FINANCIAL STABILITY REPORT

July 2021

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European Insurance and
Occupational Pensions Authority

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THEMATIC ARTICLE

FOREWORD BY THE VICE-CHAIRPERSON

The COVID-19 pandemic has already been a central topic of all risk discussions for over a year. Despite the progress in vaccination campaigns and decreasing trends in the number of new infections bringing some hopes, the crisis is still not over and many uncertainties remain. The initial shock to financial markets has been followed by economic recessions triggered by lockdowns, necessary to contain the pandemic. As the impact on the real economy was mitigated by extensive fiscal measures, some negative effects might be visible only when the introduced measures will phase out. Among them, increased unemployment and corporate credit downgrades might have a negative impact on both insurance and pension sectors. In case of a reversal of the currently observed decoupling between financial markets' performance and the macroeconomic environment, prices of equities, bonds and other assets could face losses. All these aspects will be analysed in the ongoing EIOPA EU-wide insurance stress test, together with an assessment of liquidity risk.

While the EU economy is still subject to high risks, the end of the crisis will allow time to analyse the lessons learned. Some have already been reflected in the Solvency II review, where EIOPA's approach focused on improving the existing regulation based on the experience during the first years of application and taking into account the changes in the current economic context. In this respect, EIOPA recommended in its opinion that supervisors should have additional powers, including a macroprudential toolkit to tackle systemic risk, such as restrictions on distributions of dividends to preserve insurers' financial position in periods of extremely adverse developments. Moreover, the ongoing crisis highlighted the critical importance of coordinated approaches among the National Competent Authorities.

It is also crucial to keep the focus on new emerging risks such as cyber and climate risk. Amid Covid-19 remote working arrangements, the cyber-attacks increased with supervisors anticipating a growing importance in the materiality of risks related to digitalisation. Moreover, the increasing prevalence of cyber security risk across sectors could boost cyber insurance demand. Such development brings both risks and opportunities for insurers. Environmental, Social and Governance (ESG) factors that increasingly shape investment decisions of insurers and pension funds and affect their underwriting, remain one of the focal points for the insurance and pension industry. EIOPA has been on the forefront of the developments in the area, also from the financial stability perspective. After the publication of a Sensitivity analysis of climate-change related transition risks in December 2020, EIOPA is exploring the impact of increased environmental risks and protection gap on the real economy also in cooperation with other EU institutions, in particular the European Central Bank. In this context, insurance has a key role to play in mitigating the impact of future natural catastrophes.

The crisis highlighted that we are better prepared due to the Solvency II regulatory framework. However, we need to continue strengthening our methodological approaches to capture also the aforementioned new emerging risks. In this respect, EIOPA launched an external research platform to leverage on the expertise and capacity of external researchers, aiming at enhancing cooperation with academia.

In line with its mandate, EIOPA will continue to facilitate discussion and cooperation with all stakeholders and contribute to safeguarding the financial stability of insurance and IORPs sectors.

Peter Braumüller

EXECUTIVE SUMMARY

After more than one year since the outbreak of the Covid-19 pandemic, the **macroeconomic environment** is still under strains and the uncertainty about the recovery remains high. The European economy reverted to growth in the third quarter of 2020, but turned negative towards the end of the year, reflecting the new round of lockdowns. Inflation is now recovering, and could be further boosted by increased demand once the containment measures end. In this context, expectations for 2021 point to growth for the European economy, but an asymmetric recovery across countries could exacerbate vulnerabilities in the aftermath of pandemic. The prompt execution of vaccination campaigns and the evolution of the virus remain crucial for these expectations to materialise.

The unexpected Covid-19 virus outbreak posed challenges to the insurance and IORPs sectors, in particular to the life insurance business and Defined Benefit occupational pension schemes that were already facing difficulty because of prolonged period of low interest rates.

The European **insurance sector** entered year 2020 in good conditions. Throughout 2020, gross written premiums declined in the life business, while they increased for the non-life business. **Investment profitability** deteriorated mainly due to the negative developments of the financial markets in the first half of the year. At the same time, **underwriting profitability** was heterogeneous between the lines of business. The number of claims decreased for workers' compensation and transport related lines of business as a consequence of the lockdown measures and restrictions on travelling. Instead, claims increased for fire and other damage to property and general liability insurance. Solvency ratios for non-life and composite undertakings remained solid throughout the year, while the capital positions for life insurers deteriorated in the first half of 2020 and then recovered slightly at the end of the year. Lapse rates on life policies continued to increase in 2020. In addition, insurers' liquid asset ratios slightly decreased, but the impact on insurers' disposable liquidity remains limited.

The **reinsurance sector** was exposed to unprecedented uncertainty. In addition, 2020 has been a year characterized by high worldwide catastrophe activity. Against this background, the sector shows signs of deterioration with a reduction of gross written premiums for life reinsurance and a worsening of underwriting profitability for non-life business. Capital positions of reinsurers decreased in the first half of 2020, but then partially recovered at the end of the year. Looking ahead, the higher expected frequency and severity of natural disasters combined with a potential reduction in reinsurance coverage, aimed at reducing potential unknown losses arising from the pandemic, could lead to negative implications in the EU market, ultimately affecting the insurance protection gap.

Following the development of one comprehensive reporting framework for **Institutions for Occupational Retirement Provisions** (IORPs), which information requirements are aligned with other European and international reporting standards, EIOPA is now in a position to enhance its assessment of exposures and financial situation of the European IORP sector. Despite the markedly decreasing and recovering market values of assets in 2020, the DB IORPs' cover ratios remained stable at around 100% throughout 2020.

There is a stabilising effect of reinsurance, considering losses of IORPs' investments observed in the first half of 2020. This is evident in countries where reinsurance is used to a significant extent.

Climate risk remains one of the focal points for the insurance and pension industry, with Environmental, Social and Governance (ESG) factors increasingly shaping investment decisions of insurers and pension funds but also affecting the underwriting of the latter. As natural disaster incurred losses in 2020 are significantly higher than in the previous year, 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.

Amid Covid-19 remote working arrangements, cyber-attacks have increased. Supervisors expect a rise in the materiality of **risks related to digitalisation** over the next year. The increasing prevalence of cyber security risk across sectors could boost cyber insurance demand.

When looking at the investment portfolio of insurers there is a slight shift from corporate to government bonds compared to the last year. Also, the share of listed equity slightly decreased while the share of unlisted equity increased. All these changes capture both changes in prices and changes in quantities. During the last year, there have been strong market movements. In particular, for equity prices there was a sharp drop in the first quarter with a recovery over the course of 2020. Moreover, investment exposures towards those sectors that might experience only slow or no recovery in the post Covid-19 period need to be monitored. However, the conducted analysis suggest that such exposures have been very low so far.

One of the key risk transmission channel might be the **interconnectedness between European insurers and IORPs with the banking sector** as banks are exposed to the expected increased in nonperforming loans after the introduced fiscal COVID-19 related measures will be phasing out. In this respect, the exposures to both sectors are significant and need to be considered. However, in this regard, the results of the conducted analysis might point out a de-risking trend reducing insurers' exposures to banks.

A further analysis of **insurers' trading activity** shows that in Q1 and Q2 of 2020 insurers increased the net buying of bonds issued by non-banks, probably in relation to a global issuing cycle. On the contrary, insurers' net purchases of government bonds in the first half of 2020 were lower than the historical average. The trends reverts in the second half of 2020, when insurer shifted from corporate to government bonds. Results also show that insurers tend to sell downgraded bonds both before as well as during the pandemic, in particular BBB-rated bonds, which then became BB, the so-called fallen angels; BBB is the threshold of the investment grade category. Insurers appear to be sensitive to visible thresholds in ratings, probably due to investment mandates, and are willing to reduce risks by selectively selling bonds. In any case, the magnitude of the observed selling of downgraded corporate bonds remains largely contained without evidence suggesting significant pro-cyclical effects triggered by insurers' response to the crisis.

Finally, the conducted sensitivity analysis of **climate-change related transition risks** for the European insurance sector suggests that the equity investments might be quite sensitive to this risk potential losing more than quarter of their values. The impact on bonds are lower, reflecting the fact that profitability declines are likely to impact equity prices first. However, in terms of overall impact, the insurance sector also stands to potentially gain from the transition through investments in renewable power generation.

The report consists of two parts – the standard part and the thematic article section. The standard part is structured as in previous versions of the EIOPA Financial Stability Report. The first chapter discusses the macro environment and the key risks identified for the insurance and occupational pension fund sector. The second, third and fourth chapter elaborate on these risks covering all sectors (insurance, reinsurance and IORPs). The fifth chapter provides a more in-depth qualitative and quantitative assessment of the risks identified. Finally, there are two thematic articles provided in this report. The first one empirically assess the impact of EU-wide insurance stress tests on equity prices and systemic risk. The second one investigates the interplay between climate change and insurance coverage.

PART I

1. KEY DEVELOPMENTS

The European macroeconomic conditions have improved since the first hit of the Covid-19 pandemic, but the scars from the ongoing crisis elevate the uncertainties. The policy measures taken and the stimulus injected in the economy by central banks were and remain pivotal to contain the impact of the pandemic and facilitate the recovery.

The European economy is shown to revert to growth in the third quarter of 2020, but turned negative in the close of the year reflecting the new round of lockdowns. European inflation is recovering, and could be further boosted, due to increased demand once the containment measures shift. In this context, for the 2021, the expectations point to growth for the European economy, but the potential of asymmetric recovery across countries could exacerbate vulnerabilities in the aftermath of pandemic. In fact, the evolution of the virus and of the vaccination campaigns remain crucial for these expectations to materialise. In this context, fixed income and equity markets have recovered to a significant extent since last year. Amid strengthening in the equity market, yields increased whereas credit spreads decreased from the highs of last year, both in sovereigns and in corporate bonds. Nevertheless, the low interest rate environment was and remains the main economic narrative.

The macro and market environment remains challenging for the insurers. The swap curve remains in negative territory for significant number of tenors keeping the market value of liabilities elevated. Bond and equity markets recovered, however, the risk of an abrupt correction remains material. From a profitability perspective, operating results of insurers could potentially be stressed. The writing of new business might increase following the expected growth in 2021 GDP. However, after the containment measures, some lines of business which turned profitable during Covid-19, e.g. motor insurance, would revert to pre-pandemic loss ratios and for other lines of business the Covid-19 related losses might unwind more adversely than expected. Investment yields remain ultra-low, exacerbating reinvestment risks and pushing investment margin lower. Finally, an increase in premium rates might help insurers mitigating these downside pressures on profitability. However this increase could result on an overall widening of the protection gap, through lower demand.

The new development of one comprehensive reporting framework for the European Institutions for Occupational Retirement Provisions (IORPs) allows EIOPA to enhance its assessment of exposures and financial situation. Following the improvement of the markets throughout 2020 after the shock in the first quarter, IORPs showed a recovery, illustrated by an increase in total assets. Also, the total assets covering the total liabilities, remained broadly stable at around 100% throughout the year. As investment allocations and strategies of IORPs in Europe are quite diverse, the impacts of the repricing of equities, corporate and sovereign bonds on the IORPs are equally diverse.

Climate risk remains one of the focal points for the insurance and pension industry, with Environmental, Social and Governance (ESG) factors increasingly shaping investment decisions of insurers and pension funds but also affecting the underwriting of the latter. As the world natural disaster balance for 2020 showed losses much higher than in the previous year, the extreme weather events may put significant pressure on non-life insurers especially if they become more frequent and severe due to climate change. In its efforts to address the impact of climate related risks, the EU is proposing to cut net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. Furthermore, in order to address the protection gap issue, monitoring and promoting the insurance penetration rates in Member States is one of the actions proposed by the European Commission.

Amid Covid-19 remote working arrangements, the cyber-attacks increased with supervisors anticipating an increase in the materiality risks related to digitalisation over the next year. The increasing prevalence of cyber security risk across sectors could boost cyber insurance demand. To support the digital transformation of finance in Europe in the coming years while regulating its risks, the European Commission adopted in September 2020 a digital finance strategy. As part of the digital finance strategy, the Commission issued a proposal for a Digital Operational Resilience Act. In order to promote an increase of the operational resilience of the digital operations of insurance and reinsurance undertakings in Europe, EIOPA published Guidelines on ICT Security and Governance in October 2020. EIOPA also established a temporary work stream

involving national supervisory authorities to work on the Covid-19 consequences for cyber operational resilience.

