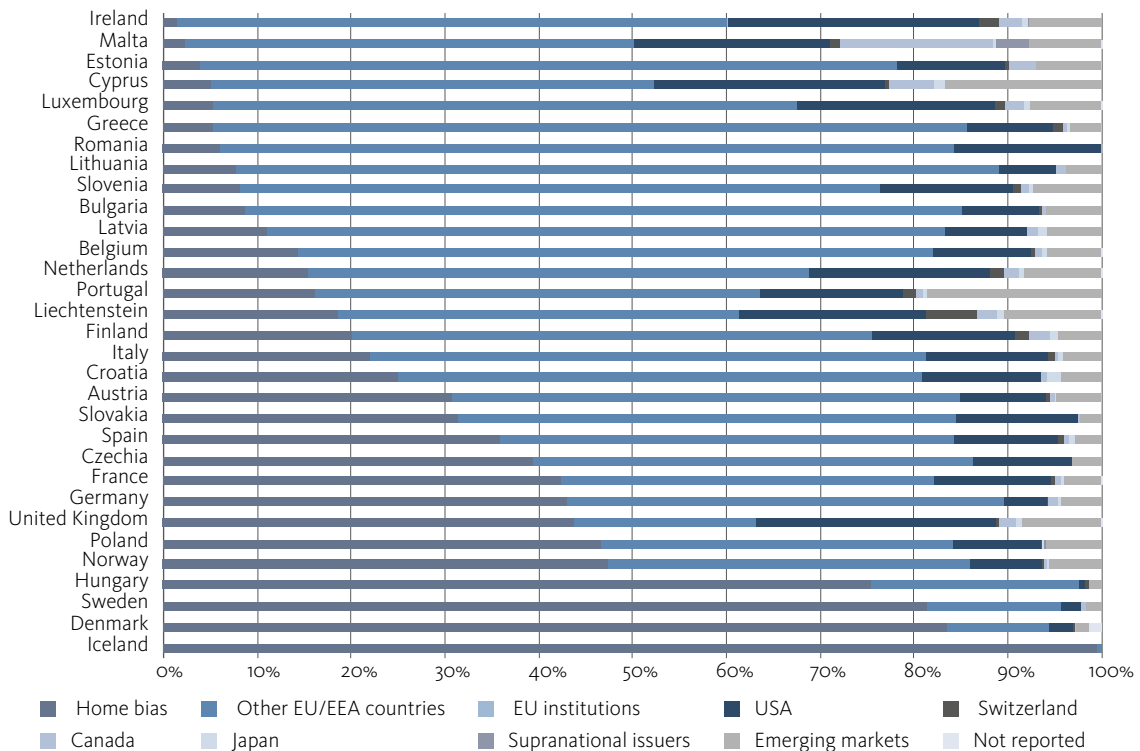
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019
Note: Look-through approach applied. Assets held for unit-linked business are included.

Figure 5.13: Overall corporate bonds exposures of the European insurers to different countries
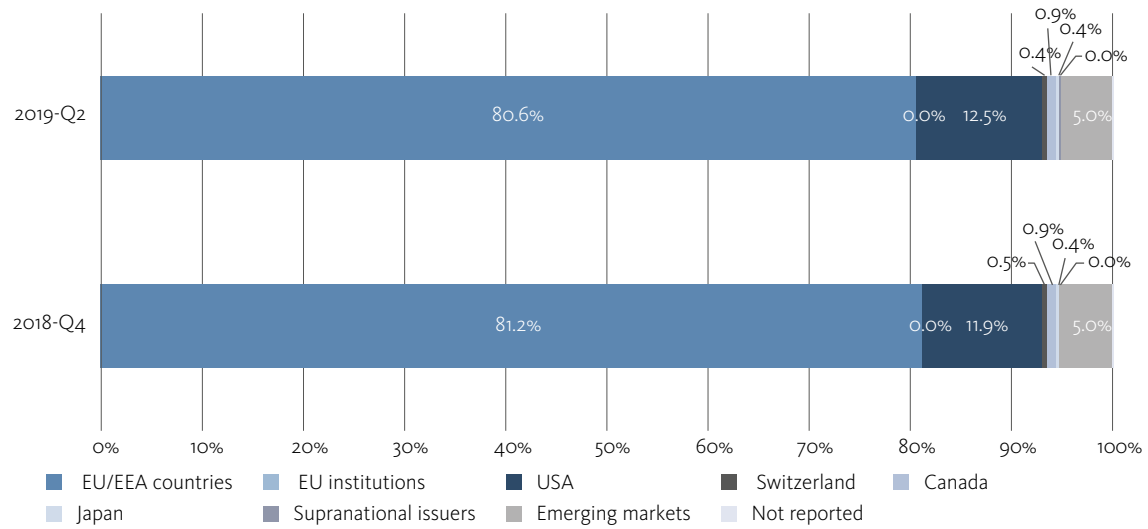
Source: EIOPA Quarterly Solo
Note: Look-through approach applied. Assets held for unit-linked business are included.

Figure 5.14: Home biased behaviour for insurers' equity investments in Q2 2019
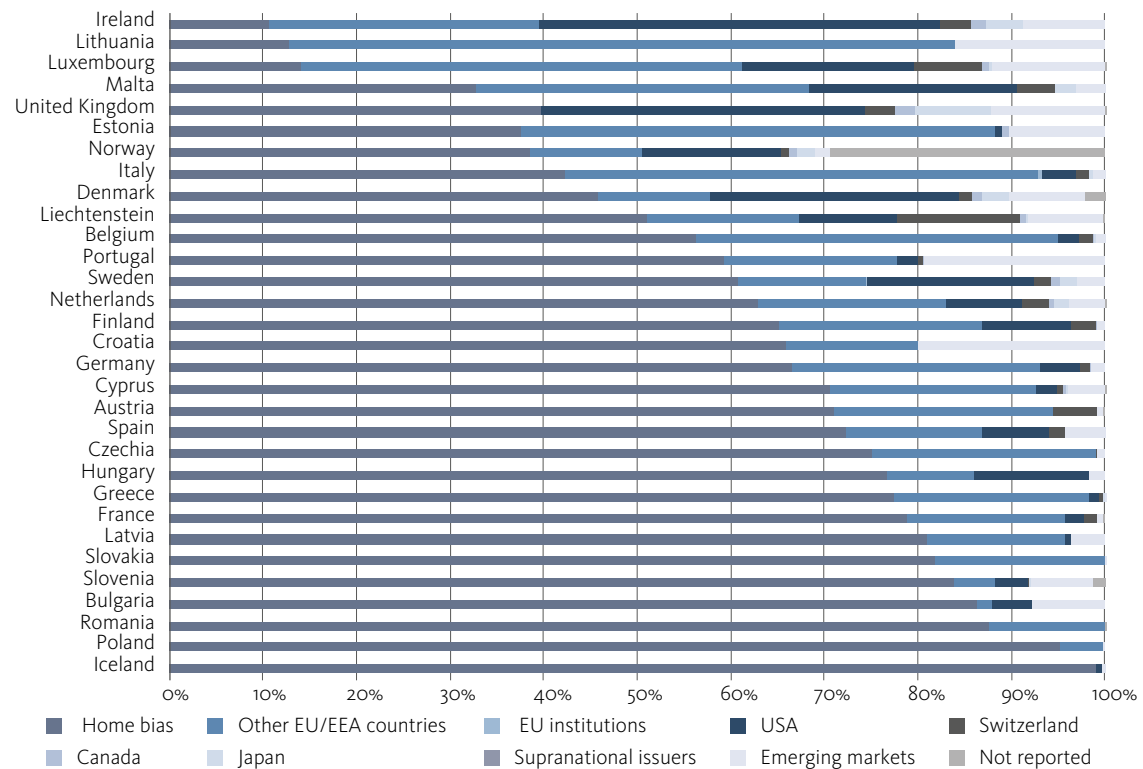
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019
Note: Look-through approach applied. Assets held for unit-linked business are included.

Figure 5.15: Overall equity exposures of the European insurers to different countries
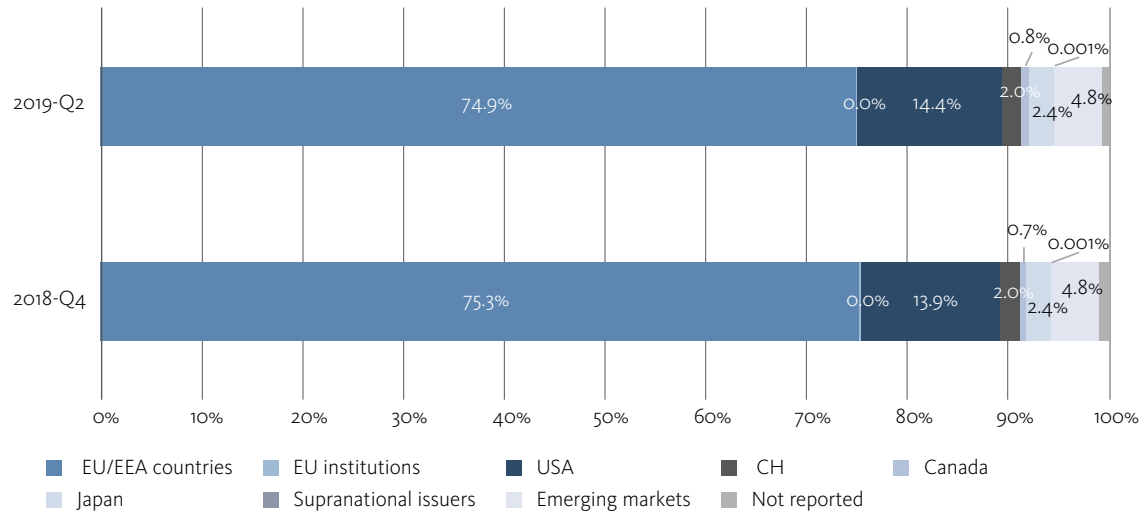
Source: EIOPA Quarterly Solo
Note: Look-through approach applied. Assets held for unit-linked business are included.

BOX 5.2: KEY DEVELOPMENTS OF INDEX LINKED AND UNIT-LINKED BUSINESS

Total assets managed under UL&IL business gradually increased at European level since 2016. Based on 2019 Q2 data, the overall portfolio amount to EUR 2,773 bn. The management of the investments under the CIUs frequently goes beyond insurers' remits; hence, it is logical to expect differences in the investment practices adopted for the direct investments. At European level, investment decisions related to 70 to 80 percent of the UL&IL assets portfolios are taken by investments funds managers with potentially different investment policies than insurers. UL&IL policyholders bear the investment risk and, to a certain extent, they are usually empowered to steer the investment policies; for this reason, their investment behaviour is likely to differ from the rest of policyholders. As suc, UL&IL policyholders' preferences may influence the composition of the assets portfolios as well as the more or less long-term oriented management of the investments.

Evidence based on the QRT asset data shows that direct investments from UL&IL business differ in terms of asset class allocation and in terms of dynamism in rebalancing the assets portfolio. EIOPA seeks to understand how the characteristics of the UL&IL business affects the ability of insurers to hold assets to maturity or to keep long-term oriented investment strategies or, to the contrary, they engage in more active trading. Analysing the rebalancing of direct investments in bonds and equities, based on quarter on quarter evolution of those portfolios rebalancing from the third quarter of 2016 until the second quarter of 2019[35], it emerges that life companies are trading more actively unit-linked than other portfolios. On average, each quarter 94% of the Non-UL&IL initial portfolio of direct investments is usually kept, while this share is lower for UL&IL portfolios (91%).

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35   For further details on the methodology please refer to section 4.1.1 of the Feedback request for the illiquid liability project https://eiopa.europa.eu/Publications/Consultations/EIOPA-PSC-18_093_Request_for_Feedback_Illiquid%20Liabilities.pdf#search=REQUEST%20FOR%20FEEDBACK%20ILLIQUID%20Liabilities

Overall, the assets class composition observed for UL&IL portfolios at European level is quite stable over time in terms of the assets classes and different from other business types. UL&IL portfolios exhibit a significantly larger share of participations in assets funds and much smaller proportion of direct investments, particularly in bonds (either corporate or government) than other insurance portfolios.

Collective investment undertakings (CIUs) represent more than 65 percent of the EEA Life UL&IL portfolios in contrast to less than 20 percent for all other insurance portfolio's types. In the case of composite and reinsurers, CIU almost reach 80% of the UL&IL investment portfolios.

Looking through the actual assets classes underlying the investments in CIU helps to complete the picture of the profound differences in the portfolio composition. UL&IL more than double the exposure to equity of the Non-UL&IL portfolios, which in turn more than double the exposure to bonds. Applying a limited look through to the 2019 Q2 data at EEA level reveals that more than 60 percent of the UL&IL portfolios invest in equity and assets funds, while the largest share Non-UL&IL portfolios are bonds. In other words, the main difference in the asset allocation among these portfolio's types is the inverse relevance of bonds and equity: while for Non-UL&IL portfolios the main exposure is towards bonds (63%) followed by equity investments (15%), UL&IL portfolios are characterised by a large share of equity (42%) and a smaller proportion of bonds (26%).

However, despite the homogeneous picture at European level, certain degree of heterogeneity in the UL&IL investment behaviours can be observed across countries[36]. Some examples of differentiated behaviours compared to the EEA aggregates are:

> Half or more of the UL&IL assets in DE, IS, SE and UK are invested in equity, while in BG, PL, PT and RO close to or more than half of the portfolio is invested in bonds;

> BE and EL hold more than 30 percent of their UL&IL investments in cash and deposits;

> in CY and FR the share of property is equal to or exceed 4%.

2019 Q2	Without look through		With look through	
	Neither unitlinked nor index-linked	Unit-linked or index-linked	Neither unitlinked nor index-linked	Unit-linked or index-linked
Bonds	54%	11%	63%	26%
of which: Government bonds	28%	6%	31%	12%
of which: Corporate bonds	26%	5%	32%	14%
Equity	12%	16%	15%	42%
Collective Investment Undertakings	20%	67%	6%	20%
Structured notes	1%	2%	1%	2%
Collateralised securities	1%	0%	1%	0%
Cash and deposits	4%	2%	5%	5%
Mortgages and loans	5%	0%	6%	0%
Property	2%	1%	2%	2%
Other investments	1%	1%	1%	3%

Source: EIOPA quarterly data, 2019 Q2.
Note: Investment allocation by type including and excluding look-through approach.

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36 Especially among the top ten in terms of total assets managed for unit linked and index linked business: UK (accounts for more than 40 of EEA total assets), FR, IE, IT, DK, LU, SE, DE, NL and BE.

IMPACT OF THE LOW YIELD ENVIRONMENT

The ongoing low/negative yield environment continues to be one of the main challenges for insurers, in particular for life insurers with potential implications on the profitability and on the solvency of these companies. Insurers reinvest, continuously, earned coupons and redemption amounts from matured bonds at current market yields. With market yields at very low levels, this will have an impact on insurer's profitability in the medium to long term. Figure 5.16 shows that 5.4% of the government bonds portfolio will reach maturity date in 1 year and that in 10 years time insurers will replace approximately 60% of their government bonds portfolio. In Q2 2019, these bonds were yielding a coupon of 3.3% assuming they were bought at issuance date and they will have to be replaced with bonds which will yield (YTM current market rates) on average approximately 0.45% across maturity buckets. This could be translated into the risk that investment yields fall below guarantees for insurers causing losses and decline in capital.

In the case of corporate bonds (Figure 5.17), 6.5% of the these will reach maturity date in 1 year. These bonds were yielding a coupon of 2.7% assuming they were bought at issuance date and will have to be replaced with bonds which will yield (YTM current market rates) on average approximately 0.9% across maturity buckets.

On the other hand, even if current market rates are low, insurers were still realising gains on government and corporate bond holdings, but these were significantly lower in 2018. Figure 5.18 shows that across the three asset classes net gains and losses (capital gains/losses on sold bonds and equities) tend to be comparatively small, with respect to total gains and losses in the three years from 2016 to 2018. Net gain and losses fluctuate dramatically based on how market yields on actual insurers' bonds holdings evolve. In 2016 insurers reported substantial net gains on bonds as yields have been going down while in 2017 and 2018 as insurers reported some losses, yields have been going slightly up, relatively more for corporate bonds. It is very likely that insurers will have gains (which could be both unrealised or realised depending on whether assets will be liquidated) on fixed income positions in 2019 as the interest has been going down all year and is only slightly reverting back in the last quarter.

Figure 5.16: Government bonds: coupon and YTM (i.e. market yields) by maturity in Q2 2019
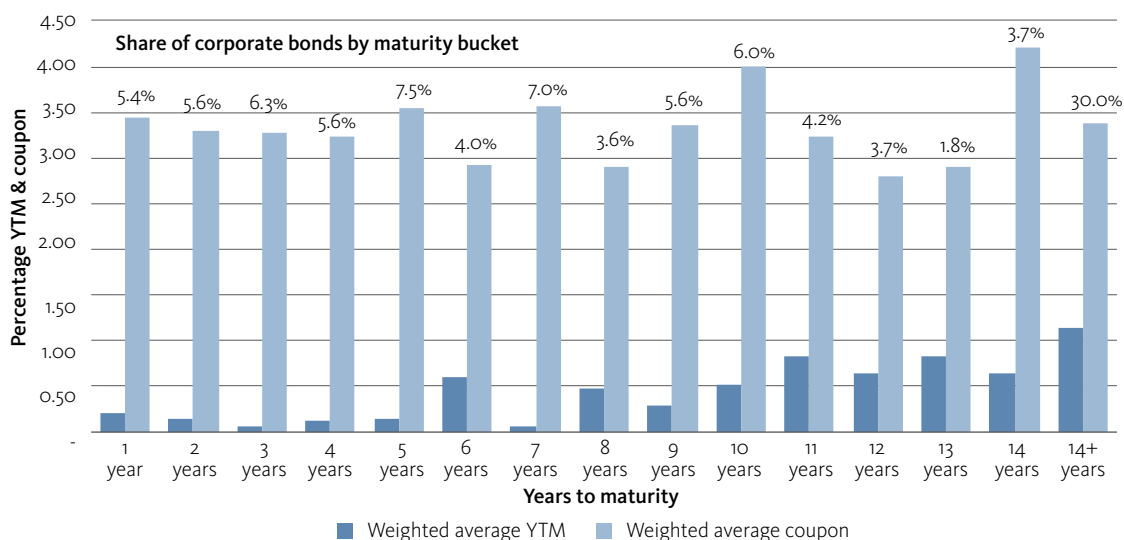
Sources. SII QRTs data from EIOPA Central repository and CSDB
Note. YTM and Coupon rate of government and corporate bonds are taken from the CSDB (extract of 30 June 2019). Information on EU insurers' government and corporate bonds holdings by maturity are from SII QRTs data – List of assets (S.06.02) Solo prudential data for Q2-2019. Weighted average YTM and Coupon by maturity buckets are calculated using SII amounts. Only bonds with fixed coupons are considered in the analysis therefore (also considering the merge between SII and CSDB and some data cleaning) the sample is left with approximately 80% of the total values of bonds in the SII EU sample.

Figure 5.17: Corporate bonds: coupon and YTM (i.e. market yields) by maturity in Q2 2019
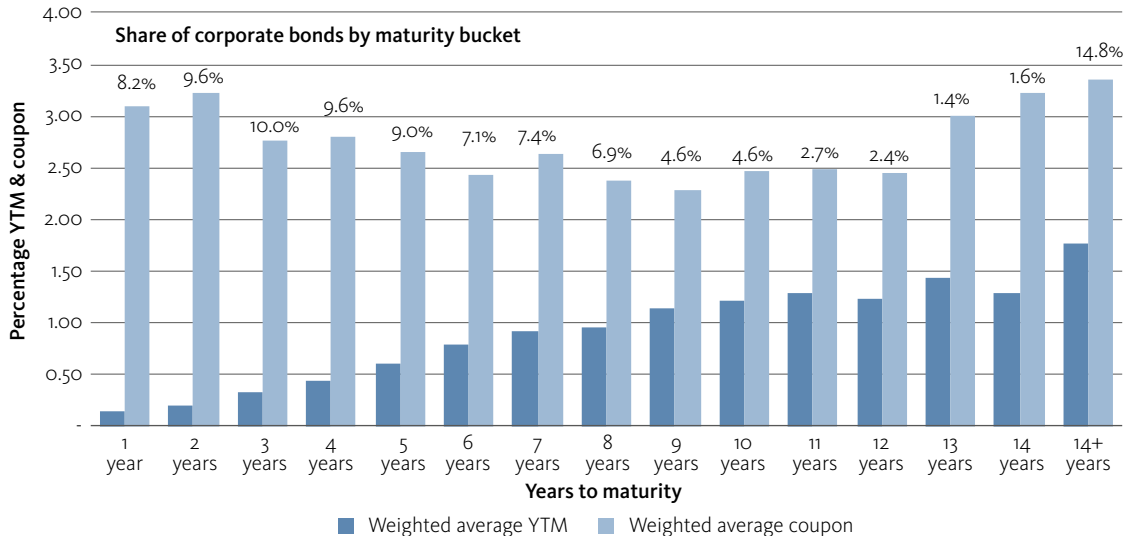
Sources. SII QRTs data from EIOPA Central repository and CSDB
Note. YTM and Coupon rate of government and corporate bonds are taken from the CSDB (extract of 30 June 2019). Information on EU insurers' government and corporate bonds holdings by maturity are from SII QRTs data – List of assets (S.06.02) Solo prudential data for Q2-2019. Weighted average YTM and Coupon by maturity buckets are calculated using SII amounts. Only bonds with fixed coupons are considered in the analysis therefore (also considering the merge between SII and CSDB and some data cleaning) the sample is left with approximately 80% of the total values of bonds in the SII EU sample.

Figure 5.18: Return on Investments per asset class (in EUR amounts)
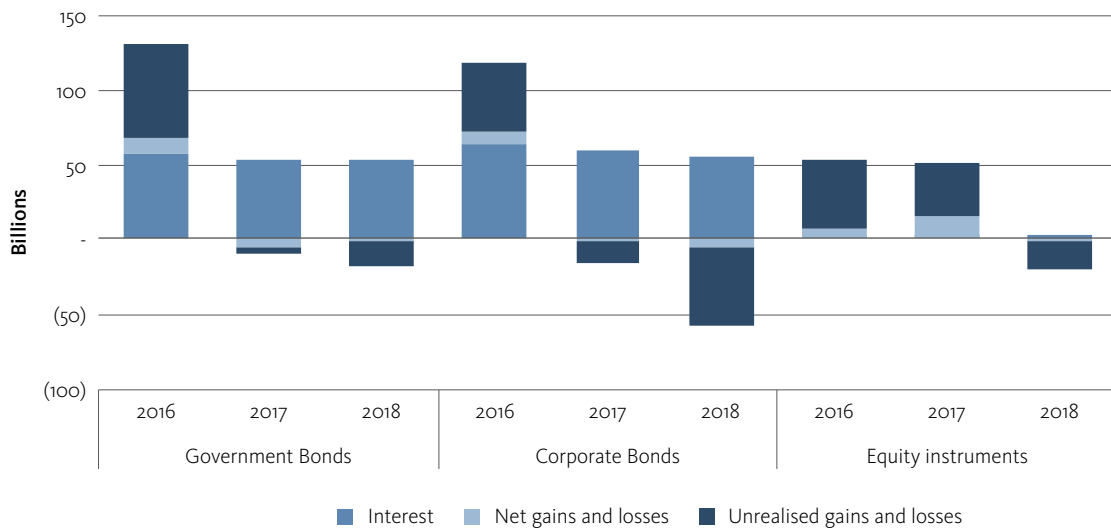
Source: EIOPA Annual Solo
Reference date: 31/12/2018
Note: Data from SII QRTs from EIOPA Central repository are employed - annual prudential data for 2016 and 2017, template S.09.01 Income gain and losses (interest gains, net gain and losses and unrealized gains and losses), breakdown by government, corporate bonds and equities.

Another consequence of the the low yield environment could be the shift of investments towards more illiquid or more riskier types of assets. In this respect, over the last few years, the leveraged lending market and collateralised loans and mortgage (CLOs and CMOs) market have increased significantly with volumes approximately 5 times

bigger at the end of 2018.[37] Figure 5.19 shows that the exposures to CLOs and CMOs have slightly increased every quarter during 2018 and 2019 and amount to EUR 5.11 bn in Q2 2019 (17% increase compared to end of 2018).

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37 See previous EIOPA June Finacial Stability Report, page 52

Figure 5.19: EU/EEA insurers' holdings of CLOs and CMOs
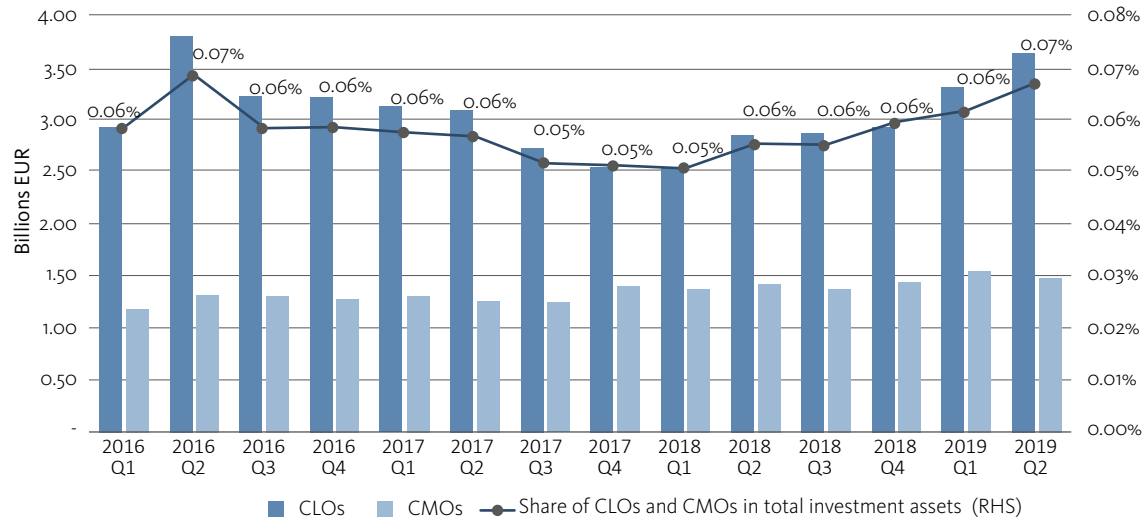
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019

INTERCONNECTEDNESS BETWEEN INSURERS AND BANKS

The overall exposures towards the banking sector remain significant for insurers in certain countries, which could be one potential transmission channel in case of a sudden reassessment of risk premia. The interconnectedness between insurers and banks could intensify contagion across the financial system through common risk exposures. A potential sudden reassessment of risk premia may not only affect insurers directly, but also indirectly through exposures to the banking sector. This is also a potential transmission channel of emerging markets distress, as banks have on average larger exposures to emerging markets when compared to insurers.

Another channel of risk transmission could be through different types of bank instruments bundled together and credited by institutional investors such as insurers and pension funds.

Insurers' exposures towards banks are heterogeneous across the EU/EEA countries, with different levels of home bias as well (Figure 5.20-5.21). Hence, countries with primary banks exposed to emerging markets or weak banking sectors could be impacted more in case of economic distress. On average, 15.95% of the EU/EEA insurers' assets are issued by the banking sector through different types of instruments, mostly bank bonds. Insurers from EE, SE and CY have a larger exposure to banks with some of them with significant home biased behaviour.

Figure 5.20: European insurers' exposures towards banks as a percentage of total investments
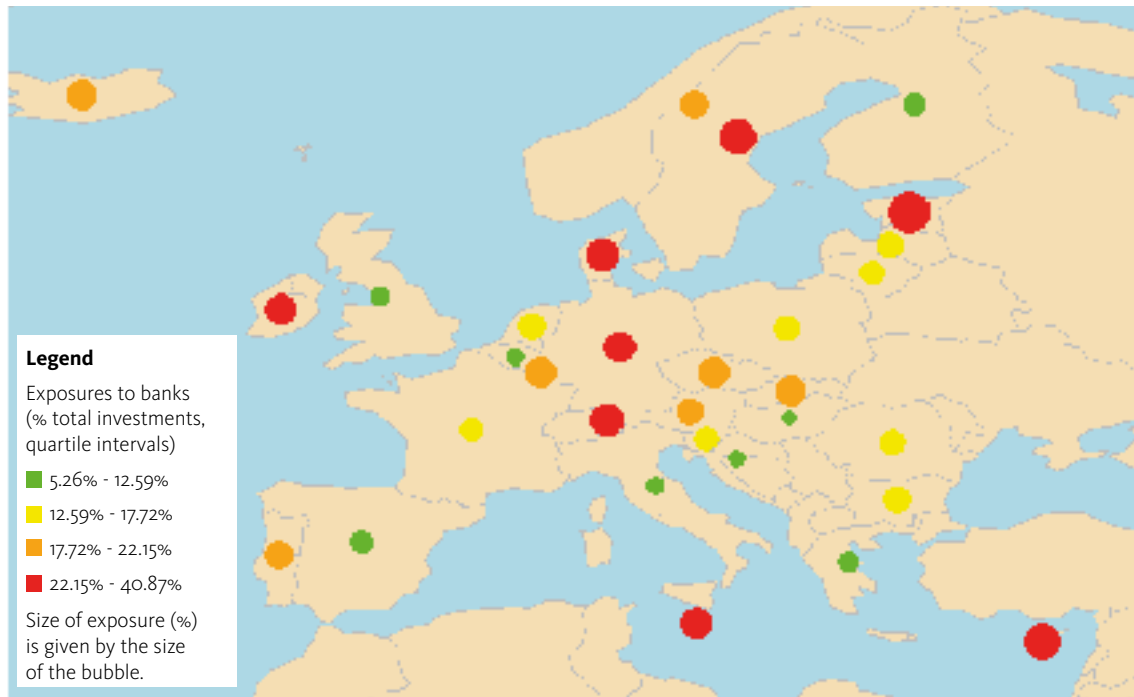
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019

Table 5.1: EU/EEA insurers' exposures towards banks as a percentage of total investments at country level

Country	% Exposure to banks	Country	% Exposure to banks
EU/EEA average	15.95%	ITALY	7.60%
AUSTRIA	17.95%	LATVIA	16.98%
BELGIUM	8.47%	LIECHTENSTEIN	24.98%
BULGARIA	17.72%	LITHUANIA	13.82%
CROATIA	6.81%	LUXEMBOURG	21.15%
CYPRUS	30.53%	MALTA	24.28%
CZECHIA	21.45%	NETHERLANDS	17.20%
DENMARK	26.11%	NORWAY	20.60%
ESTONIA	40.87%	POLAND	16.79%
FINLAND	11.97%	PORTUGAL	19.11%
FRANCE	12.90%	ROMANIA	16.56%
GERMANY	22.86%	SLOVAKIA	21.15%
GREECE	11.65%	SLOVENIA	15.00%
HUNGARY	5.26%	SPAIN	12.28%
ICELAND	20.77%	SWEDEN	31.06%
IRELAND	22.96%	UNITED KINGDOM	10.25%

Source: EIOPA Quarterly Solo
Reference Date: Q2 2019
Note: the blue colour highlights the lowest exposures towards banks while the red colour highlights the highest exposures towards banks

Figure 5.21: Insurance sector exposure towards the banking sector, domestic versus cross-border in %
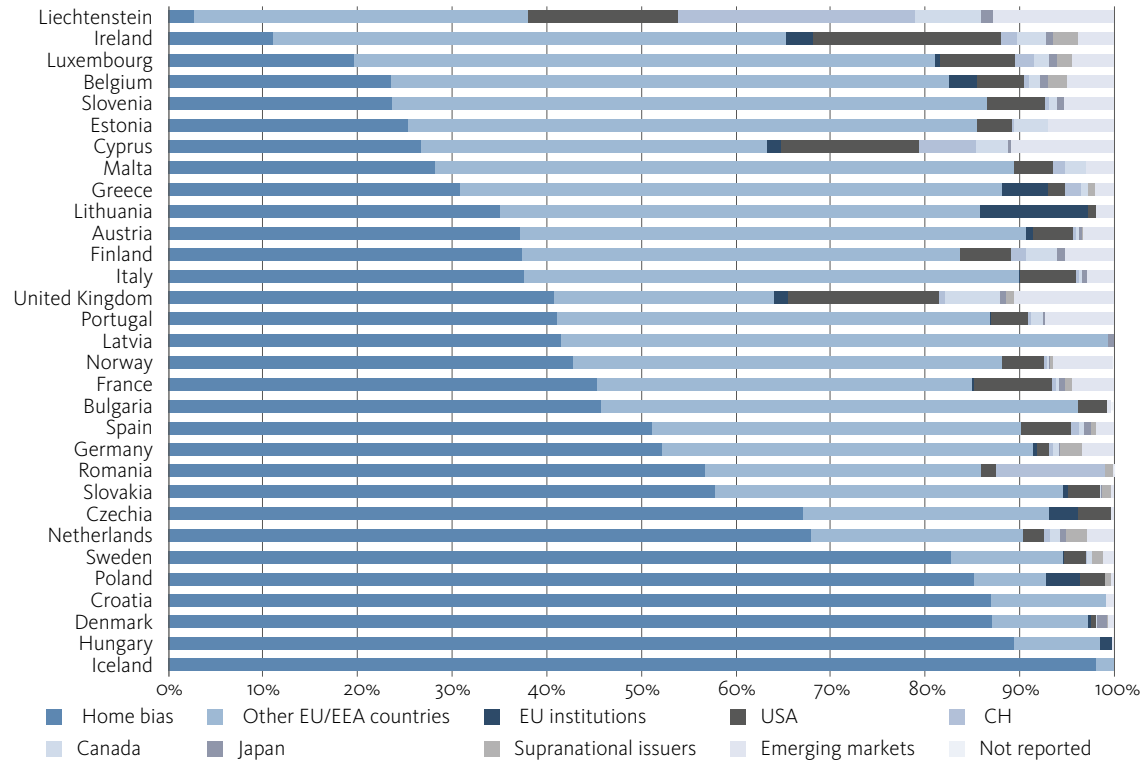
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019

Intragroup exposures between insurers and banks could create vulnerabilities for the financial stability in case there is a high concentration of the assets within the same group if a market distress were to materialize. In addition, if some EU/EEA insurers or banks that are part of financial conglomerates were to face financial difficulties, these could seriously destabilise the financial system and affect individual depositors, insurance policyholders and investors. In this regards, insurers in EU/EEA were on average exposed to their intragroup banks by approximately 1% of their total banking assets (approximately 0.1% of total investment assets) in the first half of 2019. This exposure comes mainly from equities and participations (71%), cash and deposits (13%) and bank bonds (16%). At country level, insurance sectors from PL, AT, UK and SE tend to have higher intragroup transactions due to holdings of equities and participations in the banks belonging to the same group.

INSURERS AND BANKS BAIL-IN BONDS

Risks from banking sectors could be transmitted to the insurance sector through specific financial instruments holdings (Figure 5.22). Insurers' exposures towards banks are mainly driven by holdings of bank bonds. Other significant exposures are through cash and deposits which are not effected by change in the market sentiment.