1.1. MACRO AND MARKET RISKS

European macroeconomic conditions have improved since last year, supported by the approval and roll-out of vaccinations and the policies implemented. Real GDP increased in the third quarter of 2020, recovering part of the significant decrease during the first half of 2020. However, the year for the European economy closed with negative growth, due to the containment measures taken to fight the surge in infections and the variants of the coronavirus (Figure 1.1). This downside risk remains relevant for the beginning of 2021, although the economic sentiment indicator recovered to 100 during March. On the upside, the continuing vaccinations, the policy support and the fiscal stimulus is expected to support the recovery for 2021. In this context, the GDP for EA is expected to grow by 3.8% for 2021 and 2022 (and by 3.7% and 3.9% for EU, respectively), based on European Commission winter 2021 forecast whereas, by 4.4.% and 3.8%, respectively based on IMF world economic outlook.[1] However, the speed of this recovery might differ across jurisdictions. In fact, countries significantly exposed to sectors affected the most by the pandemic might potentially experience lower speed in this recovery. This asymmetric recovery could potentially raise concerns regarding the after-pandemic European economy.

The unemployment rates were overall contained by the various policies implemented and the job retention schemes. In fact, for some countries the unemployment rate decreased during the second half of 2020 (Figure 1.2). Unemployment for EA is expected to be at 8.7% and 8.5% for 2021 and 2022.[2]

Inflation reverted for the European economy, with medium-to-long term inflation expectations pointing to relatively contained levels. However, an increase in inflation expectations could increase yields, as it is indicated by the US developments. Inflation rates (HICP rates) increased during the last months (Figure 1.3), driven by energy as well as the other components (Figure 1.4). The expected inflation for EA is 1.4% and 1.3% for 2021 and 2022 (and 1.5% for both years for EU).[3] On the post-pandemic period, the potential recovery in demand could increase inflation in the medium term, although it is still to be clarified whether this would be a cyclical or structural effect. However, the 5y5y inflation swap (measuring the average inflation over the five-year period starting five years from now) has increased slightly, but remains overall contained (Figure 1.3).

The yields of sovereign bonds increased. This recent increasing trend (Figure 1.5) could be potentially related to the increased inflation expectations but also to a tilt in preference towards the equity market. In fact, credit spreads decreased significantly and stand at levels comparable to the beginning of 2018 (Figure 1.6).

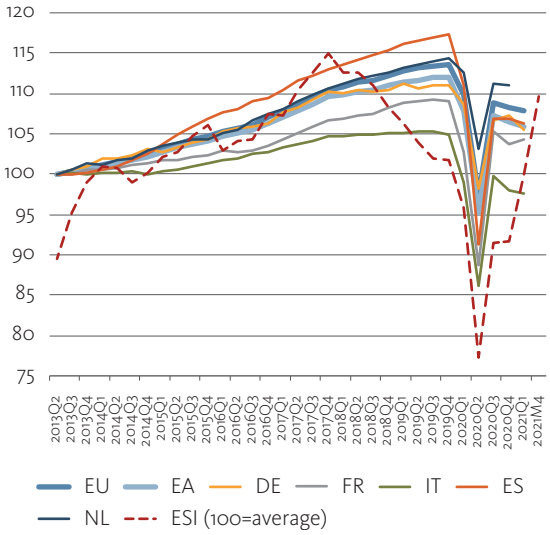
The low interest rate environment remains the dominant narrative. The government bond yields remain negative for a significant number of countries and maturities (Table 1.1). The swap curve steepened during the last months, but it is still kept in the negative territory for a significant number of tenors (Figure 1.7). The steepening could be associated to positive long-term view on the economic recovery after the pandemic.

1 European Commission Winter 2021 (interim) forecast and IMF world economic outlook April 2021.

2 IMF world economic outlook April 2021.

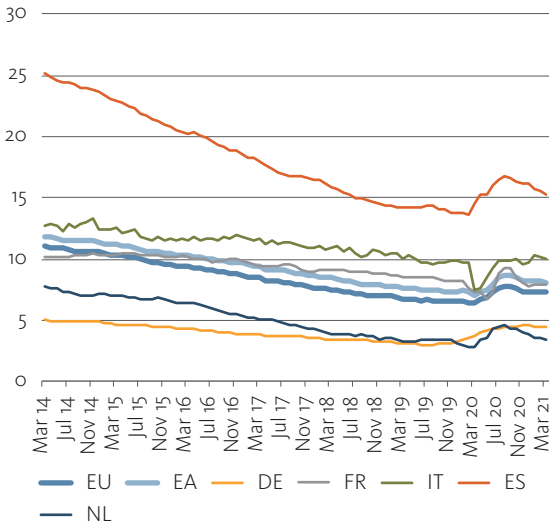
3 European Commission Winter 2021 (interim) forecast.

Figure 1.1: Real GDP growth, by country (2013Q2=100)



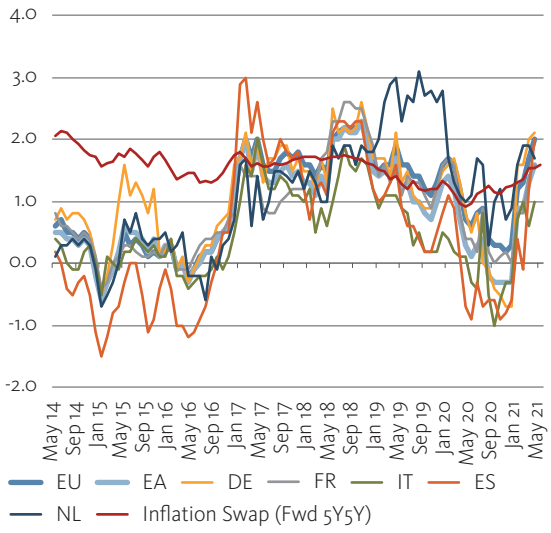
Source: ECB, Eurostat and European Commission.
Last observation: Q1 2021 for GDP (for NL Q4 2020) and April 2021 for the economic sentiment indicator (ESI). Note: For GDP, EU and EA time series refer to fixed composition, with EU referring to EU 27.

Figure 1.2: Unemployment rates (% of active population)



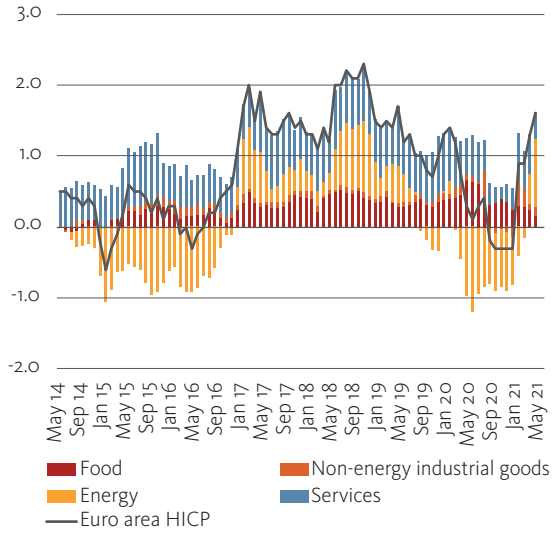
Last observation: March 2021. Note: EU and EA time series refer to 27 countries (from 2020) and 19 countries (from 2015).

Figure 1.3: Inflation rate (HICP rates), by country (in %)



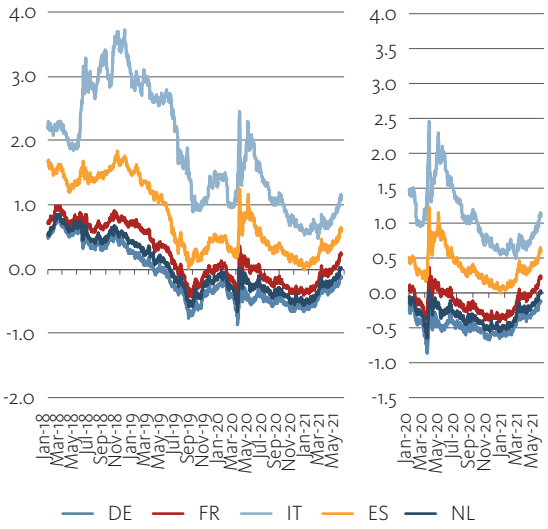
Source: ECB, Eurostat and Bloomberg.
Last observation: April 2021 for inflation rates and 20 May 2021 for the inflation swap. Note: EU and EA refer both to changing composition.

Figure 1.4: HICP main components (annual % changes)



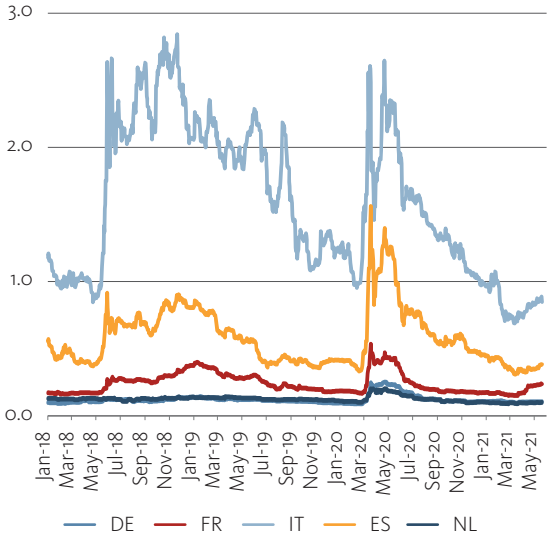
Source: ECB, Eurostat.
Last observation: April 2021. Note: EA refers to changing composition.

Figure 1.5: 10-year government bond yields (in %)



Source: Refinitiv.
Last observation: 20/05/2021.

Figure 1.6: Sovereign Credit Default Swaps (in %)



Source: Refinitiv.
Last observation: 20/05/2021.

Table 1.1: Government bond yields for different maturities (in %)

		1Y	2Y	5Y	10Y	15Y	20Y
EU- euro area	Austria	-0.573	-0.625	-0.380	0.128	0.437	0.602
	Belgium	-0.663	-0.641	-0.364	0.187	0.611	0.871
	France	-0.659	-0.616	-0.323	0.220	0.574	0.797
	Germany	-0.662	-0.676	-0.517	-0.125	0.147	0.288
	Ireland	-0.606	-0.564	-0.285	0.241	0.571	0.778
	Italy	-0.411	-0.241	0.308	1.094	1.581	1.896
	Netherlands	-0.691	-0.674	-0.431	0.015	0.274	0.414
	Portugal	-0.654	-0.583	-0.163	0.527	0.992	1.287
	Spain	-0.560	-0.509	-0.107	0.593	1.067	1.369
EEA/EU-non euro area	Bulgaria	-0.215	-0.143	-0.030	0.217	-	-
	Czech Republic	0.542	0.905	1.551	1.837	2.041	2.302
	Denmark	-0.548	-0.527	-0.283	0.140	0.390	0.523
	Hungary	0.910	1.260	2.096	2.971	3.501	-
	Norway	0.272	0.559	1.113	1.568	-	-
Others	United States	0.059	0.151	0.843	1.693	2.071	2.352
	United Kingdom	0.041	0.065	0.390	0.945	1.280	1.415
	Switzerland	-0.828	-0.751	-0.503	-0.182	0.084	0.143
	Japan	-0.123	-0.134	-0.095	0.091	0.305	0.484

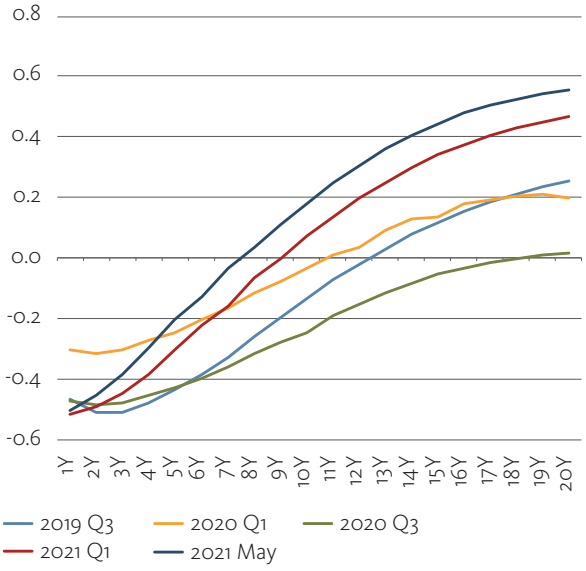
Source: Refinitiv.
Reference date: 20/05/2021.

However, an increase in interest rates above economic growth would pose risks for highly indebted countries. On the one hand, when interest rate charged on government debt remains below average economic growth, countries can manage their debt-to-GDP ratios, even without primary surpluses.[4] However, the scenario under which interest rates will be higher than economic growth could imply that countries would potentially need more than balanced budgets to sustain their debt-to-GDP ratios. Factoring in the risk of asymmetric post-pandemic recovery across countries, this development would exacerbate domestic vulnerabilities and resurface the risk of sovereign debt crises.

Euro area corporate bond yields reverted to pre-pandemic levels, with their yields increasing recently. The decrease of corporate bonds' yields has been supported by policy measures as well as by the positive risk sentiment on the vaccine developments (Figure 1.8). The recent increase could be associated with the inflation expectations but also to some downside risks. The asymmetric economic recovery exacerbates the risk of corrections and a potential discontinuation of the policy measures threaten the solvency of many corporates, which might ultimately affect the yields.

Equity markets recovered since the outbreak of the pandemic, but uncertainties remain. The US and emerging markets show a stronger recovery with the EA equity market reaching pre-pandemic levels at the end of the first quarter of 2021 (Figure 1.9). The decrease in volatilities support this recovery, although they oscillate and stand slightly higher compared to the pre-pandemic period (Figure 1.10).

Figure 1.7: Swap curves (in %)



Source: Refinitiv.
Last observation: 20/05/2021.

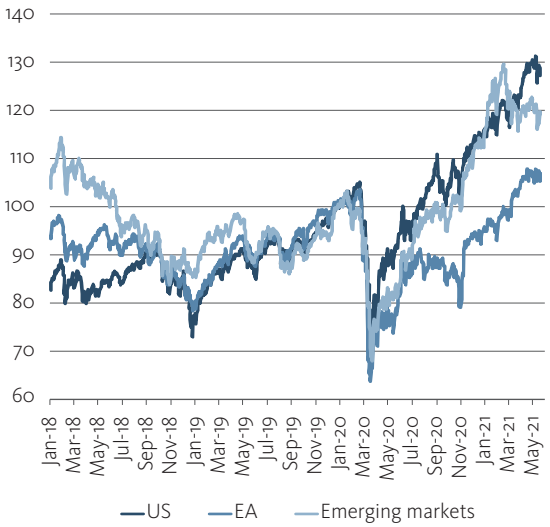
Figure 1.8: Corporate bond yields (in %)

Source: Refinitiv.
Last observation: 20/05/2021.

4 Based on the debt accumulation equation:

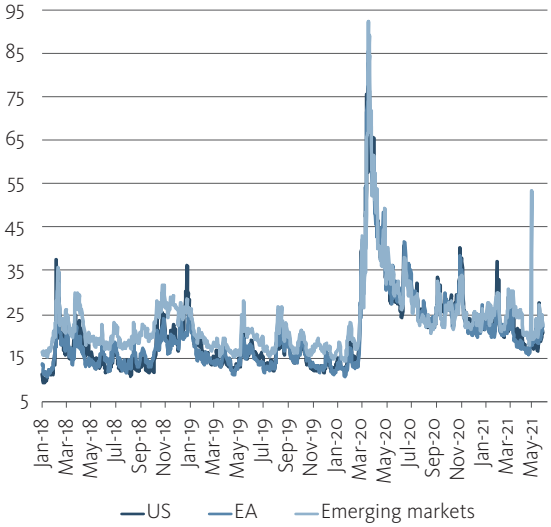
$\Delta b_t = (\frac{i_t - g_t}{g_t})*b_{t-1} - pb_t + dda_t$ where Δb_t is the gross government debt-to-GDP ratio, the $(\frac{i_t - g_t}{g_t})$ is the impact from the difference between the average nominal interest rate charged on government debt (i_t) and the nominal GDP growth rate (g_t) multiplied by the debt-to-GDP ratio in the previous period (b_{t-1}) the primary budget balance ratio (pb_t) and the deficit-debt adjustment as a share of GDP (dda_t). The formula is based on the paper "Checherita-Westphal, C. and Domingues Semeano, J., 2020. Interest rate-growth differentials on government debt: an empirical investigation for the euro area (No. 2486). ECB Working Paper.".

Figure 1.9: Equity market performance (Index: 01/01/2020=100)



Source: Refinitiv and EIOPA calculations.
Last observation: 20/05/2021.
Note: US: S&P 500 INDEX, EA: Euro Stoxx 50 Pr, Emerging markets MSCI EMERGING.

Figure 1.10: Market volatilities



Source: Refinitiv.
Last observation: 20/05/2021.
Note: US: CBOE SPX VOLATILITY INDX, EA: VSTOXX Index, Emerging markets CBOE EM ETF Volatility.

Expectations regarding the economic recovery, vaccines rollout and the continuation of policy measures are significant factors for the equity market recovery, therefore making the current equilibrium fragile in case they do not materialise. On the one hand, the narrative regarding the speed and extent of equity and financial market recovery can be associated with the stimulus provided in the economy. In fact, although the interventions do not take place directly in the equity market, yet the liquidity injected in the market could indirectly support the equity performance. On the other hand, the reaction of the equity market to the stimulus remains subdued when compared with the previous two-year levels (Figure 1.11). This could justify the perspective that the equity market recovery potentially depends significantly on an expectations equilibrium, which makes the economic environment more fragile in case they do not materialise, e.g. in case the policy measures are discontinued.

In this context, the 2020 January-to-date performance for selected markets reflects the general recovery of the majority of markets, with the SP500 showing a remarkable rebound (Figure 1.12). Notably, banks and insurers have not recovered yet.

The equity market performance of insurers improved, but still to recover the losses from Covid-19.[5] Insurer's stock performance trended upwards after the pandemic breakout, although with some corrections during the second half of 2020 that could potentially be associated to the Covid-19 impact on the outlooks during this period (Figure 1.13).

In terms of valuations, a simple indicator which compares the price-to-book (PB) ratio with the ratio of forward return on equity (RoE) to cost of equity (CoE) is provided in Figure 1.13.[6] This simple indicator can provide some intuition whether valuations (as captured by the PB ratio) are supported by the expected RoE, when reducing it by the cost of equity. It is shown that on average this valuation index keeps somewhat higher compared to pre Covid-19 period and, overall, oscillates significantly post Covid-19 shock.[7],[8]

Insurers' relative performance against the market oscillates, but insurers' equity risk premiums remain elevated relative to the market. Insurers tend to exacerbate the market movement, either down or up. In fact, fol-

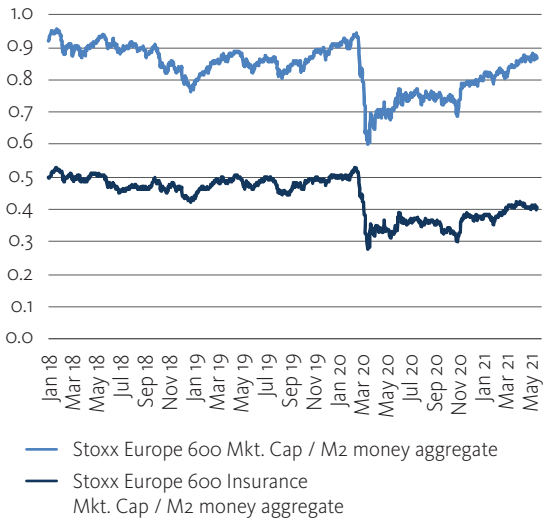
5 The index used is the Stoxx Europe 600 Insurance Index.

6 These ratios and figures refer to the index Euro Stoxx 600 Insurance.

7 The pre/post Covid-19 shock is defined by 1/03/2020.

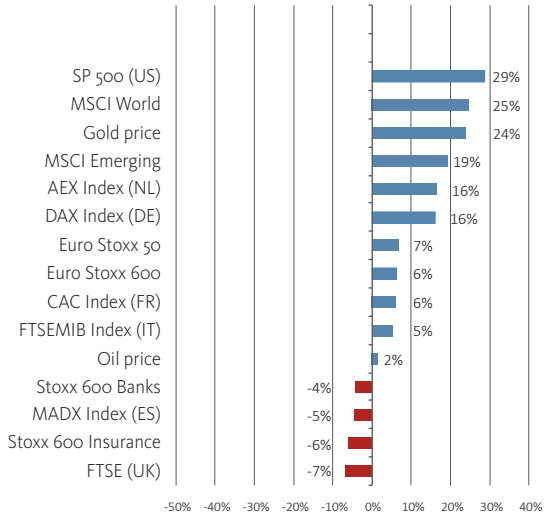
8 Looking at the valuations in terms of price-to-earnings ratios (PE), as of the 20/05/2021, the PE ratio for the Stoxx 600 Insurance index stands at around 16x (against 13x the 5-year average). The forward PE ratio is standing at around 10x, reflecting to some extent the profitability prospects for the sector. The 5-year average of forward PE ratio is around 10x and the average from 01/01/2018 is somewhat lower than 10x.

Figure 1.11: Equity performance and stimulus



Source: Refinitiv, Bloomberg and EIOPA calculations.
Last observation: 20/05/2021.

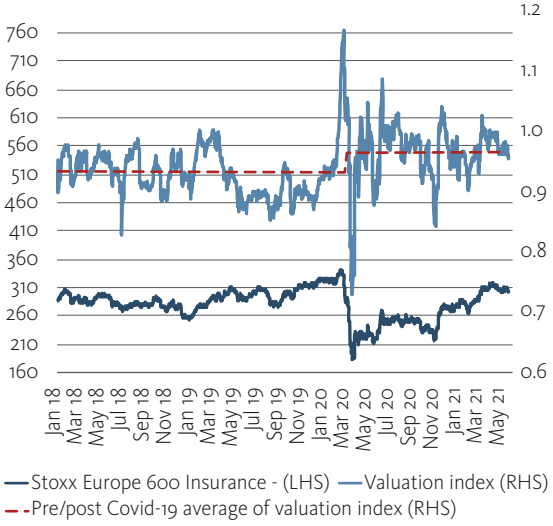
Figure 1.12: Selected market performance (2020-to-date)



Source: Refinitiv and EIOPA calculations.
Last observation: 20/05/2021.

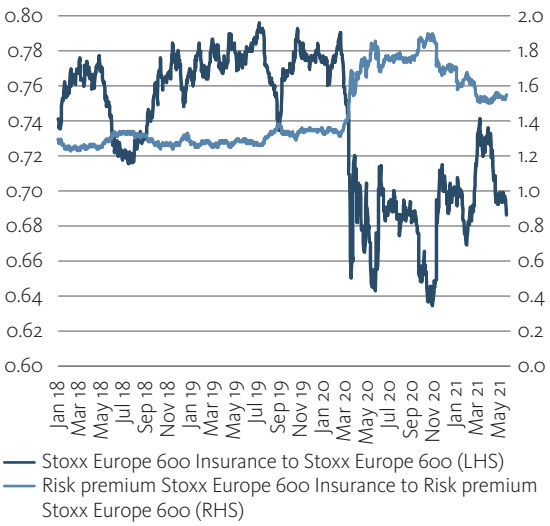
lowing November 2020 correction (Figure 1.13), the insurers have outperformed the market (on trend) (Figure 1.14) but the opposite is shown when looking from June 2020 to November 2020 (Figure 1.14), when insurers equity performance trended downwards (Figure 1.13). However, the proxy for the equity risk premium of insurers remains elevated relative to the market (Figure 1.14). Although it shows a downward trend, the fact that for the last year remains higher potentially justifies the exacerbated move of the equity prices when compared to the market.

Figure 1.13: Insurance equity market performance



Source: Refinitiv, Bloomberg and EIOPA calculations.
Last observation: 20/05/2021.
Note: The valuation proxy is based on the Stoxx Europe 600 Insurance. It is calculated as PB ratio / (Fwd. RoE / CoE). The cost of equity was proxied by the inverse of Fwd. PE ratio, after smoothing it with a 2-month average i.e. the CoE at time t in the graph is estimated as the average of the 1/Fwd. PE in the time window (t-30, t+30). Both the Fwd. RoE and the Fwd. PE are based on Bloomberg's BEst function with 2FY override period.