Furthermore, the insurer's exposure to bank 'bail-inable' bonds, which considers subordinated bonds, hybrid bonds

and convertible bonds has slightly increased to 7.8% of the total corporate bonds exposure (Figure 5.23). This is in line with what was expected, considering the concerns regarding the availability of enough preferred senior debt on the market as banks might issue more 'bail-inable' bonds to meet the MREL requirements. In the first half of 2019, approximately 78% of the exposure towards banks of the EU insurers was driven by holdings of senior bank corporate bonds, 1% more than at Q4 2018.

Figure 5.22: Exposures to banks by type of instruments and type of business
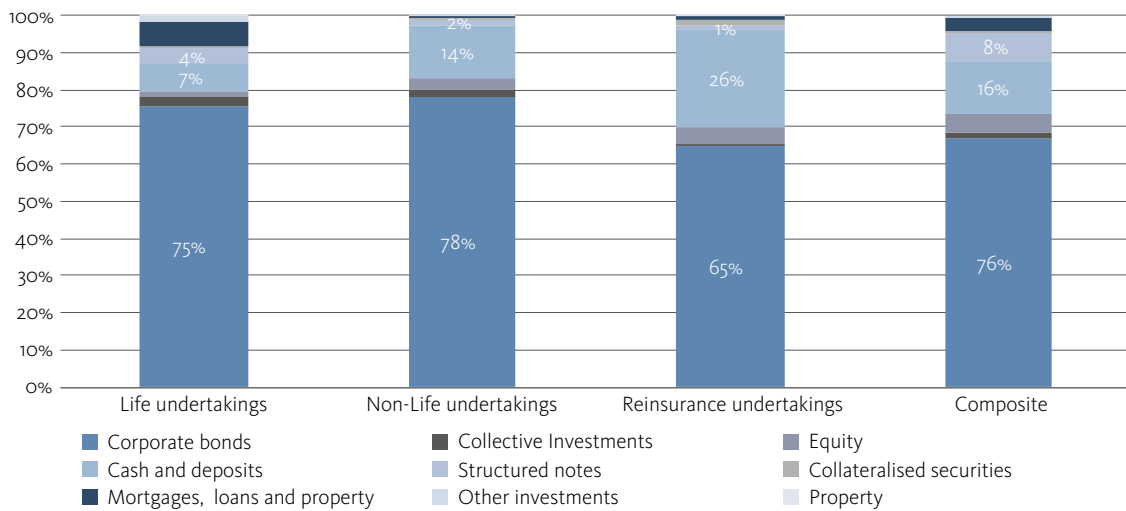
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019

Figure 5.23: Breakdown of exposures to bank corporate bonds
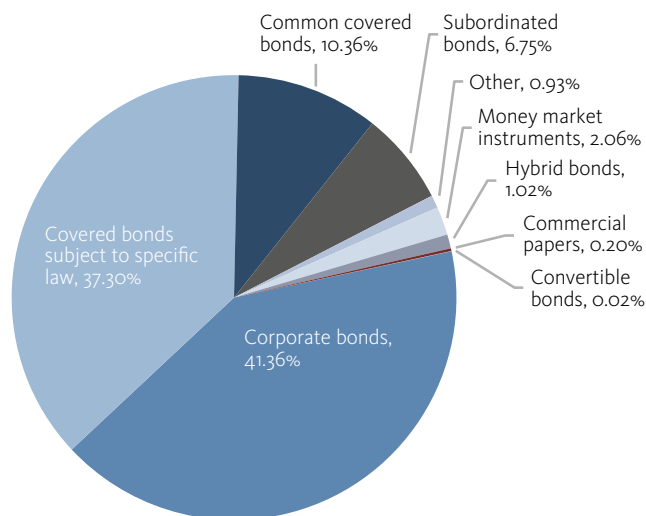
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019

Furthermore, a breakdown by country (Figure 5.24) of the bank corporate bonds held by EU/EEA insurers reveals that insurers from several countries hold significant exposures to subordinated, hybrid and convertible bonds that could be bail-inable in case of a bank failure. Banks bail-in bonds could become attractive to insurers as they could offer a higher return without requiring additional capital charge as it depends on the group of credit quality steps where they are placed in when assigning a certain capital charge.

Figure 5.24: Breakdown of exposures to bank corporate bonds by country in Q2 2019
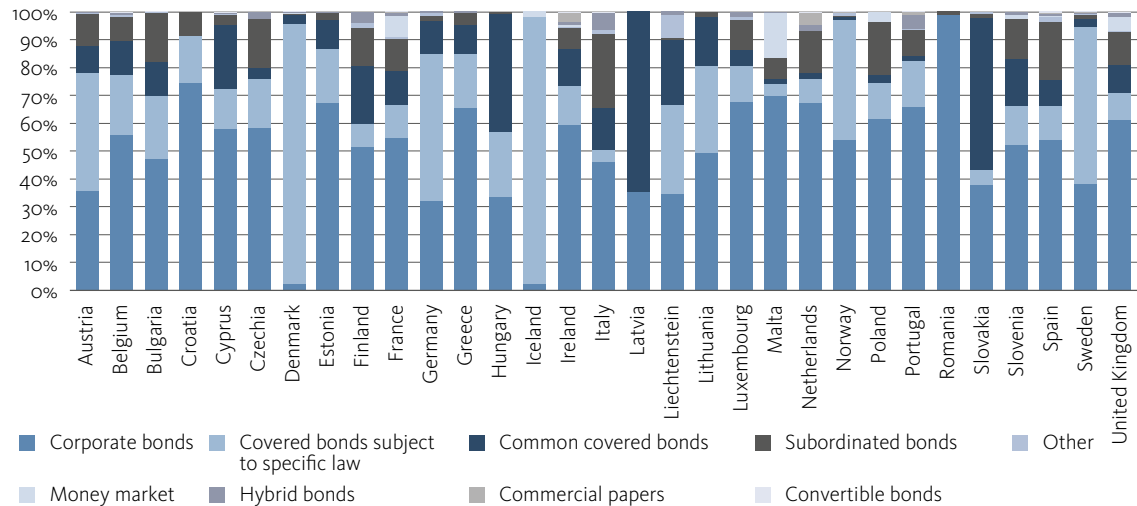
Source: EIOPA Quarterly Solo
Reference Date: Q2 2019

6. BACKGROUND INFORMATION AND DATA DESCRIPTION

OVERVIEW AND DATA (RE) INSURANCE SECTOR

EIOPA publishes statistics based on quantitative Solvency II reporting from insurance undertakings and groups in the European Union and the European Economic Area (EEA). These statistics are published on a quarterly basis. Every publication is accompanied by a note describing the key aspects of the statistics published. The tables and charts are available in PDF and Excel format and are based on information from the statistics at the publication date.[38]

The new supervisory regime Solvency II came into full force on 1 January 2016 as a result of timely preparation and appropriate transitional periods.

The Solvency II Directive (Directive 2009/138/EC) introduces advanced solvency requirements for insurers based on a holistic risk assessment, and imposes new assessment rules for assets and liabilities, which must be assessed at market values.

Currently the following type of information is available:

Indicators based on Individual insurance undertakings (solo data)

› Quarterly and annual publication of statistics based on solo prudential reporting data and available on a country-by-country basis. The number of insurance undertakings for the full reporting sample is considered as 2,631.

Indicators based on Insurance groups (group data)

› Annual publication of key indicators based on group reporting and available at EEA level from Autumn 2017.

Indicators based on reporting for financial stability purposes

Pursuant to Art. 51 Solvency II Directive 2009/138/EC insurance companies have to publish annual Solvency and Financial Condition Reports (SFCR) for groups as well as solo reports for its Solvency II regulated legal entities since May 2017. The structure of this Financial Stability Report covers Q4 2018 and focuses on European (re) insurance undertakings and groups that report regularly under Solvency II. EIOPA bases its analysis mainly on Quarterly Prudential Reporting Solo (QRS) for Q2 2019. But as not all templates and/or companies report under QRS, EIOPA also uses Annual Reporting Solo (ARS) and Quarterly Financial Stability Reporting Group (QFG) for some indicators.

Information is provided on different sample sizes as some (re)insurance companies are exempted from quarterly reporting in accordance with Art. 35 (6). Therefore, the sample of undertakings is not identical in the annual and quarterly publications. Each Figure EIOPA uses in this report is hence accompanied by a source mentioning the sample size and a note on data (if needed).

INSURANCE SECTOR

Solvency II has put in place long term guarantees (LTG) and transitional measures to ensure an appropriate treatment of insurance products that include long-term guarantees and facilitate a smooth transition of the new regulatory framework regime. The LTG measures are a permanent feature of Solvency II, wheareas the transitional measures will be gradually phased out until 2032, by which time the balance sheet position of insurance companies will be fully estimated at market value. For a period of 16 years after the start of Solvency II (re)insurance undertakings may apply the transitional measure on the technical provisions and the risk-free interest rate.

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38 https://eiopa.europa.eu/Pages/Financial-stability-and-crisis-prevention/Insurance-Statistics.aspx

The use of LTG and transitional measures is transparent and insurance companies publish their solvency ratios with and without the application of these measures. LTG and transitional measures form an integral part of Solvency II and are intended to limit the procyclicality of the regulatory changes and to facilitate the entry into the new regime by giving companies the time needed to adapt to the new solvency requirements.

The EIOPA Insurance Stress Test Report 2016 and the Report on Long-Term Guarantees (LTG) [39] have shown that, in the absence of the easing effect of the LTG and transitional measures, insurers might be induced to force sales and de-risk in order to lower their SCR and MCR, possibly pushing asset prices further down, adding to the market volatility and potentially affecting financial stability.

Pursuant to Art. 51 Solvency II Directive 2009/138/EC solo insurance companies were required to publish annual Solvency and Financial Condition Reporting (SFCR) for the first time in May 2017, followed by groups at the end of June. Hence, this report uses a huge amount of comprehensive information on Solvency II results for the first time.

The publication of SFCR reports gives access to Solvency II results. Capital requirements under Solvency II are twofold. The Solvency Capital Requirement (SCR) is the level above which there is no supervisory intervention for financial reasons. Supervisors will take measures once the SCR is breached and ultimate measures (loss of licence) once the MCR is breached.

While the quarterly templates do contain SCR and MCR information, the SCR is not necessarily recalculated for the quarterly templates which only require annual recalculation. Hence, the quarterly SCR ratios will represent a snapshot, but not necessarily the fully recalculated SCR ratios. Also, the MCR might be affected by this because the SCR is used to define a cap and a floor for the MCR value.

The SCR ratio is calculated either by using a prescribed formula, called the standard formula, or by employing an undertaking-specific partial or full internal model that has been approved by the supervisory authority. Being risk-sensitive the SCR ratio is subject to fluctuations and undertakings are required to monitor it continuously. A variety of degrees of freedom and options in the calculation of Solvency II results allows insurance companies to adjust the calculation of the SCR ratio to their risk profile.

According to Solvency II, insurers' own funds are divided into three "Tier" classes. Tier 1 capital, such as equity, is divided into restricted and unrestricted capital and has the highest ranking. Items that are included in Tier 1 under the transitional arrangement shall make up less than 20% of the total amount of Tier 1 items. Tier 2 capital is mostly composed of hybrid debt while Tier 3 is composed mostly of deferred tax assets. The eligible amount of own funds to cover the SCR has several restrictions: the eligible amount of Tier 3 capital shall be less than 15% of the SCR, while the sum of the eligible amount of Tier 2 and 3 capital shall not exceed 50% of the SCR. In order to ensure that the application of the limits does not create potential pro-cyclical effects, the limits on the eligible amounts of Tier 2 and Tier 3 items should apply in such a way that a loss in Tier 1 own funds does not result in a loss of total eligible own funds that is higher than that loss.

REINSURANCE SECTOR

The section is based on information from the Quarterly Reporting Templates (QRTs) where the reinsurance sample is calibrated with Q2 2019 data. A solo undertaking is listed as a reinsurer if it is listed as a reinsurance undertaking on the EIOPA register. The global and European market overview is also based on publicly available reports, forecasts and quarterly updates of rating agencies and other research and consulting studies.

PENSION FUND SECTOR

The section on pension funds outlines the main developments in the European occupational pension fund sector, based on information received from EIOPA's members. It covers all EEA Member States with active IORPs (i.e. occupational pension funds falling under the scope of the EU IORP Directive). There are a few Member States with pension funds other than IORPs, on which NCAs report on a voluntary basis, and/or where the main part of occupational retirement provisions is a line of insurance business, respectively underwritten by life insurers, and is therefore not covered. The country coverage is 81% (25 out of 31 countries).

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39   Note EIOPA's third LTG (long term guarantee) report was published in late 2018

Data collected for 2018 was provided to EIOPA on a best effort basis to report the financial position of IORPs during the covered period. For Romania, the data refers to 1st Pillar bis and 3rd Pillar private pension schemes only.

Data availability and valuation approaches vary substantially among the Member States, which hampers a thorough analysis and comparison of the pension market developments between Member States. Due to differences in objective, scope, coverage and reporting period or timing of the data received by EIOPA, information reported in the different EIOPA reports may differ.

Country abbreviations

AT	Austria	**IT**	Italy
BE	Belgium	**LI**	Liechtenstein
BG	Bulgaria	**LT**	Lithuania
CY	Cyprus	**LU**	Luxembourg
CZ	Czech Republic	**LV**	Latvia
DE	Germany	**MT**	Malta
DK	Denmark	**NL**	Netherlands
EE	Estonia	**NO**	Norway
ES	Spain	**PL**	Poland
FI	Finland	**PT**	Portugal
FR	France	**RO**	Romania
GR	Greece	**SE**	Sweden
HR	Croatia	**SI**	Slovenia
HU	Hungary	**SK**	Slovakia
IE	Ireland	**UK**	United Kingdom
IS	Iceland	**CH**	Switzerland

**PART II
THEMATIC ARTICLES**

CLIMATE RISK ASSESSMENT OF THE SOVEREIGN BOND PORTFOLIO OF EUROPEAN INSURERS[40]

Stefano Battiston[41], Petr Jakubik[42], Irene Monasterolo[43], Keywan Riahi[44], Bas van Ruijven[44]

ABSTRACT

In the first collaboration between climate economists, climate financial risk modellers and financial regulators, we apply the CLIMAFIN framework described in Battiston at al. (2019) to provide a forward-looking climate transition risk assessment of the sovereign bonds' portfolios of solo insurance companies in Europe. We consider a scenario of a disorderly introduction of climate policies that cannot be fully anticipated and priced in by investors. First, we analyse the shock on the market share and profitability of carbon-intensive and low-carbon activities under climate transition risk scenarios. Second, we define the climate risk management strategy under uncertainty for a risk averse investor that aims to minimise her largest losses. Third, we price the climate policies scenarios in the probability of default of the individual sovereign bonds and in the bonds' climate spread. Finally, we estimate the largest gains/losses on the insurance companies' portfolios conditioned to the climate scenarios. We find that the potential impact of a disorderly transition to low-carbon economy on insurers portfolios of sovereign bonds is moderate in terms of its magnitude. However, it is non-negligible in several scenarios. Thus, it should be regularly monitored and assessed given the importance of sovereign bonds in insurers' investment portfolios.

1. INTRODUCTION

The topic of sustainable finance has gained attention among European insurers and the financial supervisory community alike. This is fuelled by recent initiatives promoted by

financial supervisors, central banks and policy makers to align finance to sustainability. For instance, in 2018 several international central banks and financial regulators launched the Central Banks and Financial Regulators' Network for Greening the Financial System (NGSF 2018). In 2019, the European Commission (EC) launched the "Action Plan on Sustainable Finance" to tackle climate related risks and achieve the long-term goal of economic transformation towards a low-carbon economy. These initiatives are aimed to mitigate the potential financial risks stemming from a disorderly low-carbon transition, by supporting the alignment of investments to the climate targets.

Limiting the global temperature increase to 2°C above pre-industrial levels (i.e. consistently with Paris Agreement, UNFCCC 2016) requires the timely and coordinated introduction of climate policies, e.g. a global carbon tax (Stiglitz et al., 2017; IMF, 2019) aimed to drastically decrease the CO_2 emissions produced by the combustion of fossil fuels in the economy.

However, governments are delaying in the introduction of climate policies, leading potentially to a disorderly transition, where the introduction of climate policies is sudden and cannot be fully anticipated and priced in by investors (Battiston et al., 2017). In this context, firms whose revenues depend directly or indirectly on use of fossil fuels energy and electricity could face significant losses (the so-called "carbon stranded assets", Leaton et al. 2012). These losses will affect the value of the financial contracts issued by such firms and cascade onto their investors (Battiston et al., 2017), with implications on price volatility if large and correlated asset classes are involved (Monasterolo et al., 2017), and on firms and countries' financial stability (Battiston and Monasterolo, 2019). In this respect, not only climate related exposures of insurance firms towards the corporate sector but also towards the sovereigns in which those activities take place could be negatively affected. Given the role of the insurance sector in the economy and finance, the exposure of insurance firms to climate-related financial risks deserve to be monitored and assessed.

A main obstacle for insurers to embed climate in their portfolios' risk management strategies is represented by the lack of appropriate methodologies to price forward-looking climate risks and opportunities in the value of individual financial contracts and in the probabilities of default of investors portfolios. The reason is that climate risks are forward-looking (because they refer to future occurrences), characterised by deep uncertainty (thus leading to fat tailed distributions, Weitzman, 2009), non-linearity (Ackerman, 2017), and endogeneity that could give rise to multiple equilibria (Battiston et al., 2017). These characteristics makes the reliance on historical data much less relevant for risk assessment. This means that climate transition risks cannot be priced based on historical market data (e.g. to calculate volatility measures), but require to use the information on future climate policy shocks produced by climate economic models (e.g. Integrated Assessment Models - IAMs), and to introduce climate ambiguity.

Nevertheless, traditional financial pricing models (e.g. Merton, 1974; Black and Scholes, 1973; Black and Cox, 1976; Duffie and Singleton, 1999) are not able by construction to embed the characteristics of climate risks. Indeed, their financial risk assessment is based on past firms' performance (e.g. the computation of volatility measures based on historical data). In addition, they are constrained by conditions of normal distributions, complete markets, and lack of arbitrage (Battiston and Monasterolo, 2019).

Thus, pricing climate in investors' portfolio requires to move from the backward-looking nature of traditional financial risk assessment and of investors' benchmarks to a forward-looking assessment of risk. In this paper, we develop an application of the CLIMA-

FIN framework (Battiston et al., 2019) to calculate the probability of default of sovereign bonds, portfolio's financial risk metrics (e.g. the Climate Spread), and the largest losses/gains on insurers' portfolios conditioned to future climate transition shocks. This analysis represents the first climate-financial risk assessment developed in collaboration between scientists of the climate economic community that informs the Intergovernmental Panel on Climate Change (IPCC), climate financial risk experts and a financial regulatory institution with a mandate to contribute to financial stability.

We build on CLIMAFIN, because it is the first approach to combine forward-looking climate transition risk shocks and associated economic trajectories based on We build on CLIMAFIN because it is the first approach to combine forward-looking climate transition risk scenarios and associated economic trajectories based on climate economic models, with financial pricing models and financial risk metrics. In addition, CLIMAFIN provides a transparent and robust methodology for climate financial risk assessment under deep uncertainty, by considering the characteristics of climate risks and of financial risks.

In this application, we build on the LIMITS[45] database of climate policy scenarios (Kriegler et al., 2013). These models are the reference for scientific community and the IPCC, with climate financial risk metrics and methods that are now a reference in both the academic and practitioners' community, i.e. the Climate Spread, the Climate VaR, climate financial pricing models and financial network-based Climate Stress-tests (Battiston et al., 2017). In the context of potentially destabilizing financial impact of a disorderly climate transition and of unmitigated climate change, transparent and robust methodologies can support financial supervisors' policy decisions to align finance to sustainability and climate targets while preventing financial instability.

This article is organized as follows. Section 2 elaborates on the relevant literature. Section 3 provides a description of the data sample used and the section 4 describes the CLIMAFIN methodology for pricing forward-looking climate transition risks in the value of sovereign bonds and in investors' portfolios. The results of empirical analysis conducted on the portfolios of EU insurance companies are presented in section 5, while section 6 concludes discussing the linkages with the next steps of this research into the Climate Stress-test.

2. LITERATURE REVIEW

Recent research suggest that climate risks (and opportunities) are not properly priced yet in the value of financial contracts and thus, in investor portfolios' risk management strategies. This means that investors might, on the one hand, increase (and trade) their exposure to climate risks, and on the other hand, they might delay the scaling-up of green investments.

The literature has mostly covered corporate debt contracts, only recently the attention has focused on sovereign bonds and equity holdings. Alessi et al. (2019), Zerbib (2019) and Karpf and Mandel (2018) assessed if a green bonds' premium exists in the bond market, but found very different results, based on the type of bonds contract analysed and the "green" definition used. In the catastrophe bonds (CAT) market, Morana and Sbrana

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45   See the LIMITS database documentation for more details https://tntcat.iiasa.ac.at/LIMITSDB/static/download/LIMITS_overview_SOM_Study_Protocol_Final.pdf

(2019) found that despite climate-led disasters have steadily increased from year 2000, the "multiple" (i.e. the return per unity of risk) of the CAT bonds has decreased.

Monasterolo and de Angelis analysed the US, EU and global stock market's reaction to the announcement of the Paris Agreement. They found that the overall systematic risk for the low-carbon indices decreases consistently, while stock markets' reaction is mild for most of carbon-intensive indices. Ramelli et al. (2018) and Wagner et al. (2018) analysed the stock market's reaction to the election of Trump as President of the United States, and the appointment of the climate skeptic Scott Pruitt as a head of the US Environmental Protection Agency, and found opposite results, i.e. that investors rewarded companies in high-emissions industries/companies demonstrating more responsible climate strategies.

With regard to sovereign bonds, Crifo et al. (2017) find that high country's Environmental Social Governance (ESG) ratings are associated with low borrowing costs (spread) for short-maturity sovereign bonds in advanced economics. In the contest of low-income countries, Kling et al. (2018) focus on the most climate vulnerable low-income countries (V20) exposed to climate physical risk occurred in the past. They find a slightly higher cost of debt for a few countries, but they also point out the caveats that apply, such as the peculiarity of sovereign bonds' markets in low- income countries and the nature of risks (e.g. geopolitical) to consider in the sovereign valuation.

All these analyses, despite focusing on different types of financial contracts and climate risks analyse climate shocks that occurred in the past, and that could have represented a structural break in the series of prices and performance. In contrast, Battiston and Monasterolo (2019) developed the first approach to price *forward-looking* climate transition risks in the value of individual sovereign bonds, by including the characteristics of climate risks (i.e. uncertainty, non-linearity and endogeneity of risk) in financial valuation. They applied the model to the sovereign bonds of the OECD countries included in the Austrian National Bank (OeNB)'s non-monetary policy portfolio. They found that the (mis)alignment of an economy could already be reflected in the sovereign bonds' spread (i.e. the climate spread) and change the fiscal and financial risk position of a country.

Since financial investors take decisions based on what they can measure, and their decisions do influence (and are influenced by) the benchmark in their respective markets, assessing climate risks in financial contracts is crucial from an investors' risk management perspective, and for financial supervisors whose mandate is about preserving financial stability. To our knowledge, this article is the first study assessing climate-related financial risks stemming from insurance companies' exposures to sovereign bonds.

3.   DATA SAMPLE

We utilized Quarterly Solvency II Reporting Template on List of Assets (SII QRT)[46] and Centralized Security Database (CSDB). Solo data of insurers from 31 countries in EU/EEA that reported Solvency II data at the end of 2018 are employed. Our dataset includes all insurers' investments into sovereign bonds (CIC code equal 1). This data is complemented by information on the characteristics of the bonds available from the CSDB. The final dataset contains 1576 insurance companies, 142 bond issuers and 10746 bonds. The total amount of the insurance government portfolio considered is 2.1 trillion EUR. The full description of the data set utilized in this study is provided in the table below.

46   S.06.02 template.

Table A1.1: List of variables utilized

Variable name	Description
Insurance identifier	Unique identifier of solo insurance company (SII QRT)
Home country	Country of authorization of the insurer (SII QRT)
ISIN code	ISIN conde of the sovereign bond (SII QRT)
Issuer's country	Country that issued the bond (SII QRT)
Duration	Residual duration of the bond (SII QRT)
Maturity	Maturity date of the bond (SII QRT)
Term	Difference in years between the date of bond's maturity and the date of bond issuance (SII QRT)
Price	Market value of the bond (SII QRT)
Nominal value	Nominal value of the bond (SII QRT)
Coupon	Coupon of the bond (CSDB)
Coupon type	Type of the bond's coupon (fix, zero coupon) (CSDB)
Coupon frequency	Coupon frequency of the bond (monthly, bi-monthly, quarterly, semi-annually, annually, zero coupon) (CSDB)

Note: All variables refer to 2018Q4.

4. METHODOLOGY

In this section, we introduce the concepts of climate physical and transition risks. Then, we define the climate policy shocks that we analyse in the context of a disorderly low-carbon transition. Finally, we present the CLIMAFIN tool that we apply to price forward-looking climate transition risk in the value of individual sovereign bonds (introducing the climate sovereign spread) under deep uncertainty, and to assess the largest gains/losses on investors' portfolios. CLIMAFIN includes climate scenarios adjusted financial pricing models (for equity holdings, sovereign and corporate bonds, and loans) and climate scenarios conditioned risk metrics (such as the Climate Spread and the Climate VaR). These allow us to embed forward-looking climate risk scenarios in the valuation of counterparty risk, in the probability of default of securities and in the largest losses on investors' portfolios (Battiston et al., 2019).

We opted for CLIMAFIN for two reasons. First, it is the first approach that combines forward-looking climate transition risk shocks and associated economic trajectories based on climate economic models (in this application, the LIMITS IAMs), which are the reference for the scientific community and the IPCC, with climate financial risk metrics and methods that are now a reference in both the academic and practitioners' community (Battiston et al., 2019). Second, CLIMAFIN provides a transparent and robust methodology for climate financial risk assessment under deep uncertainty. Importantly, this represents the first climate-financial risk assessment developed in collaboration between scientists of the climate economic community, climate financial risk experts and a financial regulatory institution with a financial stability mandate.

4.1.   CLIMATE CHANGE AND FINANCIAL STABILITY: TRANSITION RISKS

Two main channels of risk transmissions from climate change to finance have been identified and analyzed so far, i.e. climate physical risks and climate transition risks. In our analysis we focus on *climate transition risk* because while climate physical risks are expected to be more visible in the mid to long-term period, triggering potentially irreversible socio-economic and environmental impacts (see IPCC 1.5°C 2018 Allen et al. 2018, Steffen et al. 2018), climate transition risks could happen sooner and be more financially relevant (V. de Gaulhau (2018))[47].

Climate transition risk refers to the economic and financial risk arising from a sudden revaluation of carbon-intensive and low-carbon assets and that cannot be fully anticipated by financial actors. This risk can be driven by (i) *Technological shocks* (e.g. the fast decrease of renewable energy production costs and fast increase in their performance, or the change in minimum technology standards); (ii) *Policy and regulatory shocks* (e.g. the disordered introduction of a global carbon tax IMF, 2019) or a change in prudential regulation such as the introduction of Green Supporting Factors (HLEG, 2018); (iii) the sudden changes in the *climate sentiments* of financial actors (Dunz et al., 2019), as a result of the expectations of market participants about the implementation of the climate policies.

Most important, climate risks differ from the type of risks that investors are used to consider in finance. In particular, the nature of climate risks introduces several conceptual and methodological challenges for traditional economic and financial models, which then need to consider (Monasterolo, 2019):

> *Non-linearity of impacts*. The probability of forward-looking climate shocks can't be inferred from historical data being non-linear and not normally distributed (Ackerman, 2017);

> *Forward-looking nature of risk.* The impacts of climate change are on the time scale of two decades or longer[1]. However, the time horizon of financial markets is much shorter. Investors' decisions follow a much shorter time horizon (e.g. three months for fund managers) and are based on a market benchmark (performance) that is backward-looking because estimated on past companies' performance.

> *Deep uncertainties* that characterize climate impacts and their costs, due to the nature of the earth system that leads to the presence of tail events (Weitzman 2009), tipping points and domino effects (Steffen et al., 2018), which are associated to large uncertainty (Kriegler et al., 2009). Tipping points mean that the estimates of the costs and benefits of (in)action may vary substantially across climate scenarios with the assumptions on agents' utility function, future productivity growth rate, and intertemporal discount rate (Stern, 2008, Pyndick, 2013).

> *Endogeneity and circularity of climate risk*. The likelihood of achieving the global climate targets depends on the orderly introduction of climate policies, and their anticipation by financial actors in their investment decisions. However, climate policies' uncertainty affects investors' expectations on the financial risk deriving from the very same policies, and thus their investment decision. In turn, the lack of climate aligned investments makes it impossible to achieve the climate policy targets. This generates the possibility of multiple equilibria, a situation where a rational agent cannot identify a preferred investment strategy (Battiston and Monasterolo, 2018).

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47   https://www.bis.org/review/r180419b.htm

4.2. THE CLIMAFIN CLIMATE FINANCIAL RISK PRICING MODEL

4.2.1. Climate policy scenarios

We consider the climate policy scenarios developed by the International Scientific Community and reviewed by the IPCC. In particular, we select all the climate policy scenarios aligned to the 2°C target made available from the LIMITS project, which includes six IAMs. We use the LIMITS project database (Kriegler et al., 2013) to compute the trajectories of the shocks in the market shares for several variables, including the output of all the economic activities in primary and secondary energy (e.g. primary energy from fossil fuels, electricity produced by solar panels, etc.) conditioned to climate policies' introduction (i.e. a carbon tax). The two emissions concentration targets chosen under milder and tighter climate policy scenarios (i.e. 500 parts per million (ppm) and 450 ppm) refer to the stabilization concentration of CO_2 at the end of century consistently with the 2°C aligned scenarios, and are associated to two different policy implementation scenarios, i.e. the

Reference Policy (RefPol) and the Strong Policy (StrPol) (IPCC, 2014). RefPol assumes a weak near-term target by 2020 with fragmented countries' action, while StrPol assumes a stringent near-term target by 2020 with fragmented countries' action, to achieve emissions reduction by 2050. The 500 and 450 ppm scenarios are associated to a probability of exceeding the 2°C target by 35-59% and 20-41% respectively (Menishausen et al., 2009). Thus, the choice of specific emissions concentration targets could be considered as a proxy for the stringency of the global emission cap imposed by potential climate treaty. A change in climate policy (i.e. in the value of the carbon tax every 5 years' time step) implies a change in the sectors' macroeconomic trajectory, and thus a change in the market share of primary and secondary energy sources based on their energy technology (fossil/renewable).

4.2.2. Climate policy shocks

In the context of climate transition risks, climate policy shocks are defined as the transition from a business as usual scenario of no climate policy, to a policy scenario characterised by the introduction of a climate policy (e.g. a carbon tax, or a Green Supporting Factor). Climate policy shocks arise from a disorderly transition, i.e. when the introduction of climate-aligned policies is carried out at a schedule that is not predictable by investors. These, in turn, cannot fully anticipate (and price) it in their portfolios' risk management strategies (Battiston et al., 2017; NGSF, 2019). In the current scenario where governments have not coordinated yet to introduce stable climate policies, we might end up in a disorderly transition scenario (Battiston, 2019). The transition entails a jump from one equilibrium state of the economy (e.g. the current state) to another equilibrium state where the composition of the economy and the weight of the economic activities (carbon-intensive, low-carbon) could consistently change.

In a disorderly transition, assets price adjustments would directly or indirectly negatively impact the value of fossil fuels and related assets. The lack of investors' anticipation of the climate policy shock could have relevant and long-lasting consequences for the financial conditions of a private investor and of a sovereign, and eventually it would affect the achievement of the 2°C aligned climate mitigation scenarios. As several recent policy events show (e.g. the US withdrawal from Paris Agreement, the outcome of 2018 Italian elections), the assessment of the future policy shock could be incorrect even on average

across market participants, and yet can have severe long-term effects on the financial conditions of a country (Battiston, 2019).

4.2.3. Investors' information set

Here we present the information set that a rational risk averse investor should use to assess financial risk under climate transition scenarios. We consider a risk averse investor that aims to assess the exposure of her portfolio to forward-looking climate transition risk. This information set can accommodate the presence of incomplete information and deep uncertainty (Keynes, 1973; Knight, 1921; Greenwald and Stiglitz, 1986). The information set covers a time-horizons that is relevant both for investment strategies and for the low-carbon transition from 2020 to 2050, and is composed of:

> **Climate policy scenarios** corresponding to Greenhouse Gases (GHG) emission reduction target across regions (B = Business-as-Usual), provided e.g. by the IPCC reports;

> The future **economic trajectories** for carbon-intensive and low-carbon activities, provided by climate economic models (e.g. IAMs);

> A set of forward-looking **Climate Policy Shock Scenarios** intended as a disorderly transition from B (Business as Usual) to P (a given climate policy scenario);

> A set of **Climate Policy Shocks** on the economic output of low-carbon/carbon-intensive activities, on their Gross Value Added (GVA) and on their contribution to the fiscal revenues of the sovereign. The policy shocks are conditioned to transition scenarios and, to a specific climate economic model.

4.2.4. Investors' risk management strategy

The investor's risk management strategy is based on the minimization of the worst-case losses of the portfolio under different forward-looking climate transition scenarios. The definition of the risk management strategy accounts for (i) the investor's specific risk aversion levels, (ii) the counterparty risk adjusted for climate policy shock scenarios (e.g. Probability of Default (PD)), (iii) metrics relevant for financial regulation (e.g. risk measures such as the Climate Spread and VaR). The Climate VaR Management Strategy can be written as:

$$\text{ClimVaRStr} = \min_{\text{Portfolio}}\{\max_{\text{Shock}}\{\text{VaR}(\text{Portfolio},\text{Adj.PD}\,|\,\text{Policy Shock})\}\}$$

In this context, future asset prices are subject to shocks that depend on the issuer's future economic performance, the risk premia demanded by the market, as well as the implementation of the climate policy and the outcome of the energy transition of individual firms and countries. The investor considers different feasible climate policy scenarios (but has no information on the probability associated) for which she can calculate the impacts (negative or positive) on the market share of carbon-intensive or low-carbon economic activities and firms. The investor is subject to incomplete information on her (and competitors') exposure to risk stemming from a disordered transition from a climate policy scenario to another one, uncertainty on the outcome of the firms and country's energy transition, and no information on the probability distribution. Thus, her risk management strategy is to consider a set of feasible climate transition scenarios that her portfolio should withstand, and then compute the VaR conditional to those scenarios.

4.2.5. Composition of the economy

We consider n countries j whose economy is composed of m economic sectors S. Economic activities included in S are based on a refined classification of the Climate Policy Relevant Sectors (CPRS Rev 2), which identify the main sectors that are relevant for climate transition risk (fossil-fuel, electricity (from fossil or renewable sources), energy-intensive, transportation (low/high-carbon), buildings), and were originally introduced in Battiston et al. (2017). As a difference from the NACE classification of economic sectors, CPRS Rev 2 capture the energy and electricity technology embedded in the economic activity (e.g. utility|electricity|wind, solar, gas). Firms that compose economic sectors S are considered as a portfolio of cash-flows. The classification of countries and regions affected by the climate shock is based on the LIMITS aggregation[48], see Kriegler et al. (2013).

4.2.6. Impact of climate policy shock on economic activities' GVA and profitability

We consider the contribution of issuer j to the sector S GVA and fiscal assets and how this can be affected by changes in its economic performance, either negatively or positively. We then relate the performance of the economic activity to the change in its market share as a result of a climate transition scenario.