Figure 1.14: Insurance relative performance



Source: Refinitiv, Bloomberg and EIOPA calculations.
Last observation: 20/05/2021.
Note: The valuation proxy is based on the Stoxx Europe 600 Insurance. The risk premium was proxied based on the inverse of Fwd. PE ratio. The Fwd. PE is based on Bloomberg's BEst function with 2FY override period.

1.2. CLIMATE RISK AND SUSTAINABLE FINANCE

The world natural disaster balance for 2020 shows losses much higher than in the previous year, and also that almost two thirds of the losses in 2020 were uninsured, particularly in growing countries in Asia. The global losses from natural catastrophes and weather related events in 2020 amounted to USD 210 bn. of which approximately USD 82 bn. were insured.[9] The highest damage of the year in terms of cost was caused by the severe floods in China with overall losses amounting approximately USD 17 bn. of which only around 2% were insured. In Europe, the losses caused by natural disasters in 2020 were minor summing to USD 12 bn. with insured losses of USD 3.6 bn.

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. In fact, in 2020, the number of climate related events has already increased to 980 compared to 860 in 2019. In terms of temperature, with the period 2014-2020 as warmest years on record, 2020 is considered the second warmest year with just 0.01°C lower than the hottest year of 2016.

In its efforts to address the impact of climate related risks, the EU presented as part of the European Green Deal the 2030 Climate Target Plan in September 2020. It is proposing to cut net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels, up from the current target for 2030 of at least 40%. Among other actions as part of the European Green Deal, the EC launched in December 2020 The Climate Pact with the aim to spread scientifically sound information about climate action and support local initiatives and encourage climate action pledges by individuals or collectives. The importance that green bonds could play to finance the transition and facilitate compliance with EU's commitment is depicted in the Box below.

The insurance sector plays a significant role in closing the protection gap as insurance products could be used as risk-transfer mechanisms to absorb financial losses related to climate risks. The February 2021 communication on the EU Strategy on Adaptation to Climate Change[10] adopted by the European Commission outlines the long-term vision for the EU to become a climate-resilient society and fully adapted to the impact of climate change by 2050. In this context, one of the topics relates to the climate protection gap that appears to be broadening because of slow adaptation action and more frequent extreme weather events. Currently, only 35% of the total losses caused by extreme weather and climate-related events across Europe are insured.[11] In order to address the protection gap, monitoring and promoting the insurance penetration rates in Member States is one of the actions proposed by the European Commission.

Regarding the air pollution, the rate of emission reductions in 2019 for the EU-27 was a 4% below that of 2018, compared to 2% reduction in 2018[12]. The decrease in emissions occurred before the Covid-19 pandemic and is explained, largely, as the result of cumulative, long-term efforts towards lower emission levels across Europe. Furthermore, the lockdown measures introduced by most European countries in the COVID-19 context during spring 2020 led to significant reductions in emissions of air pollutants, particularly from road transport, aviation and international shipping. The EEA measurements[13] show that the nitrogen dioxide (NO_2) concentrations were significantly reduced in April 2020, independently of meteorological conditions with reductions exceeding 60% observed in some cases.

The consumption of energy from renewable sources (Figure 1.15) in the EU countries has been increasing in 2019 by 4.3% compared to the previous year. Considering benefits such as the reduction of the dependence on imported fuels, the reduction in gas emissions from fossil fuel sources, and the decoupling of the energy costs from oil prices, the latest available figures show that in 2019, renewable energy represented 19.7 % of energy consumed in the EU 27.

As long-term investors, insurers have the potential to contribute to the transition towards a low-carbon economy. On one side, insurers are incorporating risks in their underwriting and investment activities as part of an enhanced approach towards Environmental, Social and Governance (ESG) factors, but also invest in green assets.

The Box below provides further insights into the green bonds market in view of recent EU regulatory developments and examines potential risks for insurers and pension funds.

9 Source: Munich Re https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2021/2020-natural-disasters-balance.html

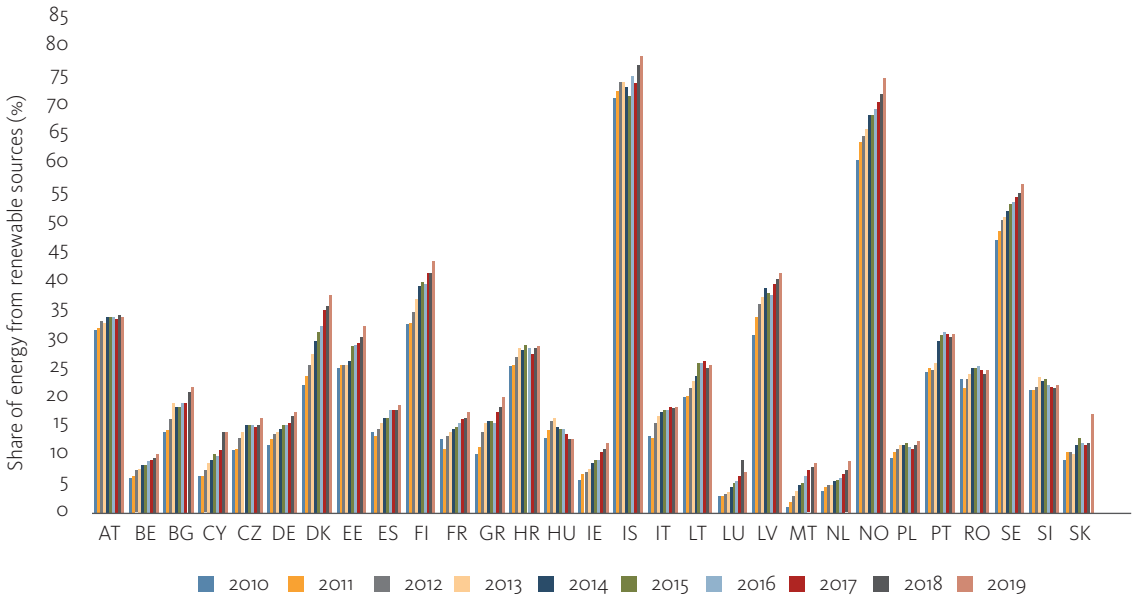
10 Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the committee of the regions empty

11 EIOPA (2019). Staff discussion paper: Protection gap for natural catastrophes.

12 Trends and projections in Europe 2020, Tracking progress towards Europe's climate and energy targets, EEA (European Environment Agency)Report, No 13/2020

13 Air quality in Europe — 2020 report, EEA (European Environment Agency)Report, No 09/2020

Figure 1.15: Share energy from renewable sources (% of gross final energy consumption)



Source: Eurostat, table nrg_ind_ren
Last observation available: 2019

BOX 1.1. GREEN BONDS

Definition and importance for achieving EU climate change commitments

Green bonds are fixed-income financial instruments whose proceeds are specifically earmarked for climate and environment-related objectives[14]. Green bonds form a sub-set of a larger category of green securitisation.

This area of finance gained prominence in the EU since 2018 with the publication of the European Commission's Action Plan: Financing Sustainable Growth[15], and a number of follow-up actions aiming to implement it in practice[16]. The most recent action in this regard is the provisional agreement between the co-legislators on the the European Climate Law in April 2021[17]. Achieving the envisaged reductions in greenhouse gas emissions will

14 See for example See Jakubik, P. and S. Uguz (2019); available at Impact of Green Bond Policies on Insurers_ Evidence from the European Equity Market - EN.pdf.

15 Further details available at Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth | European Commission (europa.eu).

16 Overview of other associated initiatives can be found here: Renewed sustainable finance strategy and implementation of the action plan on financing sustainable growth | European Commission (europa.eu)

17 The European Climate Law enshrines the EU's commitment to reaching climate neutrality by 2050 and the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels; see Provisional agreement on the European Climate Law (europa.eu).

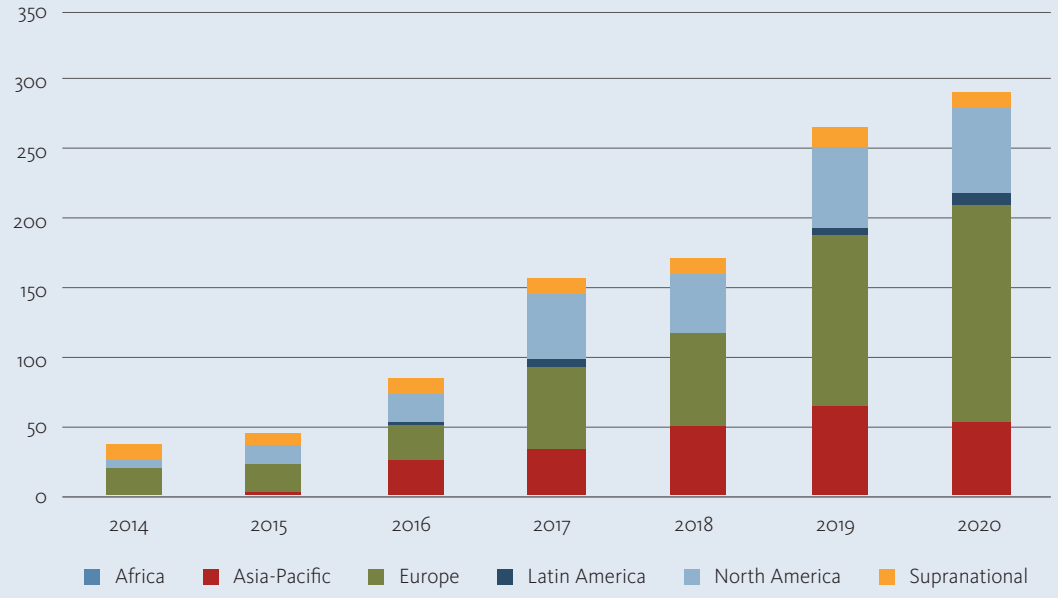
require significant investments reaching more than EUR 260 bn a year by 2030[18]. Another building block, the Sustainable Europe Investment Plan should mobilise through the EU budget and the associated instruments at least EUR 1 trillion of private and public sustainable investments over the upcoming decade[19]. Green bonds play an important role in this regard and both the EU and individual Members States envisage to become or already are important issuers of green bonds (see Figure B.1.1.).

Given that a plethora of different labels still remains[20], the Commission also aims to foster harmonisation among the standards for green bonds with its consideration for an EU Green Bond Standard[21]. This could build upon the Green Bonds Principles[22] developed by the International Capital Market Association (ICMA) which promote harmonisation and transparency; are however not binding on issuers.

Market developments and role of insurers

Although total issuance numbers in comparison to other finance instruments remain still rather low, green bonds has been a fast growing segment in recent years. Even though the Covid-19 pandemic initially subdued the issuing activity, 2020 was still the most successful year in terms of volume issued. Furthermore, there seems to be a growing demand from potential investors – including from insurers and pension funds – which was difficult to fulfil and recent issues remained heavily oversubscribed.

Figure B.1.1.1: Green bonds issuance by region (in $bn)



18 This estimate by the European Commission refers to less ambitious climate plans for 2030 of at least 40% cuts in greenhouse gas emissions (from 1990 levels). The European Climate Law foresees a cut by 55%. Please refer to COM(2020) 21 final; COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Sustainable Europe Investment Plan European Green Deal Investment Plan;https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0021&from=EN; p.1.

19 ibid

20 Examples of different labels comprise green bonds, sustainability bonds, performance-linked bonds, transition bonds, blue bonds.

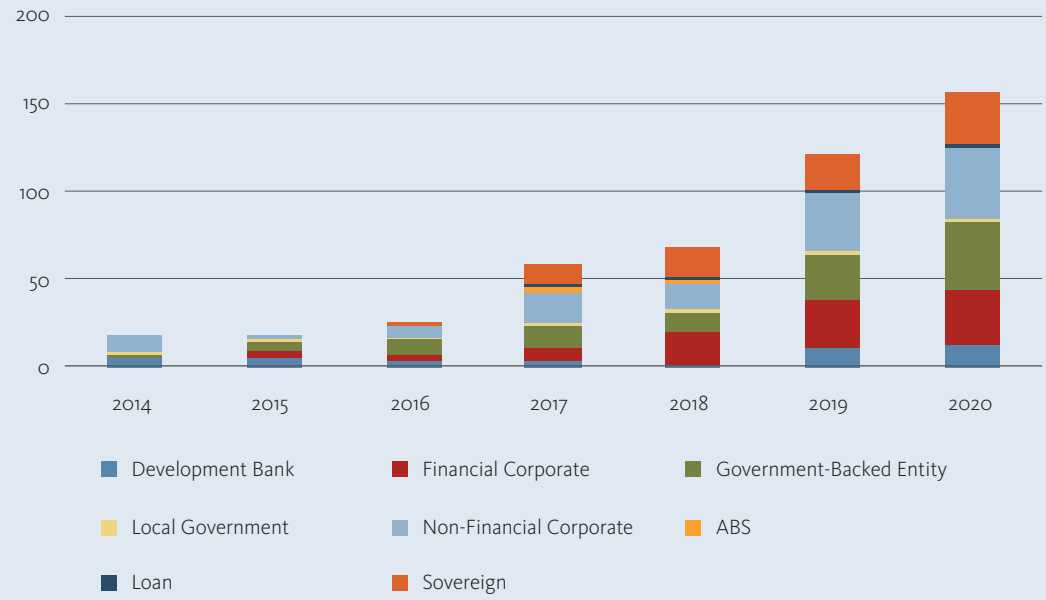
21 EU Green Bond Standard | European Commission (europa.eu)

22 These include among others the following components: (i) the use of proceeds for environmentally sustainable activities; (ii) a process for determining project eligibility; (iii) management of the proceeds in a transparent fashion that can be tracked and verified; and (iv) annual reporting on the use of proceeds.

Source: Climate Bonds Initiative

Until 2020, insurers and pension funds were interested in this market from their perspective of investors. It is estimated that EU insurers hold up to 30% of outstanding instruments[23]. This perspective however seems to be changing since 2020 was the first time when (re-)insurers started to become issuers as well[24].

Figure B.1.1.2.: Issuance by type of issuer (Europe only, in $ bn)



Source: Climate Bonds Initiative
'Financial Corporate' category includes insurance companies.

The interest from insurers and pension funds may be driven by two factors. Firstly, green bonds are expected to offer good returns. This is highly beneficial in the current low yield environment. Secondly, the market and analysts seem to have started factoring in an engagement in green projects. While research has shown a positive impact on ratings[25], reluctance to engage in green projects or lack of perseverance in pursuing own commitments can have a damaging effect on the reputation of the companies[26].

Potential risks

Despite obvious benefits for insurers and pension funds in terms of a rewarding investment opportunity and for the economy as a whole due to the possibility to mobilise funds to finance the green transition, engaging in green bonds may bear also potential risks for insurers and pension funds. These are associated in particular with various elements of the reputational risk.

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23 https://www.boersen-zeitung.de/banken-finanzen/versicherer-stossen-weiter-in-green-bonds-vor-5e1facd7-b139-4fe9-a6a2-a3956ba3a1c4?read=true.

24 https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2020/2020-09-24-munichre-issues-green-bond.html.

25 See Jakubik, P. and S. Uguz (2019); available at Impact of Green Bond Policies on Insurers_Evidence from the European Equity Market - EN.pdf.

26 See for example backlash on Danish insurer PFA; https://www.ft.com/content/88b07cc1-544b-472e-b399-b11a029046cc.

Firstly, on the issuer side, high demand in combination with lack of harmonised and binding standards may potentially give incentives to fast issuance without ensuring appropriate quality. Insurers and pension funds need to navigate with caution this complex environment when searching for a suitable investment opportunity.

Secondly, should insurers appear also more actively as issuers, the structuring of the instrument is to be carefully thought through and they need to be aware that their commitments towards reducing their own carbon footprint will be scrutinised and have strong signalling effect. For example, performance-linked bonds link the coupon to the fulfilment of pre-defined Key Perfomance Indicators (KPIs). If these are not met, the coupon would increase automatically as agreed beforehand. This mechanism however is not without dispute as some challenge it as giving incentives to "greenwashing".

Overall, the market for green bonds seems to be on a successful path towards more growth and prominence in facilitating sustainable economy. This would be greatly helped by further increasing the transparency and developing of binding standards.

1.3. CYBER RISKS AND THE INSURANCE SECTOR

The number of cyber-attacks has been on the rise and the financial sector has become a key target. The International Monetary Fund (IMF) estimates that the number of cyberattacks has tripled over the last decade, with financial services being the most affected industry due to the increased digitalisation of its business models.[27] Attackers have now access to cheaper, simple and more powerful hacking tools and the availability of mobile services for many people expands the opportunities for cyber-attacks. A successful attack on a major financial institution, or on a core system or service used by many, could spread to the entire financial system due to interconnectedness, with potential consequences in terms of business continuity, reputation and, under extreme scenarios, liquidity and financial stability.

The Covid-19 pandemic and related remote working arrangements have expanded the landscape of opportunities for cyber attackers, including within the financial sector. Covid-19 has prompted a move to working from home and an increased reliance on digital solutions, including among financial institutions. Calculations from the Bank of International Settlements (BIS) show that the financial sector ranks high both in terms of working from home and frequency of cyber events during the pandemic when compared to other sectors.[28] Furthermore, it has the largest share of Covid-19-related cyber events after the health sector, with payment firms, insurers and credit unions being most affected.

Most insurance supervisors anticipate an increase in the materiality of risks related to digitalisation over the next year. The results of the EIOPA Spring 2021 insurance bottom-up survey (BUS) among supervisors show risks related to digitalisation ranking in the fifth place in terms of materiality, after macro, market, credit and profitability and solvency risks, but still above e.g. underwriting, liquidity and ESG risks. When considering the expected developments in terms of risk materiality over the next year, risks related to digitalisation are ranked first. These results are comparable to those of the EIOPA Autumn 2020 BUS.

The new working arrangements in place during the pandemic are expected to heighten cyber security risk for insurers. Cyber security risks are considered the main driver of the developments in digitalisation risks (73% of supervisors), followed by cyber underwriting risks (19%) and InsurTech competition (8%). The Covid-19 pandemic and the associated increased reliance on digital solutions and infrastructure to conduct business and telework are perceived as having increased the vulnerability of the sector to cyber-attacks, with insurers in some jurisdictions already reporting an increasing number of malware and other cyber attempts.

27 Cyber Risk is the New Threat to Financial Stability, Elliott J. and N. Jenkinson, IMF, December 2020.

28 Covid-19 and cyber risk in the financial sector, Aldasoro I., J. Frost, L. Gambacorta and D. Whyte, BIS, January 2021.

The increasing prevalence of cyber security risk across sectors could boost cyber insurance demand[29]. Increasing demand for cyber insurance is expected to be driven by the rising frequency, severity and costs of cyber incidents but also by a tightening in data protection regulation across the world. The increased demand is expected to originate from the activity sectors more exposed to cyber security risk, such as healthcare and the financial services, but also from individuals and families.

To support the digital transformation of finance in Europe in the coming years while regulating its risks, the European Commission adopted in September 2020 a digital finance strategy.[30] This strategy identifies four main priorities: removing fragmentation in the Digital Single Market, adapting the EU regulatory framework to facilitate digital innovation, promoting a data-driven finance and addressing the challenges and risks with digital transformation, including enhancing the digital operational resilience of the financial system.

As part of the digital finance strategy, the Commission issued a proposal for a Digital Operational Resilience Act (DORA)[31], which will enhance and streamline the financial entities' conduct of Information and Communication Technology (ICT) risk management, establish a thorough testing of ICT systems, increase supervisors' awareness of cyber risks and ICT-related incidents faced by financial entities, as well as introduce powers for financial supervisors to oversee risks stemming from financial entities' dependency on ICT third-party service providers. The proposal will also create a consistent incident reporting mechanism that will help reduce administrative burdens for financial entities, and strengthen supervisory effectiveness. DORA has been developed on the basis of the technical advice provided by the ESAs.

In order to promote an increase of the operational resilience of the digital operations of insurance and reinsurance undertakings in Europe, EIOPA published Guidelines on ICT Security and Governance in October 2020.[32] Operational resilience is key to protect insurance and reinsurance undertakings' digital assets, including their systems and data from policyholders and beneficiaries. In particular, the guidelines: i) provide clarification and transparency to market participants on the minimum expected information and cyber security capabilities; ii) avoid potential regulatory arbitrage; and iii) foster supervisory convergence regarding the expectations and processes applicable in relation to ICT security and governance as a key to proper ICT and security risk management. National supervisory authorities are expected to apply these guidelines from 1 July 2021.

EIOPA is currently working, in cooperation with the national supervisory authorities, on the consequenses of the Covid-19 on cyber operational resilience. The discussion includes topics such as business continuity, impact of remote working on the overall number of cyber-attacks reported by EU insurance undertakings, readiness of the firms to tackle such high volume of remote workers, etc. The group has been engaging in targeted discussions on the mentioned topics, standing ready to issue experts' views on the topic if needed.

29 Projections by Munich Re show that the global cyber insurance market could reach approximately USD $20bn by the year 2025. Cyber insurance: Risks and trends 2021, Munich Re.

30 Digital finance package, European Commission, September 2020.

31 Text of the proposal for a regulation on digital operational resilience for the financial sector, European Commission, September 2020.

32 Guidelines on information and communication technology security and governance, EIOPA, October 2020.

2. THE EUROPEAN INSURANCE SECTOR

The European insurance sector entered year 2020 in good conditions in all aspects. In 2019 non-life and life premiums increased respectively by 6 and 12%, the median return on excess of assets over liabilities (used as a proxy of return on equity) reached 9% and the sector was well capitalised with a median SCR ratio of 213%.

The unexpected Covid-19 virus outbreak, in the first quarter of 2020, led European countries to lockdown major part of their economies, aiming at containing the outbreak. Financial markets experienced huge losses and flight-to-quality investment behaviour. After the first year since the outbreak of the pandemic, the macroeconomic environment is still under strains and the uncertainty about the recovery is still very high. This situation poses challenges to the insurance sector, in particular to the life insurance business that was already facing difficulty because of the prolonged low interest rate.

During 2020, the life business experienced a decline of gross written premiums (GWP), while for the non-life business an increase was observed. Investment profitability for insurers deteriorated mainly due to the negative developments of the financial markets in the first half of the year. Whereas, the underwriting profitability was heterogeneous among the lines of business. Given the lockdown measures and restrictions on travelling, the number of claims decreased for workers' compensation and transport related lines of business. Instead, claims increased for fire and other damage to property and general liability insurance line of business.

Solvency positions for non-life and composite undertakings remained solid throughout the year, while the capital ratios for life insurers deteriorated in the first half of 2020, then recovered slightly in the end. Lapse rates on life policies continued to increase in 2020. Also, insurers' liquid asset ratios decreased, but the impact on insurers' disposable liquidity remains limited.

Concerns going forward remain due to the prolonged low interest rates and the economic slowdown that could potentially continue throughout 2021. The consequences of the pandemic, if the support measures are interrupted, might hit with a delay non-financial corporations and households and materialise in an increase in default rates and unemployment, which as of now remains relatively contained. There could be further pressure on the underwriting activities, as well as on insurers' investment portfolio returns. On the other hand, the slight increase in yields in early 2021 and potential positive developments related the vaccines against Covid-19 could ease the challenging environment for the insurance sector.