In a disorderly transition, a climate policy shock affects the performance of issuers in sectors S via a change in economic activities' market share, cash flows and profitability, eventually affecting the GVA of the sector. The climate policy shock is calculated at the sector, country and regional level. The country's GVA composition is available at NACE 2-digit level from official statistics (e.g. from Eurostat). Negative shocks result from the policy impact on the GVA of sectors based on carbon-intensive (i.e. fossil fuels) technologies, while positive shocks result from the impact on the GVA of sectors based on low-carbon (i.e. renewable energy) technologies.

We assume that a percentage shock on output to a percentage shock on GVA, u_j^{GVA}, for each sector j, so that:

$$u_j^{GVA}(P) = \frac{GVA_j(P) - GVA_j(B)}{GVA_j(B)} = \sum_S u_{j,s}^{GVA}(P) \, w_{j,s}^{GVA}(B)$$

Where $u_{j,s}^{GVA}(P)$ is the shock on the GVA of sector S of the sovereign issuer j; $w_{j,s}^{GVA}(B)$ is the share of GVA of sector S. We then define the net fiscal assets related to sector S, $A_j(S)$, as the difference between accrued fiscal revenues from sector S and public investments and subsidies granted by j to the same sector. The impact of the market share shock (resulting from the policy shock P) on net fiscal assets of sector S is thus assumed to imply a change $A_j(S, P, M)$ as follows:

$$\frac{\Delta A_j(S,P,M)}{A_j(S)} = \chi_s \, u_j(S,P,M)$$

Where χ denotes the elasticity of sector S profitability with respect to the market share. While the policy shock could affect at the same time several sectors in the economy of the issuer j, here we consider the total net effect on the issuer's net fiscal assets as follows:

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48   See the LIMITS database documentation for more details https://tntcat.iiasa.ac.at/LIMITSDB/ static/download/LIMITS_overview_SOM_Study_Protocol_Final.pdf

$$\frac{\Delta A_j(P,M)}{A_j} = \sum_s \left(\frac{\Delta A_j(S,P,M)}{A_j(S)} \frac{A_j(S)}{A_j}\right) = \sum_s \chi_s \, u_j(S,P,M) \frac{A_j(S)}{A_j}$$

The elasticity coefficient could be estimated empirically for the specific sectors of the sovereign issuers in the portfolio. However, in our application, the data to carry out this estimation was not available. Thus, for estimating the elasticity we consider a mild and adverse scenario with values equal to equal to 0.2 and 0.5, respectively (see also Battiston and Monasterolo, 2019). This allows us to provide an estimation of the magnitude of the shocks due to a given climate policy scenarios P, where the shock is transmitted to the value of the sovereign bond via the change in sectors' market share, GDP and fiscal assets.

4.2.7. Model for sovereign bonds' valuation

We consider a risky (defaultable) bond of a sovereign entity j, issued at t_0 with maturity T. The value of the sovereign bond at time T, with R being the Recovery Rate of the bond (i.e. the percentage of notional recovered upon default), and LGD Loss-Given-Default (i.e. the percentage loss) can be written as:

$$v_j(T) = \begin{cases} R_j = (1 - LGD_j) & \text{if } j \text{ defaults (with probability } Q_j) \\ 1 & \text{else (with probability } 1 - Q_j) \end{cases}$$

The unitary price $P_j(t)$ of the sovereign bond at time t<T and t>t_0 follows the usual definition of discounted expected value at the maturity,

$$\Delta q_j(P) = q_j(P) - q_j(B) = \int_{\eta_{inf}}^{\theta_j(P)} \phi_{(\eta_j)} d\eta_j, \text{ with } \theta_j(P) = \theta_j(B) - \xi_j(P)$$

$$P_j = \exp(-r_f(T-t)) \, E[v_j(T)] = \exp\left(-r_f(T-t)\right) (1 - Q \, LGD),$$

where r_f is the risk-free rate and the expectation is taken under the risk neutral measure. Moreover, the cumulative probability of default Q, is related to the annual probability of default as follows: $Q = 1 - (1 - q)^{(T-t)}$. The formula can be used to determine from the market price the value of the annual default probability q, called "q implied", for a given risk free rate and LGD. In the case of a multi-coupon bond, the formula gets more complicated since one has to sum over the expected value of the coupons but the logic remains the same. For each coupon k, the coupon amount is assumed to be paid only if j does not default before. The determination of the q implied requires then to solve numerically a polynomial equation.

4.2.8. Sovereign default conditions

Following a stream of literature (Gray et al., 2007), we model the payoff of the defaultable sovereign bond as dependent on the ability of the sovereign to repay the debt out of its fiscal revenues accrued until the maturity. Differently from Gray et al. (2007), we do not consider whether debt is issued in local or foreign currency, nor the exchange rate risk.

We can define the sovereign's net fiscal assets at the present time of the valuation and at the maturity respectively as $A_j(t)$ and $A_j(T)$, and the liabilities at the maturity as $L_j(T)$. Thus, the sovereign default conditions read as:

$$A_j(T) = A_j(t) \, (1 + \eta_j(T)) < L_j(T)$$

We add a climate policy shock ξ_j on j's net fiscal assets (as a "jump" up or down), assuming that the idiosyncratic shock η_j and policy shock ξ_j are independent. The new sovereign default condition reads as:

$$A_j(T) = A_j(t)\,(1+\eta_j(T) + \xi_j(P)) < L_j(T) \Leftrightarrow \eta_j(T) < \theta_j(P)$$
$$= L_j(T)/A_j(t) - 1 - \xi_j(T,P)$$

where $\theta_j(P)$ is the default threshold under scenario P, $\xi_j(P)$ is the climate policy shock from B to P (can be positive or negative) that shifts the idiosyncratic shock η_j, with $\xi_j(P)>1$, possibly correlated across j.

4.2.9.   Sovereign default probability

We can define the Probability of Default (PD) $q_j(P)$ of issuer j under Climate Policy Scenario P as:

$$q_j(P) = \mathcal{P}\,(\eta_j < \theta_j(P)) = \int_{\eta_{inf}}^{\theta_j(P)} \phi_{(P)}(\eta_j)\,d\eta_j$$

where $\phi_{(P)}(\eta_j)$ is the probability distribution of idiosyncratic shock η_j, η_{inf} is the lower bound of distribution support.

In principle, frequent small productivity shocks across time and firms occur in a similar way, with or without the climate policy shock. We introduce now a proposition of the PD adjustment Δq conditioned to the climate policy shock, which shifts the probability distribution of the small productivity shocks and thus the default probability of issuer j:

$$\Delta q_j(P) = q_j(P) - q_j(B) = \int_{\eta_{inf}}^{\theta_j(P)} \phi_{(\eta_j)}\,d\eta_j,\ \text{with}\ \theta_j(P) = \theta_j(B) - \xi_j(P)$$

Thus, assuming that the climate policy shock on fiscal asset is proportional to shock on GVA of low-carbon and carbon-intensive sectors i.e. $\xi_j = \chi_j u_{j,s}^{GVA}\,(P)$, with elasticity the adjustment $\Delta q_j(P)$, the default probability of sovereign j under Climate Policy Shock Scenario:

> Increases with GVA shock magnitude $|u_{j,s}^{GVA}(P)|$ if $u_{j,s}^{GVA}(P)<0$, and decreases vice versa;

Is proportional to the GVA shocks on the CPRS (in the limit of small Climate Policy Shocks).

5. EMPIRICAL RESULTS

Overall, we consider the combination of two market conditions scenarios with climate policy scenarios described in Section 4. The market condition scenarios are reflected in the different values of loss-given-default LGD and elasticity.In the mild scenario, LGD = 0.2 and = 0.2. In the adverse scenario, LGD = 0.4 and = 0.5.

For each scenario combination and IAM, we compute the shock on the value of each bond in the holdings' dataset. The description of the scenarios considered in this exercise are provided in the Appendix. We then compute the resulting aggregate shocks on the value of the portfolio of each European insurance company ("solo"). We define as *portfolio impact* of the climate policy shock the ratio of the value of the portfolio after the shock over the initial value before the shock. In a series of boxplots, we study the distribution of the values of the portfolio impact of climate policy shocks under varying levels of aggregation. The difference between the median impact and 100% is considered as the *median shock* on the portfolio values.

Notice that three dimensions drive the magnitude of portfolio impact. First, for each sovereign bond negative shocks (e.g. on primary energy fossil sector) can be possibly compensated by positive shocks (e.g. on secondary energy electricity based on renewable sources). Second, in a portfolio of sovereign bonds issued by several countries, negative aggregate shocks from a less climate-aligned sovereign can be possibly compensated by positive shocks from another more climate-aligned sovereign (see also Appendix Table A1.3). Third, in some of the figures the results from several models or several scenarios are pooled together in one distribution. These three dimensions concur to limit the magnitude of the median value of the portfolio impact in the following charts. Further, recall that in this application of the CLIMAFIN framework, we do not consider the macro-economic reverberations of a shock on a given sector. Therefore, the results are to be considered as conservative.

Chart A1.1-2 show the box plots of the portfolio impact distribution across insurance holders and IAMs, for selected climate policy scenarios. Chart A1.1 and A1.2 refer, respectively, to the mild and adverse scenario on market conditions. In the mild scenario, the first quartile of the distribution varies between 99.6% and 99.8%. In the adverse scenario, the same quantity varies between 98.2% and 99.4%. The median shock in the adverse scenario is about 3 times larger than in the mild scenario.

Figure A1.1: Distribution of impact on sovereign holdings of European insurers across climate policy shock scenarios, under the **mild** scenario on market conditions.
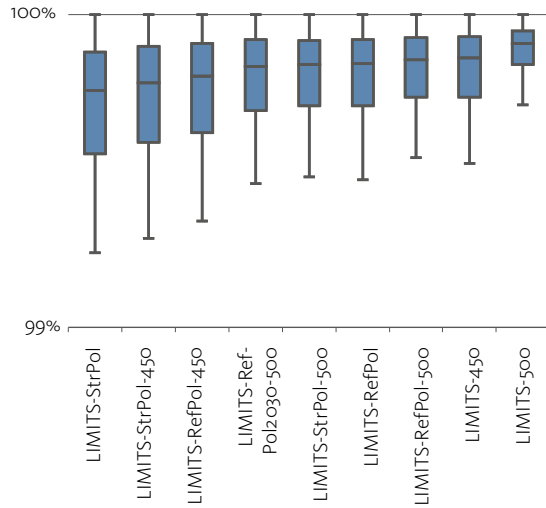
Figure A1.2: Distribution of impact on sovereign holdings of European insurers across climate policy shock scenarios, under the **adverse** scenario on market conditions.

Source: EIOPA and own calculations

Source: EIOPA and own calculations

Note: Y-axis corresponds to the percentage of the original value of government portfolios (e.g. 100% expresses 0% impact, 97% corresponds to drop of 3%). The description of scenarios is provided in Appendix.
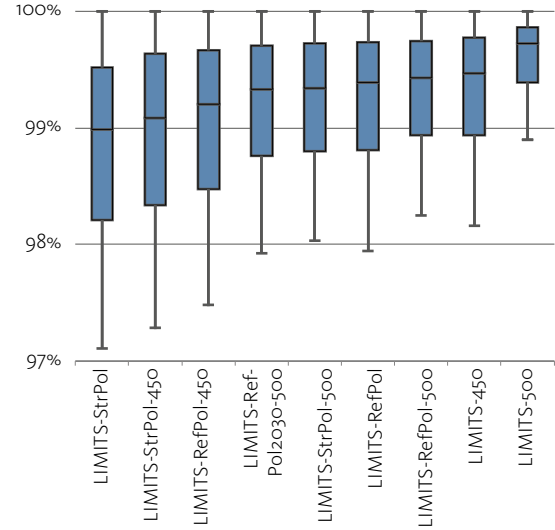
Chart A1.3-4 show the box plots of the portfolio impact distribution across holders, estimated by the model MESSAGE (Krey et al. 2016; Fricko et al. 2017), for selected climate policy scenarios. Chart A1.3 and A1.4 refer, respectively, to the mild and adverse scenario on market conditions. In the mild scenario, the first quartile of the distribution varies between 99.3% and 99.8%. In the adverse scenario, the same quantity varies between 97.4% and 99.0%. The median shock in the adverse scenario is again about three times larger than in the mild scenario.

Figure A1.3: Distribution of impact on sovereign holdings of European insurers estimated by the model MESSAGE across climate policy shock scenarios, under the *mild* scenario on market conditions.

Source: EIOPA and own calculations

Figure A1.4: Distribution of impact on sovereign holdings of European insurers estimated by the model MESSAGE across climate policy shock scenarios, under the *adverse* scenario on market conditions.

Source: EIOPA and own calculations

Note: Y-axis corresponds to the percentage of the original value of government portfolios (e.g. 100% expresses 0% impact, 97% corresponds to drop of 3%). The description of scenarios is provided in Appendix.
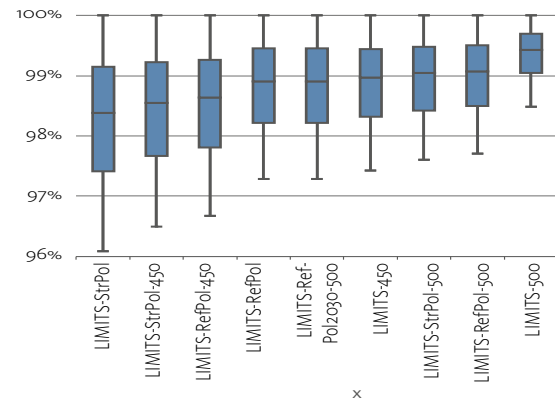
Chart A1.5-6 shows the box plots of the portfolio impact distribution across holders, conditioned to the country of the insurance holder, for a given selected climate policy scenario, and estimated across all the models in the LIMITS database (Kriegler et al. 2013). Chart A1.5 refers to the climate policy scenario RefPol500 and the mild market condition scenario. Chart A1.6 refers to the climate policy scenario StrPol450 and the adverse market condition scenario. In the mild scenario, the first quartile of the distribution varies between 99.3% and 100.0%. In the adverse scenario, the first quartile varies between 96.2% and 99.5%. The median shock in the adverse scenario is about 5 times larger than in the mild scenario. Note that we have excluded countries for which the number of observations did not allow to draw the box plot (i.e. Romania in A1.5, Romania and Iceland in A1.6).

Figure A1.5: Distribution of impact on sovereign holdings of European insurers conditioned to the country of the holder, across climate policy shock scenarios and under the *mild* scenario on market conditions.
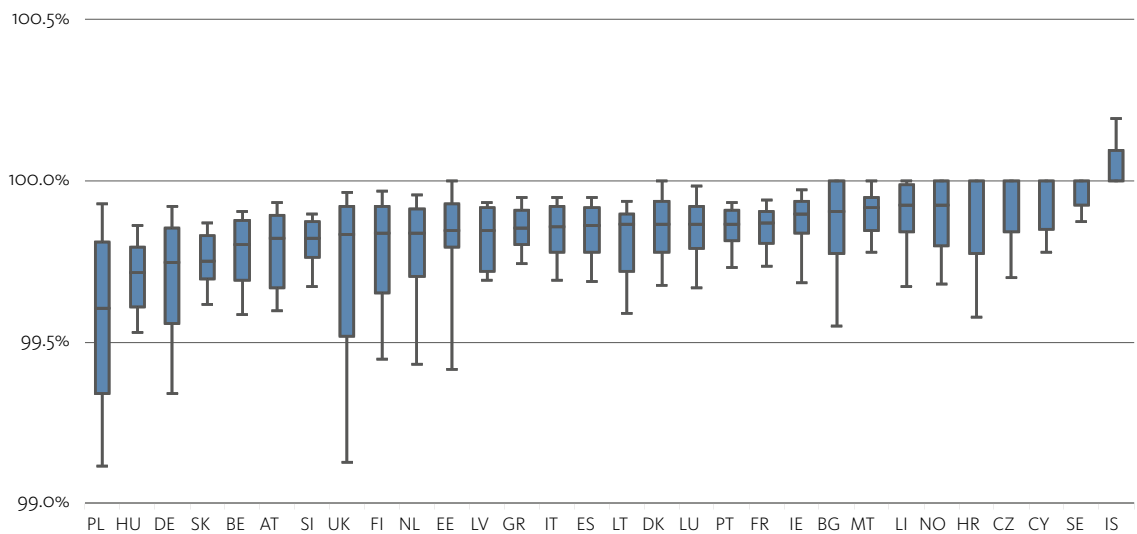
Source: EIOPA and own calculations

Note: Y-axis corresponds to the percentage of the original value of government portfolios (e.g. 100% expresses 0% impact, 97% corresponds to drop of 3%). The description of the scenarios is provided in Appendix.