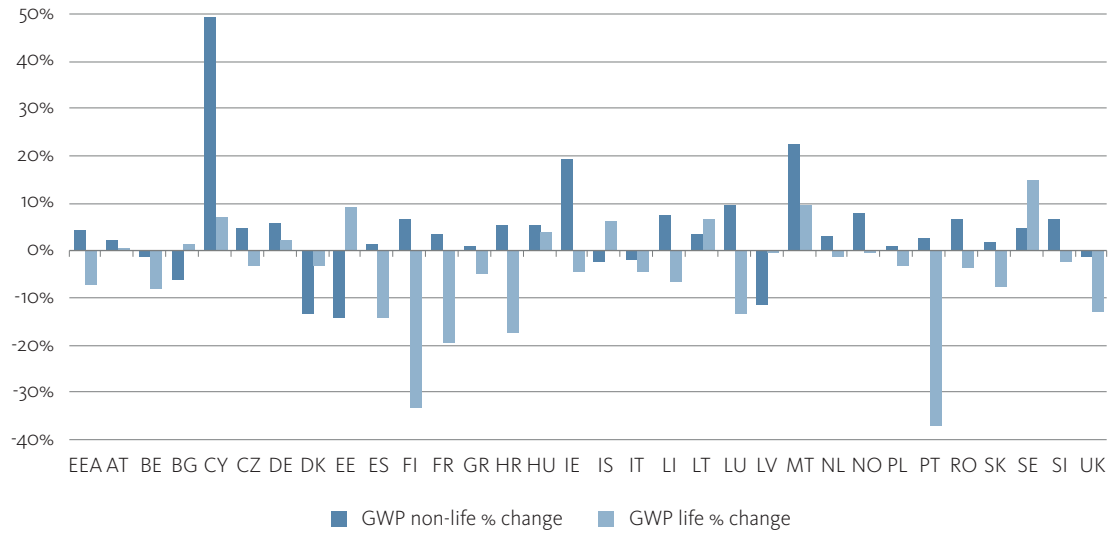
Furthermore, differences in initial positions and specificities across countries, along with differences in the severity of the spread of the virus, generate different degrees of resilience among the EEA countries.

2.1. MARKET SHARE AND GROWTH

In 2020, life gross written premiums slightly decreased, whereas non-life gross written premiums increased (Figure 2.1). The ongoing low yield environment coupled with the turbulent market conditions experienced during the beginning of 2020 challenged insurers' growth. Life-business contracted by 7%[33] in 2020 (y-o-y) for the first time after the growth observed in the last years (6% from 2018 to 2019). In 2020, more than two-thirds of EEA countries reduced their life-business, in particular the largest contraction is observed in Portugal (-37%), Finland (by -13%) and France (-19%). On the other side, the non-life-business segment continued to increase in 2020 by 8% since 2019 (12% from 2018 to 2019) supported by Cyprus (49%), Malta (22%) and Ireland (19%) that displayed the highest growth in 2020 (y-o-y) for non-life.

33 The figures for 2020 provided in this Chapter have been adjusted for EU27 (by excluding UK) following the Brexit withdrawal agreement. Additionally, adjusted EU27 figures for years prior 2020 have been added in order to reflect variations due to the structural break in the sample. Those figures are considered in the analysis performed in this chapter. Hence, the figures for years prior 2020 are not comparable with the figures displayed in previous EIOPA's Financial Stability Reports.

Figure 2.1: Total Life and Non-Life GWP growth in from 2019 to 2020 (in %, year-on-year)



Source: EIOPA QRS
Reporting reference date: Q4-2019 and Q4-2020
Note: EEA weighted average excludes United Kingdom.

The decreasing premiums in life-business could pose challenges for insurers. The slowdown of economic activities in 2020 coupled with the low yield environment, which is a situation that has been existing for a long time, resulted in a contraction for life-business GWP. This decrease, although limited heretofore, could challenge further the profitability and liquidity positions of insurers. Additionally, the new restrictions and lockdowns in EEA countries introduced at the beginning of 2021 and not captured in the latest available Solvency II data, could potentially worsen the business prospects in the coming months. The final effects are expected to significantly vary across EEA countries due to differences in the impact of the Covid-19 pandemic along with the substantial differences of insurance lines of business written across EEA countries (Figure 2.2).

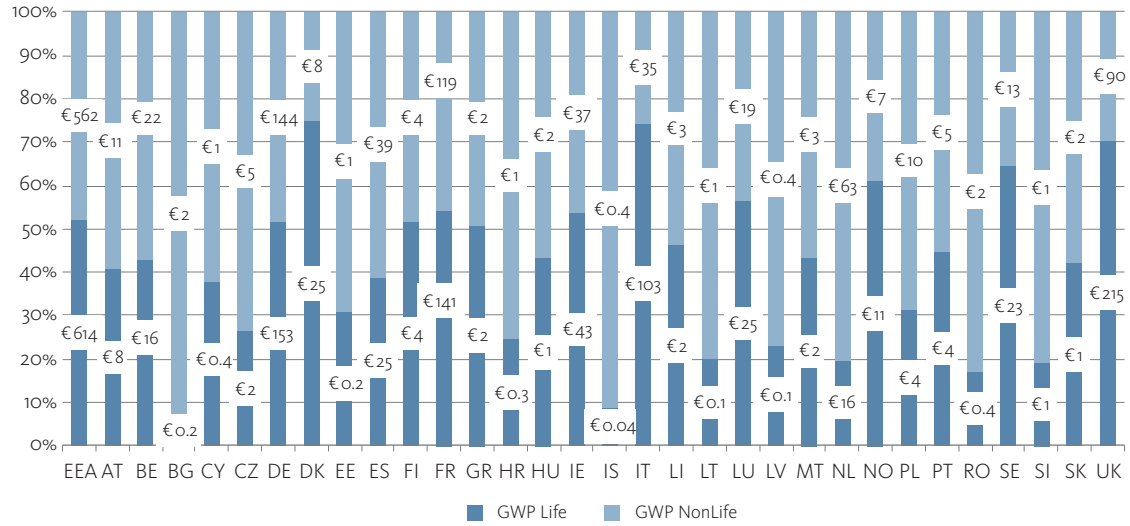
Overall, GWP as a percentage of GDP remained unchanged at 8% in 2020 with respect to 2019 for the European insurance market as both GWP and GDP decreased proportionally. Total assets as a share of GDP increased from 67% in 2019 to 74% in 2020, mainly because the increase in total assets coupled with a decline of GDP.[34]

The share of unit-linked in the life business has increased in 2020, above the levels reached in 2017 and 2018. The average share of unit-linked in the total life business first declined from 31% in Q4-2017 to 30% in Q4-2018 and then increased from 30% in Q4 2019 to 33% in Q4 2020 (Figure 2.4). Likewise, the share for the median insurance company slightly increased from 29% in Q4 2019 to 33% in Q4 2020. (Figure 2.5). The high returns offered by insurance unit-linked products in 2019[35] could have motivated an increased demand for these products, especially in those countries with a high unit-linked share such as Finland, Sweden, Liechtenstein or Ireland (Figure 2.6). In particular, a substantial increase in Q4-2020 over the year was observed for Portugal. Considerable differences in the use of unit-linked business remain across countries. On the one side, in countries with higher shares of unit-linked, undertakings could be less economically exposed to a financial downturn, as losses would be taken by the policyholders. On the other side, unit-linked business entails potential liquidity risks for insurers in stress times, since it may not be possible for the investment fund to sell unit-linked assets, especially those which are illiquid such as for example property, in time or at a fair price for insurers to be able to meet surrender payments required by policyholders.

34 See footnote 33.

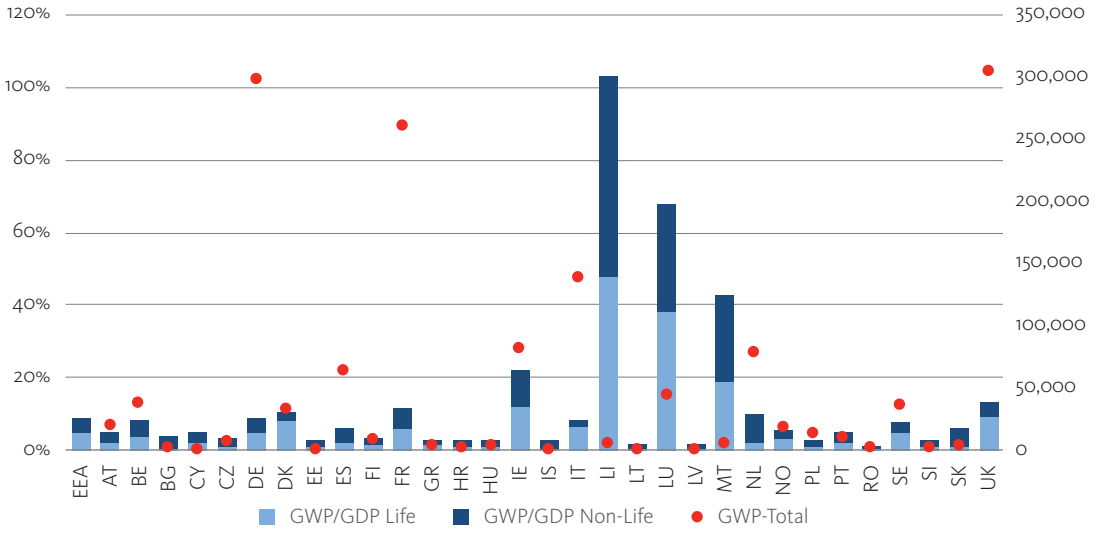
35 Cost and past performance 2021 report, EIOPA. Link available: https://www.eiopa.europa.eu/content/cost-and-past-performance-report-2021_en

Figure 2.2: GWP Non-life as a share of total GWP (in %) and GWP Life as a share of total GWP (in %), and in EUR billions in 2020



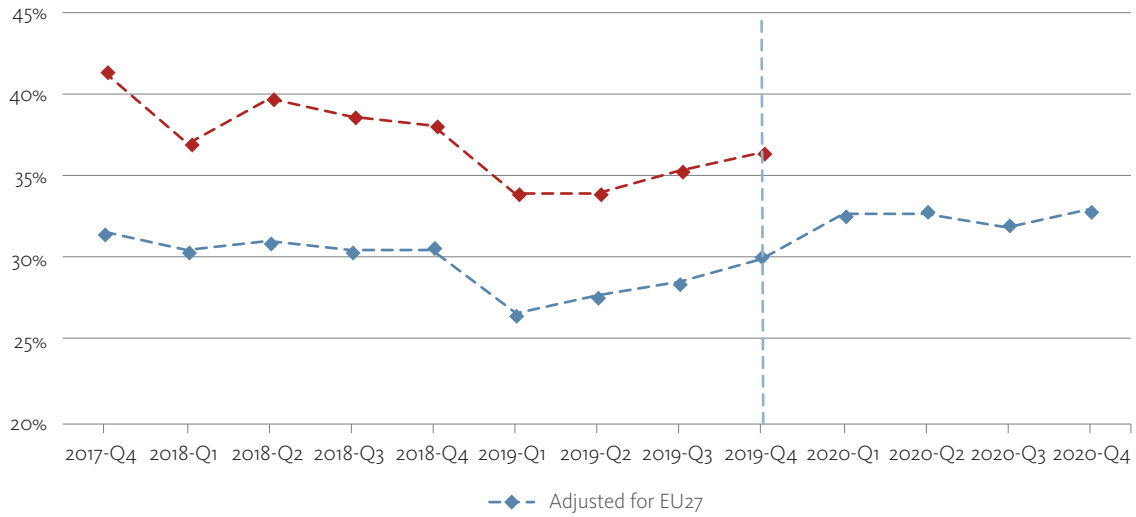
Source: EIOPA QRS
Note: EEA weighted average excludes United Kingdom.

Figure 2.3: GWP as a Share of GDP (in %) (LHS) and total GWP (in EUR million) (RHS) by country in Q4 2020



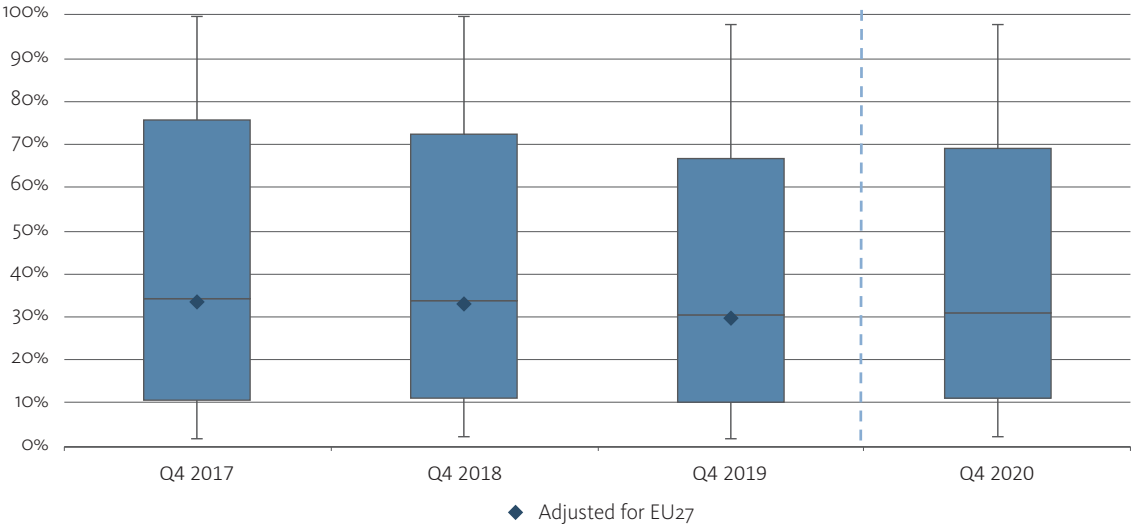
Source: EIOPA QRS
Note: EEA weighted average excludes United Kingdom.