Figure A1.6: Distribution of impact on sovereign holdings of European insurers conditioned to the country of the holder, across climate policy shock scenarios and under the ***adverse*** scenario on market conditions.
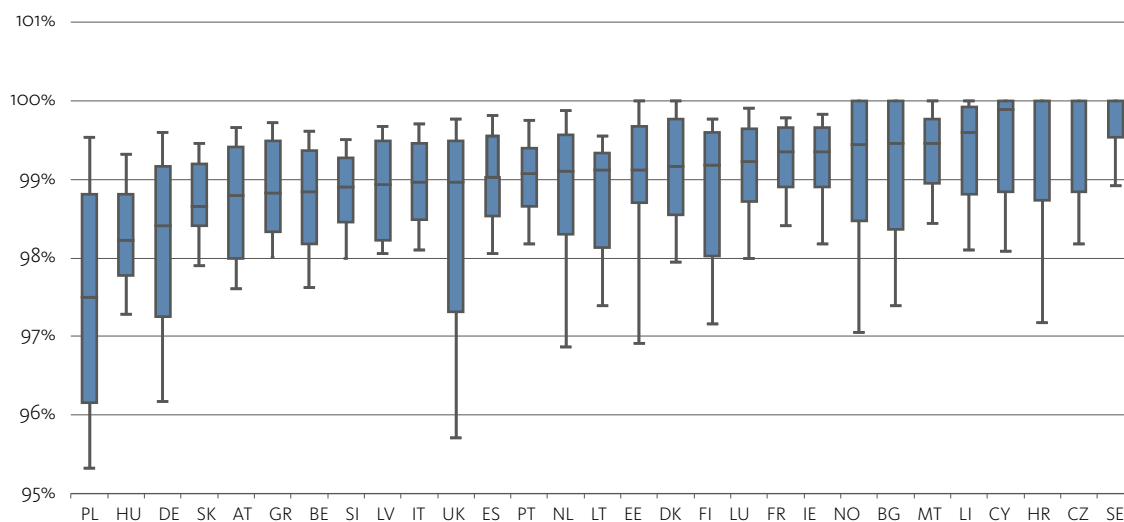
Source: EIOPA and own calculations
Note: Y-axis corresponds to the percentage of the original value of government portfolios (e.g. 100% expresses 0% impact, 97% corresponds to drop of 3%). The description of the scenarios is provided in Appendix.
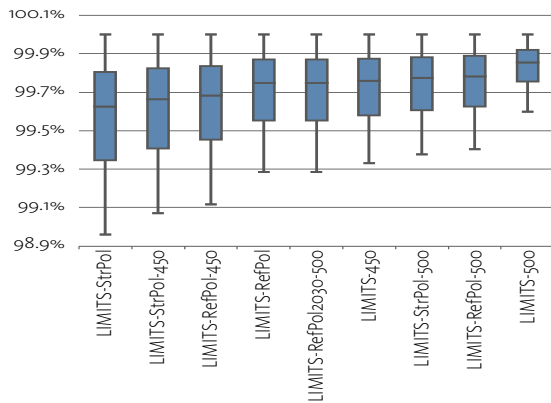
The results of this analysis should be considered as conservative for the following reasons. First, since global GHG emissions are still increasing (WMO 2019) and countries are not aligning their policies to their climate pledges, stricter climate policies might be introduced. Second, the IAMs' policy scenarios that we considered were defined before the Paris Agreement. Thus, tighter policy scenarios are likely to be needed to achieve the 2°C target. Further, it must be noticed that the energy technology shocks (both on fossil and renewable energy sources) vary considerably across the IAMs used, for the same regions and countries considered. Finally, we should consider investors' sentiments, i.e. the expectations about changes in (even few decimal points) in GVA and GDP growth could impact sovereign bonds' yields.

6.   CONCLUSION

In this analysis, we have developed the first climate transition risk assessment of the sovereign bonds' portfolios of solo insurance companies in Europe under deep uncertainty. This is the result of the first collaboration between, climate economics modellers, climate financial risk scholars and researchers from a public authority with a mandate to contribute to financial stability. We opted for the CLIMAFIN framework by Battiston et al. (2019) because it is the first and transparent approach that combines 1) forward-looking climate transition risk shocks obtained from climate economic models that are the reference for scientific community and the IPCC (in this context, the LIMITS IAMs) with; 2) climate financial risk metrics and methods that are now a reference in both the academic and practitioners' community (Battiston et al., 2017). In particular, the CLIMAFIN approach allows to embed forward-looking climate transition risk scenarios (i.e. a disorderly introduction of climate policies that cannot be fully anticipated and priced in by insurers) in the valuation of counterparty risk, in the probability of default of individual sovereign bonds and largest losses on investors' portfolios (Battiston et al., 2019).

In this application, we have considered a simple financial pricing model for zero and multi-coupon sovereign bonds adjusted for climate policy shock scenarios. This allows to compute an adjusted value of bonds' portfolios in order to assess how future climate transition risk could affect the probability of default of individual sovereign bonds, the financial solvability of the sovereign and the performance of European insurers who are exposed to those bonds. The analysis uses the solo data of insurers from 31 countries in EU/EEA that reported Solvency II data at the end of 2018, including all insurers' investments into sovereign bonds, complemented by information on the characteristics of the bonds available from the CSDB.

Our results show that the potential impact of a disorderly low carbon transition on insurers portfolios of sovereign bonds is moderate in terms of its magnitude. However, it is non-negligible in several feasible scenarios. Overall, it emerges that the climate policy transition path chosen, and the role of fossil fuels and renewable energy technologies in the sovereign's GVA and fiscal revenues, can considerably affect the fiscal and financial risk position of a country, via the change in the probability of default (PD) and in the value of the sovereign bonds and the Climate Spread. In general, countries that have already started to align their economy to the low-carbon transition (and thus where renewable energy technologies play a larger role on its GVA and fiscal revenues) face a decrease in the PD and in the Climate Spread, and thus better refinancing conditions. In contrast, countries whose GVA is carbon intensive would face an increase in the PD and in the Climate Spread.

This, in turn, could have relevant implications for the financial risk profile of the insurers who own sovereign bonds of countries that are misaligned to the low-carbon transition and the climate targets. Thus, it would be in the interest of insurers' supervisors to extend this climate financial risk pricing exercise (ideally in a climate stress-test exercise, see e.g. Battiston et al., 2017) for financial risk monitoring and assessment purposes.

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APPENDIX

CLIMATE POLICIES SCENARIOS LIMITS.

In this exercise we consider the scenarios elaborated by the international scientific consortium LIMITS. This is a database of economic trajectories that are consistent with 10 climate transition scenarios. The main features of climate mitigation are the following:

> The level of ambition in emission reduction in the near-term (2020):

   ▪ reference policy 'weak' corresponds to unconditional Copenhagen Pledges; more 'stringent' based on conditional Copenhagen Pledges.

> The level of ambition in emission reduction in the long-term (2100):

   ▪ either no target or concentrations targets of 450 and 500 ppm CO2-eq, corresponding to high chances of achieving 2°C

> The level of international cooperation until 2020 and 2030:

   ▪ no cooperation, fragmented action, coordinated action.

Table A1.2: LIMITS scenarios' characteristics.

Scenario class	Scenario name	Scenario type	Level of ambition (near term)	Level of ambition (long term)	Level of international cooperation
No policy	Base	Baseline	None	N/A	None
Fragmented action	RefPol	Reference	Weak	2100	None
	StrPol	Reference	Stringent	2100	None
Immediate action	450	Benchmark	None	N/A	450 ppm
	500	Benchmark	None	N/A	500 ppm
Delayed Policy	RefPol-450	Climate Policy	Weak	2020	450 ppm
Delayed Policy	StrPol-450	Climate Policy	Stringent	2020	500 ppm
Delayed Policy	RefPol-500	Climate Policy	Weak	2020	500 ppm
Delayed Policy	StrPol-500	Climate Policy	Stringent	2020	500 ppm
Delayed Action	RefPol2030-500	Climate Policy	Weak	2030	501 ppm

Source: Table based on: E. Kriegler, M. Tavoni, T. Aboumahboub, G. Luderer, K. Calvin, G. De Maere, V. Krey, K. Riahi, H. Rosler, M. Schaeffer, D. van Vuuren (2013): Climate Change Economics 4(4), doi: 10.1142/S2010007813400083.

We consider the trajectories computed under 6 Integrated Assessment Models (AIM-Enduse, GCAM, IMAGE, MESSAGE, REMIND, and WITCH). More information is available at: https://tntcat.iiasa.ac.at/LIMITSDB/dsd?Action=htmlpage&page=about#tutorial

CLIMATE POLICIES SCENARIO LIMITS REDPOL-450 MILD COMPUTED WITH THE IAM MESSAGE

The following table provides simple average of results of shock for the scenario LIMITS RedPol-450 mild computed with the IAM MESSAGE aggregated by bond issuers and their residual maturities. The sovereigns that were not sufficiently represented across different residual maturities were excluded from the table. As sovereign bonds that are held by insurers in their investment portfolios could have different parameters, the obtained results were smoothed out using estimated linear trends. In this way the results could be generated even for residual maturities that were not available in our data sample. The following table could be used as an illustrative example how to integrate forward-looking climate transition in a bottom up insurance stress test. The climate shocks could be then combined with other shocks, e.g. market shocks prescribed in the given stress test scenario.

Table A1.3: Average impact of scenario LIMITS RedPol-450 mild computed by IAM MESSAGE for different sovereigns and residual maturities

	1	2	3	4	5	6	7	8	9	10	15	20
Austria	-0.31%	-0.33%	-0.35%	-0.37%	-0.38%	-0.40%	-0.42%	-0.44%	-0.46%	-0.48%	-0.57%	-0.66%
Belgium	-0.24%	-0.27%	-0.29%	-0.31%	-0.34%	-0.36%	-0.38%	-0.41%	-0.43%	-0.45%	-0.57%	-0.68%
Denmark	-0.07%	-0.10%	-0.13%	-0.16%	-0.19%	-0.22%	-0.25%	-0.29%	-0.32%	-0.35%	-0.50%	-0.65%
Finland	-0.07%	-0.11%	-0.15%	-0.19%	-0.23%	-0.27%	-0.31%	-0.35%	-0.39%	-0.42%	-0.62%	-0.82%
France	-0.32%	-0.34%	-0.37%	-0.39%	-0.42%	-0.45%	-0.47%	-0.50%	-0.52%	-0.55%	-0.67%	-0.80%
Germany	-0.12%	-0.19%	-0.25%	-0.31%	-0.38%	-0.44%	-0.50%	-0.56%	-0.63%	-0.69%	-1.00%	-1.32%
Greece	-0.26%	-0.27%	-0.27%	-0.28%	-0.28%	-0.29%	-0.30%	-0.30%	-0.31%	-0.31%	-0.34%	-0.37%
Iceland	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Ireland	-0.01%	-0.07%	-0.13%	-0.18%	-0.24%	-0.30%	-0.36%	-0.42%	-0.48%	-0.54%	-0.83%	-1.12%
Italy	-0.22%	-0.2.3%	-0.25%	-0.26%	-0.27%	-0.29%	-0.30%	-0.31%	-0.33%	-0.34%	-0.40%	-0.47%
Luxembourg	-0.02%	-0.04%	-0.07%	-0.09%	-0.12%	-0.14%	-0.16%	-0.19%	-0.21%	-0.24%	-0.36%	-0.48%
Netherlands	-0.10%	-0.20%	-0.30%	-0.40%	-0.50%	-0.60%	-0.70%	-0.80%	-0.90%	-1.00%	-1.49%	-1.99%
Norway	-0.01%	-0.01%	-0.02%	-0.02%	-0.02%	-0.03%	-0.03%	-0.04%	-0.04%	-0.04%	-0.06%	-0.08%
Poland	-0.74%	-0.73%	-0.72%	-0.71%	-0.70%	-0.69%	-0.68%	-0.67%	-0.66%	-0.65%	-0.60%	-0.54%
Spain	-0.18%	-0.21%	-0.25%	-0.28%	-0.32%	-0.35%	-0.39%	-0.42%	-0.46%	-0.49%	-0.67%	-0.84%
Sweden	-0.02%	-0.02%	-0.02%	-0.01%	-0.01%	-0.01%	-0.01%	0.00%	0.00%	-0.01%	0.00%	0.01%
United Kingdom	-0.33%	-0.28%	-0.23%	-0.18%	-0.12%	-0.40%	-0.44%	-0.47%	-0.50%	-0.53%	-0.69%	-0.85%
Switzerland	-0.24%	-0.28%	-0.31%	-0.34%	-0.37%	-0.07%	-0.02%	0.00%	0.00%	0.14%	0.40%	0.66%
United States	-0.13%	-0.13%	-0.14%	-0.14%	-0.15%	-0.16%	-0.16%	-0.17%	-0.18%	-0.18%	-0.22%	-0.25%

Source: EIOPA and own calculations
Note: The columns represent residual maturities. The obtained results were smoothed out cross residual maturities using estimated linear trends.

IMPACT OF VARIATION MARGINING ON EU INSURERS' LIQUIDITY: AN ANALYSIS OF INTEREST RATE SWAPS POSITIONS[49] [50]

Alexandra de Jong[51], Alin Draghiciu[52], Linda Fache Rousová[53], Alessandro Fontana[52], Elisa Letizia[53]

ABSTRACT

Insures use derivatives to hedge risks from investments portfolios and underwriting, but this exposes them to liquidity risk. This study uses Solvency II reporting data to assess to what extent European (re-)insurers would be able to meet potential variation margin calls on interest rate swaps portfolios. Interest rate swaps pose the largest share of (re-)insurers derivatives' portfolios. We consider several shifts to the yield curve, calculate the corresponding variation margin calls, compare them to liquid assets available to insurers and derive the potential liquidity shortfalls. Our results reveal that there may be a liquidity risk for (re-)insurers stemming from the use of derivatives, in particular interest rate swaps (IRS). This reflects both high IRS exposure and insufficient holdings of cash and liquid assets. Based on the analysis presented in this article we conclude that some insurers have not yet adapted their asset allocation and liquidity management practices to the (new) requirements on margining practices which have been introduced as part of the OTC derivatives reform.

INTRODUCTION

Derivatives exposures of insurance companies came into the spotlight after the near-failure of the global insurance conglomerate, American International Group (AIG). This group was rescued at the height of the financial crisis because of the significant losses on the credit default swap (CDS) portfolio held by its Financial Products Subsidiary. Beside the dramatic change in market value of the protection sold, one of the main aspects of the near-failure was a liquidity shortfall in managing collaterals. When AIG's credit rating was lowered collateral provisions kicked in and AIG suddenly received massive margin calls[54]. Since then, derivatives exposures of insurers have been considered as a potential risk to financial stability.

Recent studies[55] on European insurers have shown that their aggregate derivatives holdings are small. Specifically, the market value of all derivatives positions amounts to only ca. 1% of total investments. Nevertheless, there are a number of companies with sizeable exposures. Moreover, the notional amount of interest rate swaps (IRS) – which represent the largest class in insurers' derivatives portfolios – has been steadily rising since the beginning of 2018. In particular, the amount of IRS where insurers receive fixed rate has more than doubled since then, see Figure A2.1. While European insurers use derivatives to hedge risks from investments portfolios and underwriting, their derivative holdings can also expose them to higher liquidity risk, which is the focus of this study.

Figure A2.1: Notional amounts (EUR) of interest rate swaps and cash holdings of EEA insurers
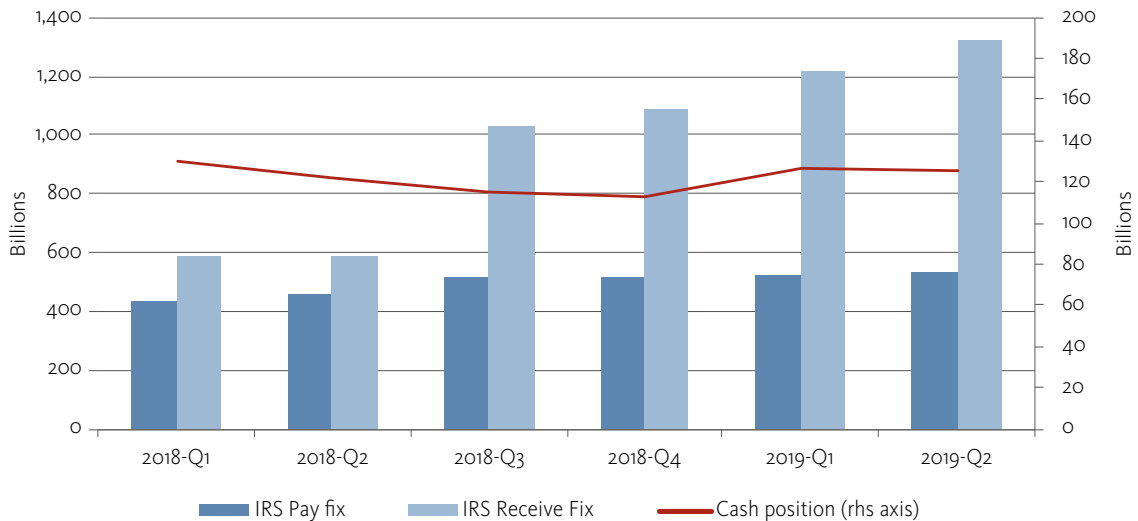
Source: EIOPA SII QRT data
Reference date: Q4 2018

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54 On September 15, 2008, the day all three major agencies downgraded AIG to a credit rating below AA-, calls for collateral on its credit default swaps raised to $32 billion a huge change from $8.6 billion in collateral calls just few days earlier.

55 EIOPA (2018); Fache Rousova, L. and E. Letizia (2019).

In the aftermath of the financial crisis, the need for reducing counterparty credit risk became apparent. This has been addressed by introducing new rules. The European Market Infrastructure Regulation (EMIR)[56] has, in particular, introduced the requirement to centrally clear the most commonly used types of derivatives contracts and to exchange collateral in the form of margins for both bilateral and centrally cleared transactions. These requirements aim to make the financial system safer by protecting participants from counterparty credit risk.

This study focusses on the exchange of 'variation margins' (VM). These reflect the change in market value and portfolio composition of the contracts of a company. Since VM calls have to be typically paid at a short notice (e.g. overnight or even intra-day), the cash position plays a central role as cash is the most widely used instrument to meet these calls owing to its fungibility (regardless of whether the contracts are centrally cleared or not). However, despite the rapid increase in insurers' holdings of IRS, the aggregate cash position of EEA insurers has remained stable since the beginning of 2018 (see Figure 1).

Against this background, this article investigates the liquidity risk faced by EAA insurers from the need to pay VM on their IRS exposures. Using Solvency II data on contract level, we first apply a parallel positive shift to the level of interest rates, calculate the corresponding variation margin calls on insurers' portfolio of interest rate swaps and compare them to different liquid assets available to insurers. In this way, we derive any potential liquidity short-falls. To assess the sensitivity and robustness of our results, we consider a range of interest rate increases and various measures of liquid assets.

Overall, we observe liquidity shortfalls for almost all combinations of interest rate shifts and liquid assets. Considering all set-ups, the aggregate estimated liquidity shortfalls for the EEA insurers in our sample implied by the variation margins calls range between EUR 1bn to almost EUR 90bn. These estimates are sizeable compared to the overall Solvency II value of plain vanilla interest rate swaps held by the companies in our sample (i.e. Q4-2018), which totalled EUR 22.5bn. By the same token, they are sizeable compared to the initial liquidity positions of these companies (EUR 21bn – EUR 740bn) and also to their average open positions in the repo market (EUR 50bn of cash borrowing and EUR 15bn of cash lending on average during 2018). On the other hand, the figures are small compared to the overall size of total investment of the companies in our sample, which stands at around EUR 4.8trn.

This article is structured as follow. Section 2 describes the data and the methodology used in this study. Section 3 presents the results. Finally, Section 4 concludes.

METHODOLOGY

This section describes the regulatory background for margining practice, the data used, the pricing of the IRS positions and the set-up of the analysis.

REGULATORY BACKGROUND FOR MARGINING PRACTICES

Recently introduced regulatory requirements have changed the risks associated with derivatives transactions from counterparty credit risk to liquidity risk. The European Market

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56   ADD reference to EMIR.

Infrastructure Regulation (EMIR) requires the most commonly used types of derivatives contracts (incl. IRS)[57] to be centrally cleared[58]. (Re)insurers that have a gross exposure of more than €3 billion in OTC interest rate derivatives will be mandated to clear[59]. Counterparties below this threshold are exempted from clearing obligations, but could be still required to meet them bilaterally. Non-centrally cleared derivatives are subject to specific requirements on margins[60]. Bilateral counterparties above specific thresholds are mandated to exchange daily variation margins and to post initial margins to each other.

Whereas all counterparties are subject to exchange of variation margins since March 2017, there is a phase-in scheduled for the obligation to exchange initial margins[61]. As of the 1 September 2019 the requirements apply to all cases where both counterparties have, or belong to groups each of which has, an aggregate average notional amount of non-centrally cleared derivatives that is above €750 billion; this threshold will be lowered to €8 billion from the 1 September 2020. Regulation admits the possibility of exchanging non-cash variation margins for non-centrally cleared derivatives. Unlike for cleared derivatives, the regulation allows to collateralise the exposure from variation margin calls with non-cash collateral. Although the evidence on non-cash variation margin payments is scarce, this option could be attractive for asset rich but cash poor insurers.

The above margining requirements only apply to new trades concluded after the applicable phasing in deadlines. It will therefore take time before new trades replace all the legacy trades which are not covered by the requirements.

DATA

This study employs quarterly reporting data for solo undertakings in Q4-2018[62]. This was the most recent data at the time when the analysis has been implemented. The sample includes derivatives held directly, not considering exposures via collective investment funds.

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57   The clearing obligation under EMIR comprises certain classes of interest rate and credit OTC derivatives, which have to be cleared by authorised or recognised CCPs. For instance, (a) fixed-to-float interest rate swaps denominated in EUR, GBP, JPY, NOK, PLN, SEK and USD and (b) several series of credit default swaps denominated in EUR are subject to the clearing obligation. The details of the derivatives under the clearing obligation are listed in "ESMA's Public Register for the clearing obligation under EMIR. ESMA Public Register for the clearing obligation under EMIR; available at https://www.esma.europa.eu/sites/default/files/library/public_register_for_the_clearing_obligation_under_emir.pdf, last updated: 6 December 2018

58   As a result of the clearing obligation, counterparties (including (re)insurers) need to gain access to a qualified CCP, either becoming a direct clearing member, or more commonly becoming a client to a clearing member which also provides indirect clearing service. Once clearing arrangements are in place and contracts are being cleared, counterparties become subject to the requirement to post cash to cover the CCP from the replacement costs in the case of their own default (initial margins) and following the daily revaluation of their positions (variation margins).

59   EMIR Refit introduced article 4(a) introduced the category of small financials, i.e. counterparties with gross notional below the clearing threshold as specified in article 10(4)(b). Small financials are not subject to the clearing obligation, but remain subject to both the reporting obligation and the risk mitigation techniques for derivatives not cleared by a CCP under article 11.

60   For detail of risk mitigation techniques applicable to non-centrally cleared derivatives see EMIR Article 11 and the related Commission Delegated Regulation (EU) 2016/2251: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R2251&from=EN

61   For details on the phase-in schedule see article 36 of the Commission Delegated Regulation (EU) 2016/2251.

62   The Solvency II Directive (amended by the Omnibus II Directive), became fully applicable to European (re)insurers on 1 January 2016. Since the implementation of the Solvency II, (re)insurance solo undertakings and groups are required to report to national competent authorities on an annual and quarterly basis, for both prudential and financial stability purposes. This information is stored in EIOPA's Central Repository, i.e. the database that collects all data from Quantitative Reporting Templates (QRTs). Aggregated information derived from EIOPA's Central Repository is also made available on EIOPA's website. Besides, the SII data has been used by EIOPA for the conduct of its tasks. This is, however, the first time that the dataset has been used for joint research and policy making purposes within the ESFS framework.

Out of the 1,970 solo insurance companies that submitted (list-of-derivatives) data in Q4 2018, 224 reported positions on interest rate swap (IRS) derivatives. Those companies reported 43,429 individual contracts, for a total a notional amount of EUR 1.8 trillion.

After data cleaning (see Annex), the data set contains 34,689 contracts by 170 companies. The sample is dominated by large and very large[63] life insurers. These companies held 4.8 Trillion euro in total investments[64], i.e. 46% of the total of 10.5 trillion held by EEA insurers as of 2018 Q4.

Further details on the data cleaning and composition of the sample are included in the Annex.

RE-PRICING METHODOLOGY

In the section, we describe how we evaluate and compare the change in IRS positions values before and after the shift of the level of the interest rate. In a first step, we invert the pricing formula to extract the fixed rate (this is not reported under SII) from the market value of each IRS contract reported by insurers. In a second step, we calculate the market value of each derivative contract after the shift of the level of the interest rate.

Our analysis is focused on plain vanilla IRS. This is a contract in which one party agrees to pay (receive) cash flows equal to interest at a predetermined fix rate on notional principal for a certain number of years. In return, it receives (pays) an interest at a floating rate. An IRS is worth zero at origin when it is negotiated. After some time its value may be positive or negative depending on interest rate movements and the direction of the exposure.

To calculate the market value of an IRS, several pieces of information are needed: the discounting curve, and the direction of cash flows, their size, their payment schedule.

We use the EIOPA monthly risk-free term structure of spot rates[65] as discounting curves. However, to be consistent with market valuation, the EIOPA rates are considered only up to the last liquid point, after which the curve is assumed to be flat.[66] The specific curve used depends on the contract's currency.

The type of IRS contract determines which of the two parties is the fixed-rate payer (and floating rate receiver), i.e. the side in the swap. In principle, if an insurer is a floating rate payer and fixed rate receiver (i.e. "receives fix") it, uses the IRS to extend the duration of the assets, most likely to closer match the duration of the liabilities (i.e. to hedge the interest rate exposure on the liabilities side). Differently, if an insurer is a fixed rate payer and floating rate receiver (i.e. "pay fix") it, uses the IRS to hedge the interest rate exposure on the asset side.

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63 To classify companies according to their size we rank of all companies in the QRT data according to their total assets. We denote as large companies, those that have total assets above EUR 1.6 billion, and very large those above EUR 8 billion in total assets.

64 Rather than "total assets", in the insurance context "total investments" is typically a figure widely used. For example, it is used as the denominator for calculating statistics such as the split of investments. In Q4-2018 total assets is 11.2 Trillion EUR, while total investment is 10.5; these two figures are very close.

65 We use the *EIOPA monthly risk-free term structure of spot rates* without Volatility Adjustment (VA) and with the Credit Risk Adjustment (CRA) added back.

66 This is different from the approach used for the calculation of capital requirements under SII regulation, in which case the curve converges to the ultimate forward rate defined in the SII regulation after the last liquid point.

The size of cash flows depends on three variables: the fixed and floating rates, and the notional amount. The fixed rate is not reported under SII. We obtain it by inverting formula that equates the market value (SII value) of the IRS observed in the derivatives template (S.08.01) at the reporting date. If its value is outside a tolerance level (-5 to 10%) then it is set to a default value of 2%, which is approximately the average in the sample. In line with the discounting approach we use, the floating rate is derived from the EIOPA term structure for a specific currency (amended after the last liquid point). The notional amount is available from SII reporting and is used to compute the cash flows to be exchanged at interest payment dates.

The maturity and the swap payment frequency determine the total number of cash flows and the schedule when they are exchanged. In line with common market practice, the payment frequency is assumed to be twice per year and both legs are assumed to have the same payment frequency. The maturity determines the time span over which cash flows are exchanged.

We apply the pricing methodology where the IRS is evaluated as a portfolio of forward rate agreements (FRAs). The steps are the following: a) calculate the present value of the cash flows of the fixed leg, b) calculate the present value of the cash flows of the floating leg and finally c) obtain the value of the IRS as the difference of the two legs. The implementation of the pricing formula in our paper is a simplification of most widely used formulas.[67] First, it allows only for parallel shifts of the risk-free rate curve. Second, our implementation uses the EIOPA's term structure to derive both the discount factor and the floating rates. These approximations would not be sufficiently accurate for trading, but our model provides a materially correct assessment of changes in market values under shifts in interest rates.

SET UP OF THE ANALYSIS

In this section, we describe how we analyse whether insurers' liquidity is sufficient to cover variation margin calls following the re-pricing of their IRS portfolio. An insurer receives a variation margin call when the market value of its IRS derivative portfolios decreases. One company may receive and send several margin calls depending on the number of counterparties and portfolios. To assess if it holds sufficient liquidity to meet such calls we make several assumptions regarding

1. the type and size of market movement;
2. which contracts contribute to the margin calls;
3. how contracts are aggregated and netted in portfolios;
4. which assets can be employed to cover such margin calls.

We consider parallel upward shifts of the reference curves. Typically, insurers set up IRS positions so to receive the fixed rate and pay floating. They are therefore likely to be more vulnerable to margin calls in the case of an increase in interest rates. In our exercise, the risk free rate curves for all currencies[68] shift simultaneously and for the same amplitude. We consider parallel shifts of 25 50, 75 and 100 basis points (bps). Historical data (see Table A2.1) show that a movement of 25bps in a day is not unprecedented; we therefore depict a 25bp increase a "one-day correction". Larger movements may be more unlikely to observe in a single day, but can represent a continued period of market tur-

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67 See for example Hull, J. Options, Futures and other derivatives (8th edition, pp 160-164)

68 Curves are identified by the currency of the contract, i.e. we assume to have only one curve for each currency.

moil over several days; we in particular focus on a movement of 75 bps, which we define as a "prolonged market turmoil".

Table A2.1. Quantile distribution of changes in 1Y EUR OIS rate during periods of 1,5 and 10 days between January 2005 and July 2018 as an example of floating rate dynamics.

1y OIS rate changes [bps]	1 day	5 days	10 days
min	-26	-48	-90
25th percentile	-1	-2	-3
median	0	0	0
75th percentile	1	2	3
max	27	35	37

Source: Bloomberg

We assume that all derivatives contracts in insurers' portfolios are collateralised by variation margins. We do not distinguish between cleared and uncleared trades for two reasons. Firstly, in Solvency II reporting it may be difficult to distinguish these two groups because of data reporting requirements and data quality issues. Secondly, for cleared contracts insurers would receive the margin call from the clearing member, with timing and modality more similar to bilateral trades.[69]

We consider the two extreme cases of no and full netting. Variation margins are computed on a portfolio basis and positive and negative contributions within a portfolio offset. A pair of counterparties may have several portfolios (also referred to as netting sets), but usually contracts of a certain type (e.g. interest rate derivatives) in the same currency are grouped together in one portfolio. The information on the composition of the netting sets is however not available in Solvency II reporting. Therefore, we opt for the two extreme cases. On the one hand, the *full netting* configuration represents an insurer trading only one type of contract with one counterpart. This is realistic as many insurers engage with only few counterparties and they typically choose few types of highly standardised contracts. The *no netting* configuration, on the other hand, represents an insurer, which has a range of portfolios with several counterparties and, therefore, margins cannot offset. While this is somewhat less realistic assumption from the perspective of the number of counterparties, this configuration could be relevant in case of intra-day or overnight variation margin calls, when the timing of a margin payment and margin reception may differ. In our analysis, we present results as a range between these two extreme configurations.

We employ cash, bond and money market fund shares holdings to define the available liquidity (see Table A2.2). Cash is the preferred asset to cover variation margin calls, primarily because it can be transferred between counterparts very quickly. One approach is to consider the entire cash available. Another is to consider only a part of the cash available. This second case is intended to cover the situations when other instruments – not included in our analysis – would also generate margin calls. For instance, interest rate shocks tend to be accompanied by FX shocks, which may generate additional margin calls on FX derivatives, the second most prominent derivative class in insurers' portfolios. Highly liquid bonds can be accepted to cover variation margin calls under a wide range of bilateral agreements, even though they may be less preferred than cash by the receiving counterpart. Furthermore, insurers can use such bonds as collateral in repurchase agreement transactions (REPOs) or they may liquidate them to obtain cash to cover margin

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69   For more detail on the clearing configurations for EEA insurers see the forthcoming ESRB publications.

calls (see cash and bond positions). Finally, insurers tend to invest in other highly liquid instruments such as money market funds, which can be quickly redeemed. Therefore, our broadest definition of liquidity considers also these instruments (last column in the table). Also, equity is very often a liquid asset, but we do not consider it in our analysis as it is generally not used as a collateral in derivatives transactions.

Table A2.2: Liquid assets

Instrument	Cash positions		Cash and bonds positions		Cash, gov. bonds and MMF shares position	Cash, gov. and corp. bonds and MMF shares position
	narrow cash	broad cash	cash & AAA bonds	cash & AAA/ AA bonds		
Cash and cash equivalents	Rescaled	X	X	X	X	X
AAA-rated gov. bonds			X	X	X	X
AA-rated gov. bonds				X	X	X
Money market funds (MMF) shares					X	X
AAA-AA corporate bonds						X
median [€ mln]	35	106	347	668	946	1,489
average [€ mln]	124	297	1,148	3,541	4,357	5,925
total [€ mln]	21,084	50,469	195,226	601,979	740,634	1,007,222

Source: Solvency II QRT
Reference date: Q4 2018
Notes: Every column indicates the instruments included in the liquidity position of the corresponding test. Cash and equivalents refers to the sum of two categories, namely coin and notes (CIC71) and cash equivalents and transferable deposits (CIC72). In first narrow cash position, we rescale the amount from Cash to the share of IRS in the derivatives portfolio following BoE FSR. For government and corporate bonds with rating AAA (CQS0) and AA (CQS1) we exclude encumbered securities and in the case of 100bps and 75 bps increases we apply a haircut of 10% and 7%, respectively, assuming portfolios have weighted average duration of approximately 10 years. Money market funds shares are estimated from the list of collective investments (CIC43). A tick (x) indicates that the instrument has included in the position.

RESULTS

In this section, we present our results on the impact of margin calls on insurers' liquidity. We show several estimates that take into account the different assumptions we presented in the previous section regarding netting, definitions of liquidity and interest rate shifts. Once we estimate the margin call for each company, we check when the margin exceeds the available liquidity. Further, we calculate the shortfall as the amount of margin not covered. On aggregate, this measure helps quantifying potential spillovers to the rest of the financial system. Finally, we elaborate on the key characteristics of the companies with liquidity shortfall.

3.1. SECTOR WIDE RESULTS

Overall, we observe shortage of liquidity, regardless of the amplitude of the interest shift and the definition of liquidity. In Table 3, we show the number of companies which are short of liquidity in all specifications of the exercise from the most severe situations (upper left corner: large shift and narrow definition of liquidity) to the less severe ones (low-

er right corner: small shift and wider definition of liquidity). The netting configuration plays a substantial role: in case of no netting the number of cases of liquidity shortage increases by 30% on average across specifications.

It is particularly relevant to consider the results for cash in combination with the small interest rate shift. We have seen such rate movements in one day happening in the past and should they repeat, cash is likely to be the only instrument to cover the overnight margin calls.

More specifically, we find that cash is not sufficient to cover margin calls for 10% to 14% of insurers using IRS, even in the scenario of 25bps shift and the broad definition of cash. These percentages reach up to 18% to 31% in the 100bps increase scenario, and triples on average in all scenarios when considering the narrow cash.

Most insurers can, however, cover their variation margin calls using highly liquid bonds or MMF shares. In the case of 25 bps shift the AAA-rated government bond holdings together with, only 4-2% of the undertakings cannot cover their margin calls. This figure declines to 1-0% when also AA-rated corporate bonds (MMF shares) are included in the available liquidity. When interpreting these figures it is important to bear in mind that using securities like high-rated bonds or MMF shares to cover variation margin calls is not always a viable solution. For example, one of the fastest ways of how insurers could get cash to cover variation margin calls is to use the repo market, where they could swap securities for cash. However, we found that only 21 insurers in our sample are currently borrowing cash in the repo market and, therefore, it can be difficult for other companies to access the market on a short notice and particularly so, when markets are in distress. Nonetheless, in the case of *a prolonged market turmoil over several days* (e.g. increases of 75 and 100 bps in our set-up), insurers may have enough time to liquidate the bonds and MMF shares, or successfully perform a collateral upgrade.

Table A2.3: Percentage and number of insurers short of liquidity.