Figure 2.4: GWP-Life business: Unit-linked share development over time



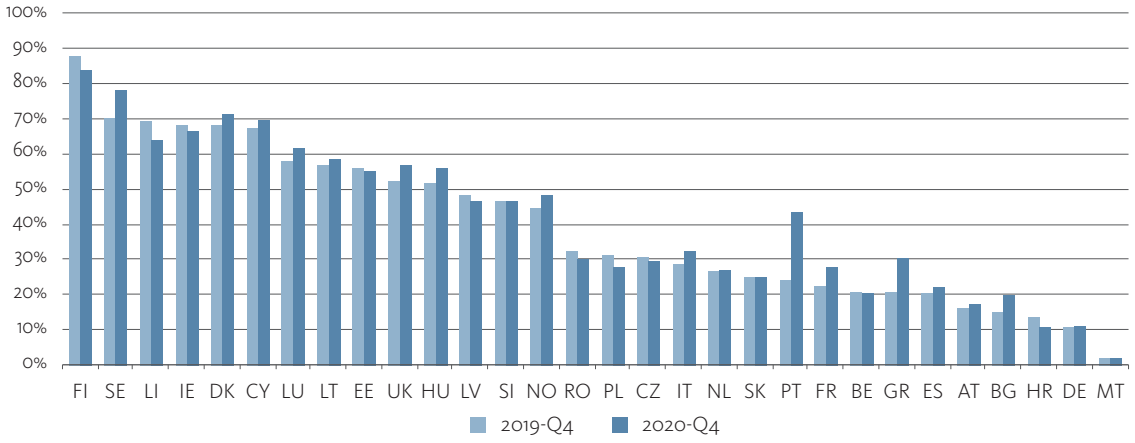
Source: EIOPA QRS
Note: The figures prior 2020 do include United Kingdom (UK), additionally the median values before 2020 are also reported adjusted for EU27 (excluding UK).

Figure 2.5: Unit-linked as a share of GWP-Life business (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). The figures prior 2020 do include United Kingdom (UK), additionally the median values before 2020 are also reported adjusted for EU27 (excludig UK).

Figure 2.6: Unit-linked as share of GWP-Life business across countries (in %)



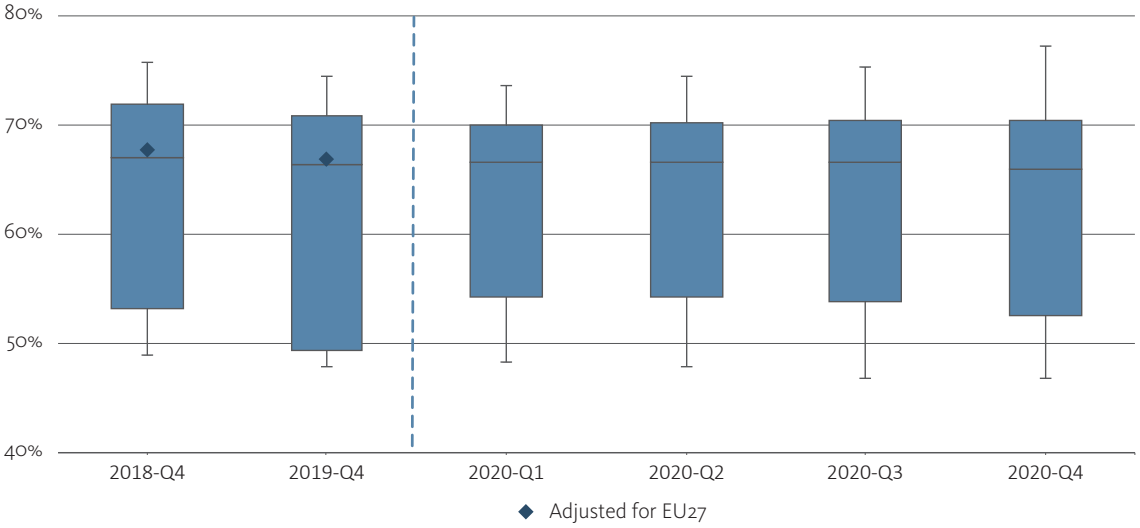
Source: EIOPA QRS

The liquid asset ratio slightly decreased in the last quarter of 2020 (Figure 2.7). The median value for liquid asset decreased to 66% at the end of 2020 (67% at the end of 2019), while the upper percentile increased. The drop in the 25% percentile of the distribution indicates that a deterioration was noticed in particular for those insurers holding less liquid assets. Whereas, the inverse trend is observed for insurers with a high liquid asset ratio.

The liquid asset ratio varies considerably across EEA countries. Malta, Finland, Cyprus, Liechtenstein, Sweden and Norway have a liquidity asset ratio below 50%, while Estonia, Hungary and Lithuania hold more liquid assets, above the EEA median (57%) (Figure 2.8).

Heretofore, the negative impact on insurers' disposable liquidity remains limited. The strong hit on economic activities slightly reduced premiums and lowered new business during 2020, however, the impact seems limited and insurers' disposable liquidity remains resilient at the end of 2020.

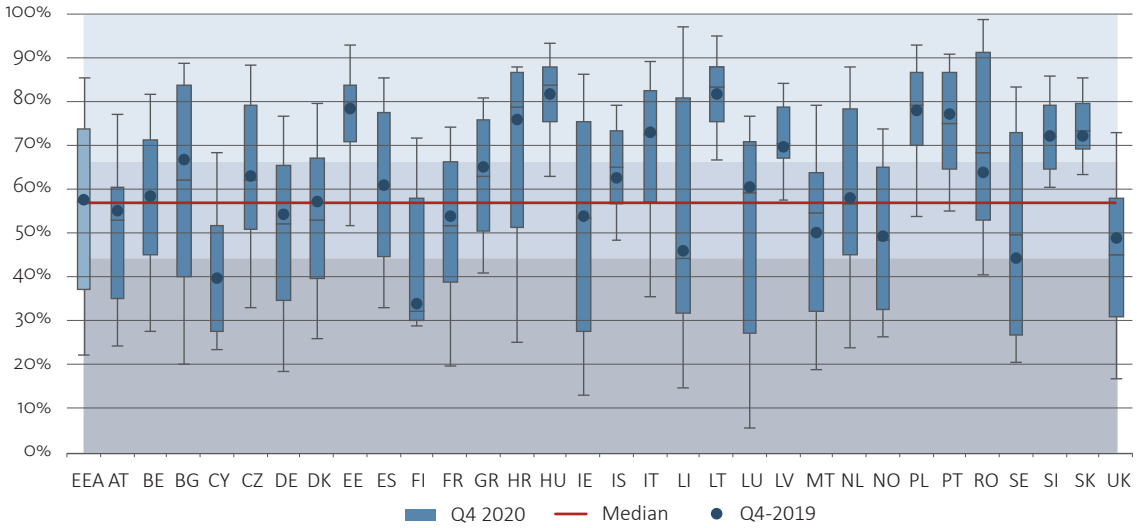
Figure 2.7: Liquid assets ratio (in %; median, interquartile range and 10th and 90th percentile)



Source: EIOPA QFG

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). The figures prior 2020 do include United Kingdom (UK), additionally the median values before 2020 are also reported adjusted for EU27 (excludes UK).

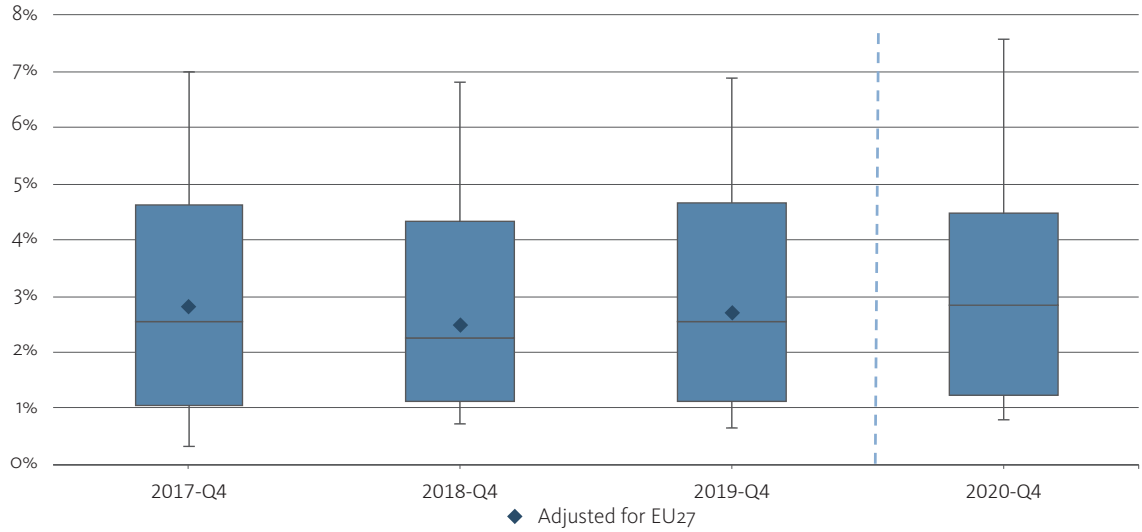
Figure 2.8: Liquid assets ratio by country (in %; median, interquartile range and 10th and 90th percentile) and EEA median in Q4 2020.



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). The figures prior 2020 do include United Kingdom (UK), additionally the median values before 2020 are also reported adjusted for EU27 (excluding UK). EEA weighted average excludes UK.

Lapse rates in the life business continue to increase over 2020 (Figure 2.9). Already prior to the Covid-19 outbreak, lapse rate (adjusted for EU27) slightly increased, with a median value going from 2.5% in 2018 to 2.7% in 2019, and the trend continued over 2020 with lapse rates reaching 2.8% (in Q4 2020). On the one hand, policyholders were probably slightly more prone to terminate their insurance contracts due the deterioration of economic activities and their income levels or income prospects. On the other hand, a reduction of the incentives to lapse insurance contracts due to the ultra-low interest rate might have partially offset the potentially increase of lapse rates, in particular for the life insurance contracts with relatively higher guarantees.

Figure 2.9: Lapse rates (in %)



Source: EIOPA QFG
Note: The figures prior 2020 do include United Kingdom (UK), additionally the median values before 2020 are also reported adjusted for EU27 (excluding UK).

2.2. PROFITABILITY

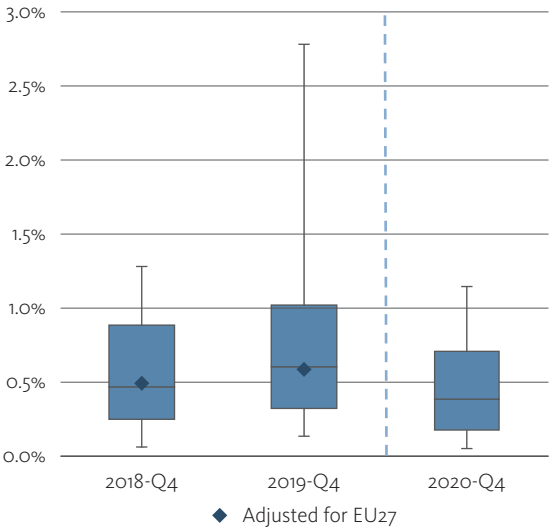
Insurer's investment profitability deteriorated in 2020, albeit the improvement of returns given the recovery of financial markets in the second half of the year neutralized the negative effects on insurers' portfolios. The median return on assets (ROA) lowered from 0.59% in 2019 to 0.38% 2020 (0.49% in 2018), likewise the median return on excess of assets over liabilities (used as a proxy of return on equity), decreased from 7.9% in 2019 to 5.5% in 2020 (6.8% in 2018) (Figure 2.10 and Figure 2.11). The former indicator descended below the 2018 levels, instead the latter remains close but above.