Up-ward par-allel shift [bps]	Cash positions				Cash and bonds positions				Cash, bonds and MMF shares positions		Cash, gov and corporate bonds and MMF shares positions	
	Cash available for IRS		Cash		Cash and AAA bonds		Cash and AAA/ AA bonds					
	No net	Net	No net	Net	No net	Net	No net	Net	No net	Net	No net	Net
100	40%	30%	24%	18%	6%	4%	4%	3%	2%	1%	2%	1%
	68	51	40	31	11	7	6	5	3	2	3	2
75	35%	25%	22%	17%	5%	4%	2%	2%	2%	1%	1%	0%
	60	42	37	29	9	7	4	4	3	2	2	0
50	29%	21%	18%	15%	5%	4%	2%	2%	1%	1%	0%	0%
	50	36	31	26	9	7	4	4	2	2	0	0
25	24%	17%	14%	10%	4%	2%	2%	2%	1%	1%	0%	0%
	40	28	24	17	6	3	4	3	2	2	0	0

Source: Solvency II QRT, Authors' calculations
Reference date: Q4 2018

Considering all test set-ups, the estimated liquidity shortfalls implied by the variation margins calls range between EUR 1bn to almost EUR 90bn (see Table A2.4). These estimates are sizeable compared to the overall Solvency II value of plain vanilla interest rate swaps held by the companies in our analysis sample, which totalled EUR 22.5bn. By the same token, they are sizeable compared to the initial available liquidity of these companies (EUR 21bn – EUR 740bn depending of the definition of liquidity) and also to their average open positions in the repo market (EUR 50bn of cash borrowing and EUR 15bn of cash lending on average during 2018). On the other hand, the figures are small compared to the overall size of total investment of the companies in our sample, which stands at around EUR 4.8 trillion.

Table A2.4: Total liquidity shortfall (EUR billion)

| Up-ward par-allel shift [bps] | Variation Margin | | Cash positions | | | | Cash and bonds positions | | | | Cash, bonds and MMF shares positions | | Cash, gov and corporate bonds and MMF shares positions | |
| | | | Cash available for IRS | | Cash | | Cash and AAA bonds | | Cash and AAA/AA bonds | | | | | |
	No net	Net	No net	Net	No net	Net	No net	Net	No net	Net	No net	Net	No net	Net
100	98.4	53.7	86.9	45.3	78.4	39.4	45.9	22.3	23.2	19.8	20.8	18.6	4.8	2.6
75	75.6	41.3	64.6	33.2	57.2	28.6	32.5	15.4	15.9	13.9	14.5	13.0	0.5	0
50	51.7	28.2	41.4	20.8	35.7	17.9	18.3	8.0	9.0	7.7	7.8	7.1	0	0
25	26.4	14.5	18.1	9.3	15.1	8.0	5.3	1.9	2.2	1.7	1.6	1.2	0	0

Source: Solvency II QRT, Authors' calculations
Reference date: Q4 2018

To narrow down this range, we focus on the increase of 25bps in combination with cash positions (and no netting), which results in a cash shortfall of EUR 15 bn. This is a large shortfall compared to the initial cash position of the companies which fall short of liquidity (EUR 5 bn, i.e. 300% of it) and also to cash positions of all companies in our analysis sample (EUR 50 bn).[70] In addition, the cash shortfall represents 1.7% of total investment of the companies experiencing capital shortfall. Since other means of transforming assets into cash such as an outright sale of securities may take several days, these companies would not be able to meet variation margin calls in cash already under the 25bps shift scenario and could become a potential source of risk in the system, with negative repercussions to their counterparties, typically banks.

Looking at larger interest rate shifts, the cash shortfalls increase significantly. This can be interpreted as the potential demand for cash by insurance companies, which spread across different markets. For instance, the shift of 75bps and 100bps under the netting assumption implies cash shortfalls in the range of EUR 28bn to EUR 45bn. Since such sizeable shifts are more likely to occur over a number of days rather than in one day, insurers may obtain cash through several channels, besides the repo market. One way, for instance, would be an outright sale of bonds, which has typically a settlement time of

70   One limitation of our study in this respect is the assumption that variation margin calls would be paid out of the cash holdings available at hand, while the insurance companies could also receive significant cash flows from premium payments and investment portfolios (e.g. coupons on bonds). We however argue that the majority of these "scheduled" payments into the company is already pre-planned for cash outflows (e.g. reinvestments of coupons in newly bought bonds) and payments to policyholders.

two days[71]. Therefore, the cash shortfalls in this case could be interpreted as the potential demand for cash from insurance companies, spread across the repo, bond, MMFs and other markets.

Looking at the results with liquidity positions broader than cash only, the short-falls decline but remain non-negligible for larger IR shifts. Specifically, we estimate liquidity shortfall of around EUR 13-22bn under the assumption of 75bps and 100bps shifts and allowing for netting. These figures are comparable to the cash short-falls estimated under the smaller shift of 25bps. However, larger shifts may occur in a time span longer than one day. Therefore, the negative spillovers to other counterparties from this type of liquidity shortfall – ceteris paribus – could be more limited.

Considering other types of securities in the liquidity positions further decreases short-falls in all scenarios. For example, adding also MMF shares and AAA-AA corporate bonds to the liquidity positions, shortfalls reduce to zero in the case of the 25 bps increase; but in the 100 bps increase scenario still 3 and 2 undertakings, respectively in the no netting and netting case, fall short of liquidity. Corporate bonds add a lot to the liquidity positions, but not enough to offset the variation margin required considering the initial large exposure towards IRS.
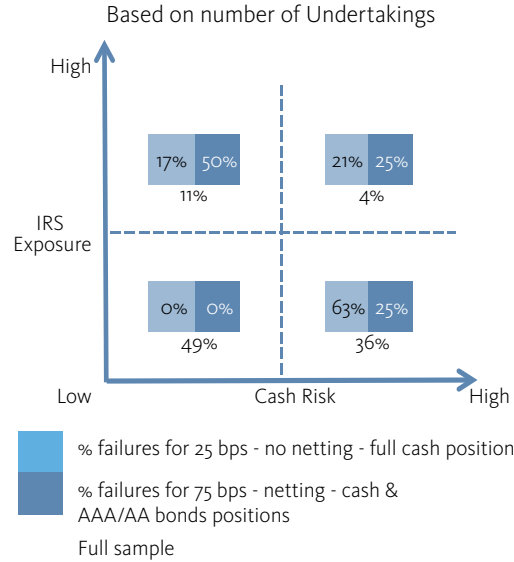
KEY CHARACTERISTICS OF THE COMPANIES FACING LIQUIDITY SHORT-FALL

Considering the results of 25bps shift in combination with the broad cash position, most liquidity shortages are due to small cash positions rather than high IRS exposure. To obtain this insight, we split companies facing liquidity short-falls in four groups based on the combination of the relative size of the IRS exposure and cash positions (labelling those with low cash as companies with high cash risk) and report their concentration in each of these groups in the light blue boxes in Figure A2.2. The results reveal that more than 80% (i.e. 21%+63%) of companies facing a liquidity shortage under this scenario are characterised by high cash risk rather than high IRS exposure, which is twice as higher frequency than in the full sample (40% = 36% + 4%)

On the other hand, three out of the four companies facing liquidity short-fall under the 75bps shift and broad liquidity definition (cash and bonds) have a relatively high IRS exposure (see dark blue boxes in Figure A2.2). This suggests that in a prolonged period of market distress associated with a more significant rate increase, the size of interest rate exposures rather than the liquidity position of a company is the main problem. In both cases, looking at the investments, the overall picture does not change.

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71   Settlement can be faster under bilateral agreements, paying higher fees to the settlement bank.

Figure A2.2: Characteristics of the companies facing liquidity short-fall: low liquidity positions or high IRS exposure?

Based on number of Undertakings

% failures for 25 bps - no netting - full cash position

% failures for 75 bps - netting - cash &
AAA/AA bonds positions

Full sample

Source: Solvency II QRT, Authors' calculations
Reference date: Q4 2018
Notes: Companies with high (low) "cash risk" are those with less (more) than 1% of cash out of total investments. Companies with high (low) IRS exposure are those for which the IRS notional amount over total investment is higher (lower) than 50%.

Companies facing liquidity short-fall are either large (25%) or very large (75%), (inner circles in Figure A2.3). These companies are also over-represented in the original sample with similar proportions. We do not observe liquidity shortages among medium size companies which represent 6% of the full sample. Figure A2.3 also shows that most of them are life companies, 75% in the 25bps scenario (middle circle) and 100% in the 75 bps scenario, even though life insurers represent 50% of the full sample. The percentage of non-life companies facing short-falls with 25 bps increase mirrors that in the full sample (around 21%), while a very low percentage (4% form 26% in the full sample) are composites.

Figure A2.3: Characteristics of the companies facing liquidity short-fall: size and type of business

X-tra large   Large
Medium   Small

Life   Non-life
Composites   Reinsurance
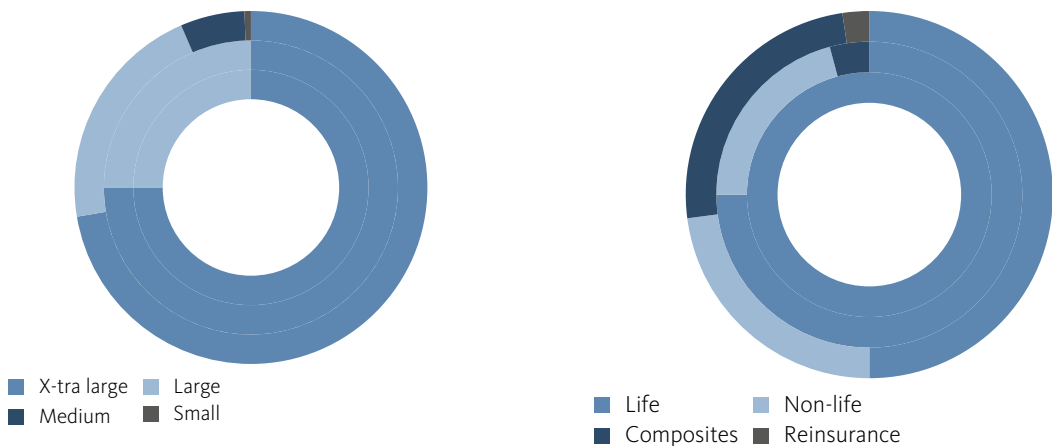
Source: Solvency II QRT, Authors' calculations
Reference date: Q4 2018
Notes: Outer circle: full sample, middle circle: less severe scenario (25 bps up, cash, no netting), Inner circle: prolonged market turmoil (75 bps up, cash and AAA/AA bond, netting).

As a final remark, we note that country concentration of companies facing liquidity short-fall may pose financial stability concerns. Twenty-two (out of twenty-four) undertakings facing liquidity short-fall in the 25bps shift scenario are concentrated in a limited number of countries. We find that the total investment of the companies facing liquidity short-fall amounts to EUR 888bn, which is 35% of EUR 2,546bn, i.e. the total investment of all the insurers in those countries. For the individual countries, this figure ranges between 6% and 64%.

CONCLUSIONS

(Re)insurers have long term liabilities with typically stable liquidity needs. Therefore, (re)insurers can act as shock absorbers under normal market conditions. Margin requirements however introduce a change in the short term behaviour of (re)insurers which can impact the functioning of financial markets, by for example reducing the shock-absorption capacity of (re)insurers' portfolios in a crisis.

Margining practices for (re)insurer's derivative portfolios may have second-round effects on financial stability, via the following channels:

a) Repo markets. To cover the margin calls, some (re)insurers may have to rely on funding through repo markets. Banks' ability or willingness to provide liquidity via repos can be limited, for instance around year end or in stressed market conditions.

b) Fire sales. The need to meet variation margin calls quickly could lead (re)insurers to liquidate assets. Depending on market conditions, this could in turn affect other investors by moving prices and hence form a feedback loop reinforcing the price fall.

c) Money market funds (MMFs). If (re)insurers collectively withdraw their investments from MMF to cover margin calls, they could liquidity knock-on effect on other sectors.

Considering future research, the analysis could be further extended in a number of ways. Firstly, other derivatives classes, in particular FX, could be also considered. Next, netting between the VM payable and receivable could be considered per counterparty. Finally, it would be worthwhile to repeat the exercise at a later stage e.g. when a significant share of the grandfathered legacy transactions have also become subject to the margining requirements.

Our results suggest that there may be a potential liquidity risk stemming from the use of derivatives and in particular IRS activities by (re)insurers. The risk is driven by two factors: i) high IRS exposure and ii) high cash risk (i.e. insufficient holdings of cash and liquid assets). About 10% of all (re)insurers in the EU use IRS; typically large insurers and life insurers. The analysis concludes that some insurers have not yet adapted their asset allocation to the (new) requirements coming from the use of derivatives and the margining practices, which have been phased in recently.

The results can be used to inform policy makers. This will become particularly relevant in the near future – once the margining requirements become fully applicable to the entire portfolio of insurers derivatives transactions[72].

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72   The margining requirements only apply to new trades concluded after the applicable phasing in deadlines. It will therefore take time before new trades replace all the legacy trades which are not covered by the requirements.

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ANNEX

DESCRIPTION OF SII DATASET

The following are the data used in the analysis:

The IRS contract information [**Maturity date, notional amount, SII market value, currency and transaction type**: FL-FX, FX-FL,] is taken from the template "Open derivatives" (S.08.01). This template contains an item-by-item list of derivatives held directly by the undertaking (i.e. not on a look-through basis), classifiable as asset categories A to F in the Regulation[73]. This template is made of two tables: one with information on the position held and the other with information at the derivative level. In SII QRTs, interest rate swap contracts are categorised with CIC D1.

Information to determine insurers' liquid assets such as [monetary amounts of **AAA and AA government and corporate bonds (unencumbered), money market funds and cash**] is take from the template "List of assets" (S.06.02). This template contains an item-by-item list of assets held directly by the undertaking (i.e. not on a look-through basis). The asset categories referred to in this template

are the ones defined in Annex IV – Assets Categories of the SII Regulation and references to CIC codes refer to Annex V – CIC table. This template is made of two tables. One with information on the position held and the other with information at the asset level.

Information on insurers **repo activity** is taken from the template "Security lending and repos" (S.10.01). This template contains an item-by-item list of securities lending transactions and repurchase agreements (buyer and seller) contracts, held directly by the undertaking (i.e. not on a look-through basis), which includes also the liquidity swaps referred to in article 309 (2)(f) of the Delegated Regulation (EU) 2015/35. The information has to include all contracts in the reporting period regardless of whether they were open or closed at the reporting date. For contracts that are part of a roll-over strategy, where they substantially are the same transaction, only open positions are reported. A repurchase agreement (repo) is defined as the sale of securities together with an agreement for the seller to buy back the securities at a later date.

Other information such as **type of company** (i.e. Life, Non Life, Composites and Reinsurance) and **country location** is taken from the template "Basic information" (S.01.02) and insurers **Total Assets** from the Balance sheet (S.02.01) template.

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73   The asset and derivatives categories referred to in this template are the ones defined in Annex IV – Assets Categories of the SII Regulation and references to CIC codes refer to Annex V – CIC table of the SII Regulation. COMMISSION IMPLEMENTING REGULATION (EU) 2015/2450 of 2 December 2015 laying down implementing technical standards with regard to the templates for the submission of information to the supervisory authorities according to Directive 2009/138/EC of the European Parliament and of the Council Amended by: Official Journal No page date ▶M3 Commission Implementing Regulation (EU) 2018/1844 of 23 November 2018, No L 299,Page 5 and Date 26.11.2018 https://eur-lex. europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX-:02015R2450-20181216&from=EN

PREPARATION OF THE DATA

This section describes the steps taken to arrive from raw data as described in the previous section to a clean dataset.

Since the start of the data collection in 2016, various automatic data validation and quality checks have been implemented into the EIOPA Central Repository. Over time, the overall data quality has been increasing steadily. Nevertheless, we have encountered a number of data quality issues which made us exclude a number of observations. Further details are described below.

We perform data cleaning at two levels: first, at the level of individual contracts and second, at the level of companies. With regard to the tests on individual contracts, we focus on those entries that are key for the later calculations of the variation margins. These are: Transaction type, notional amount, solvency II value, currency and maturity date. An overview of the data quality checks is outlined in Table 1 below.

Table 1: Overview of data cleaning steps

	Action	Number of contracts	Notional value (Trn EUR)
Initial dataset		43,429	1.811
Data cleaning at the level of transactions			
Transaction type: error/blank	Exclude		
Notional =< SII value	Exclude		
SII value: 0 or empty	Exclude		
Maturity date: 0 or empty	Exclude		
Notional: 0 or empty	Exclude		
Notional outside 1 – 1TRN EUR	Exclude		
Currency: not valid or empty	Exclude		
Data cleaning at the level of companies			
Credibility checks	Exclude	7,272	0.13
Other data reporting issues	Exclude		
Final dataset:		34.689	1.651

Next, we perform 'credibility checks' on the remaining transactions at company level; i.e. if more that 40% of the contracts for a company have been excluded during previous data checks, the remaining 60% of observations for this company are also dropped. In other words, the company is dropped from the final sample. If not excluded, these companies (remaining with fewer positions) would mechanically be in a position to more likely pass the test, for the reason that they have lower data quality. We prefer to exclude these undertaking from the analysis sample.

In a final step, we drop observations for further 4 companies due to inconsistencies in their SII reporting and for 11 which would not be impacted by the change in the interest rate as they have no exposure to interest rate risk; i.e. use only FL-FL IRS.

Table 2: Companies in thoe sample by size and type

Sample by size (EUR):	Number
Very large (>8 bn TA)	123
Large (>1.6 bn TA)	36
Medium (>0.2 bn)	10
Small	1
Total	170

Sample by type:	Number
Life undertakings	85
Non-Life undertakings	39
Composites	42
Reinsurance undertakings	4
Total	170

Source: EIOPA SII QRT data
Reference date: Q4 2018

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