The negative impact on the insurers' assets after the drops in equity indices and the widening of credit spreads driven by a 'flight-to-quality/safety' in March 2020, has been partially compensated by the recovery of the financial markets during the second half of 2020, in particular in the equity market. While the impact on the insurers' asset side is not significantly evident by the end of 2020, insurers' liabilities noticeably increased given the decline of the risk-free rate throughout the year.

The persistent uncertainty surrounding the pandemic developments could challenge insurers' profitability going forward. Although insurers' profitability remains positive at the end of 2020, it has worsened notably compared with previous years. Because of the prolonged economic slowdown, severe strains for households and non-financial corporations could materialise during 2021; this, coupled with the prolonged low interest rate could add further pressure on the investment portfolio returns of insurers.

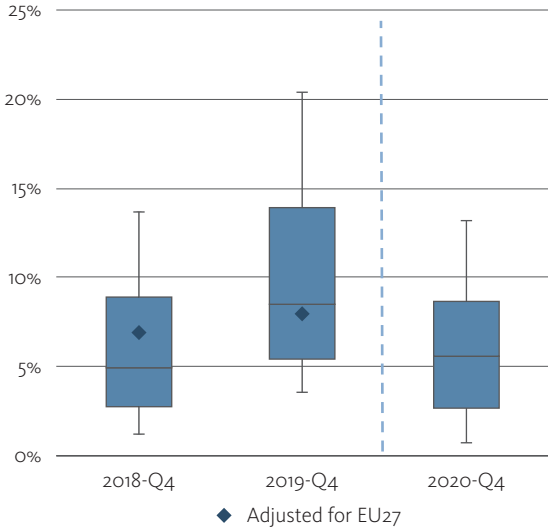
Moreover, stable expected profits in future premiums (EPIFP)[36] from Q4 2019 to Q4 2020 (10.8%)[37] suggest no expectations of profitability improvement looking ahead. However, if the increasing risk-free rate observed at the beginning of 2021 will continue on a positive trend this could improve insurers' profitability and business prospects in the medium to long-term horizon.

Figure 2.10: 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: Note: The figures prior 2020 do include United Kingdom (UK), additionally the median values before 2020 are also reported adjusted for EU27 (excluding UK).

Figure 2.11: 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: Note: The figures prior 2020 do include United Kingdom (UK), additionally the median values before 2020 are also reported adjusted for EU27 (excluding UK).

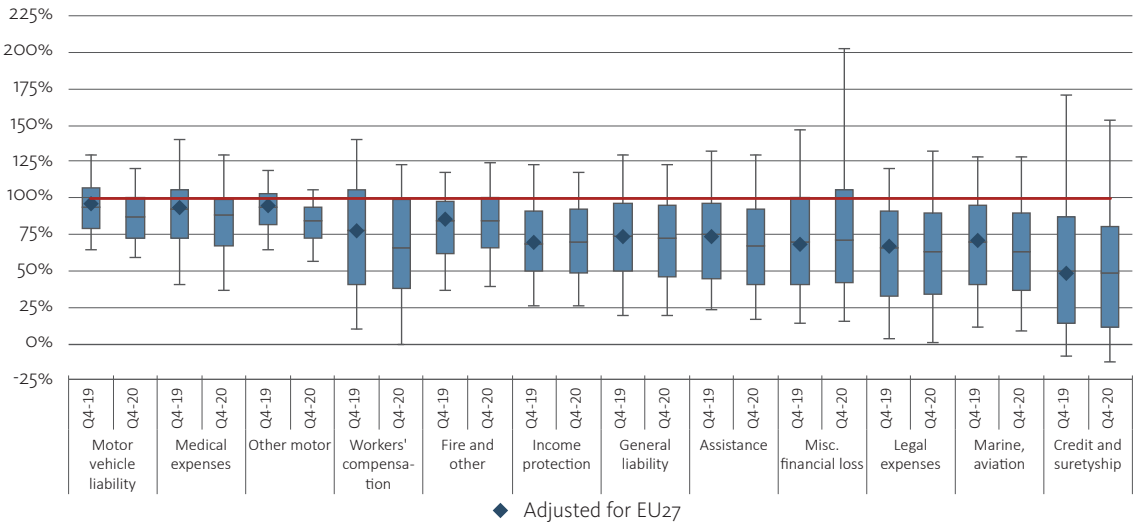
36 Expected profits included in future premiums (EPIFP) are profits which result from the inclusion in technical provisions of premiums on existing (inforce) business that will be received in the future, but that have not yet been received."

37 See footnote 33.

Underwriting profitability remained positive at the end of 2020, but there are differences across lines of business. *The* median Gross Combined Ratio for non-life business remained below 100% across all lines of business, indicating that most EEA insurers were able to generate positive underwriting results (Figure 2.12).[38] On one hand, the underwriting profitability of the transport related lines of business (motor vehicle liability, other motor and marine, aviation) improved via claims reduction. Claims decreases are mainly driven by lockdowns and restrictions on travelling imposed in many countries. Workers' compensation underwriting profitability also enhanced via claims reduction that compensated the decrease on premiums observed in 2020. On the other hand, the rise of claims for fire and other damage to property and general liability insurance resulted in a deterioration of their underwriting profitability that insurers have partially compensated with an increase of the reinsurance share and premiums' raise.

Recent decrease in premiums coupled with the persistent uncertainty around the Covid-19 virus, in particular for life insurance could pose further difficulties for insurers to maintain their underwriting profitability levels. The reduction for premiums in 2020 for life insurance and the potentially lower new business due to new lockdowns and restrictions measures affecting economic activities could potentially have a negative impact on insurers' underwriting profitability. Moreover, on the liability side, there could be potential negative effects via increases in claims, for the life insurance sector as well as for non-life.

Figure 2.12: Gross Combined Ratio across lines of business (in %; median, interquartile range and 10th and 90th percentile)



Source: EIOPA Quarterly Solo
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)[39]. The figures prior 2020 do include United Kingdom (UK), additionally the median values before 2020 are also reported adjusted for EU27 (excluding UK).

BOX 2.1 TRADE CREDIT INSURANCE DURING THE PANDEMIC

In view of its importance for the credit supply to the real economy, many European countries have introduced support schemes for trade credit insurance last year. In 2021, many of the schemes are set to expire. At the same time trade credit insurance is in the spotlight with regard to a possible increase in bankruptcies among small and medium-sized enterprises. This is accompanied by the collapse of Greensill Capital in 2021, which, the narrative goes, was triggered by the withdrawal of coverage from several trade credit insurers.

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

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

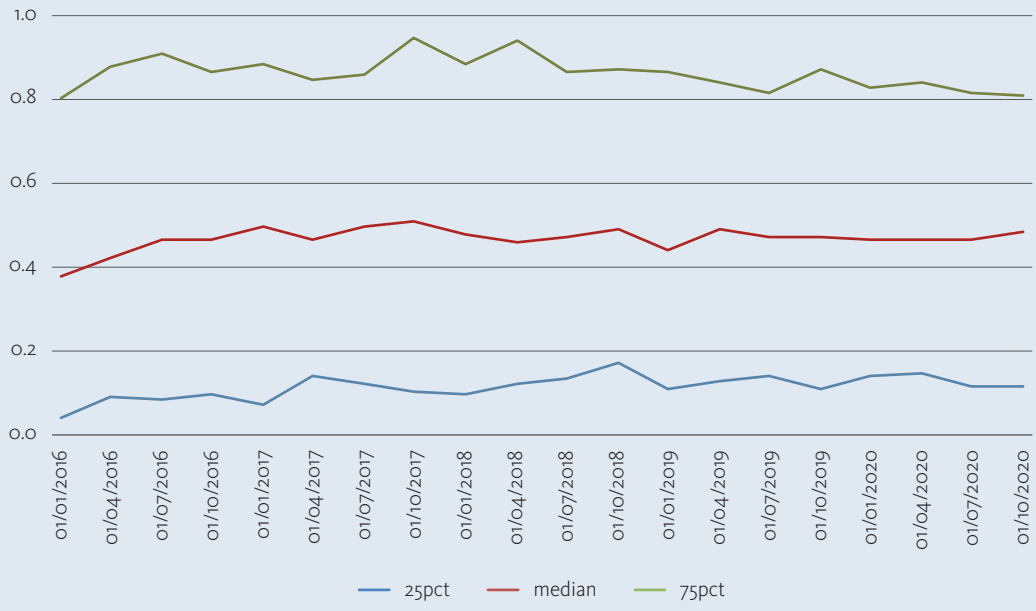
This box monitors current developments in the European trade credit insurance market. It focuses on two angles. First, it looks at the prospects of increasing risk for the sector. Second, it examines the behaviour of trade credit insurers under the condition of rising risk.

Prospects of increasing risk for the sector

As part of their trading relationship, companies grant their business customers the option of paying their invoices at some time after delivery. This is known as trade credit. Trade credit insurance covers companies against the risk that their buyers do not pay their invoices. Approximately 14% of the trade credit risk is estimated to be covered by insurers.[40] Trade credit insurance is a small segment with 2.4% of total premium volume of non-life. Although there are few large specialised insurers with an important market position, the overall market is fragmented (the Herfindahl-Index end of 2019 of gross written premia in credit and suretyship in Europe is 7%).

Claims relative to premiums did not increase in 2020 (figure B.2.1). This is in line with the development in the number of bankruptcies. While the Covid-19 pandemic caused a sharp economic downturn, it has, however, not affected bankruptcies, which in the European Union in year 2020 actually decreased. This is the result of extensive government measures to support businesses. In addition, there are public moratoria which allow suspensions of loan payments or the obligation to file for insolvency. This implies that even companies hit hard by the pandemic are able to continue to pay their invoices. Importantly, these government measures are only temporary and they are expected to gradually phase-out. Therefore, market observers expect that most bankruptcies as a consequence of Covid-19 pandemic will come in year 2021 and later. This could imply that a claim growth as a consequence is still to come. But all this is highly uncertain.

Figure B.2.1 – Combined ratio over time



Source: EIOPA Quarterly Solo, Claims and expenses divided by Earned Premiums. 05.01 filtered by C0090 (line of business credit & suretyship insurance), (R0310 + R0550) / R0210

40 Boissay, Frédéric, Nikhil Patel, and Hyun Song Shin (2020): Trade credit, trade finance, and the Covid-19 Crisis. BIS Bulletin.

Historically, the ratio claims to premiums in trade credit insurance tends to jump-up during recessions, in particular during the Global Financial Crisis 2008/09, during the early 2000s recession and the Gulf War recession in 1991. This is visible in historical data provided by ICISA, the industry association. Hence, the history strongly suggests procyclicality of claims.

Business survey results also indicate that claim growth may come with a time lag.[41] After the pandemic hit, the number of invoices that are paid late increased from 27% to 47%. At the same time, the number of invoices written-off as uncollectible decreased from 13% to 7%. Under the assumption that a share of late payments will never be paid, one can expect an increase in claims in 2021 or later.

Trade credit insurers' behaviour under the condition of increasing risk.

When the outlook darkens, insurers reduce their risk exposure. Recent financial statements of European trade credit insurers report a reduced risk exposure of around 10% in year 2020 compared to previous year. This is expected as insurers usually can adjust their contracts within a short time frame. Risk to insurers' balance sheets is particularly limited when credit risk builds-up over time. After more than a year now that the pandemic has hit Europe, insurers had plenty of time to adjust their underwriting processes and risk exposures to the new environment.

If trade credit insurers reduce coverage during the time of crisis, this could amplify negative developments in credit supply. Companies could respond by reducing the supply of goods to those customers which are unable to pay their invoices immediately. This is in particular the case when other sources of short-term financing are not available, that is when many market participants want to reduce credit risk at the same time. A wide-spread reduction in the availability of financing for businesses would be a significant let-down of the real economy. This implies the risk of slower economic recovery and of an insolvency domino would be more pronounced.

The risk for trade credit insurers is ultimately limited because governments face a trade-off: If support measures for businesses are scaled back too quickly, there is a risk of a decline in funding opportunities for small and medium-sized enterprises and thus a further slump in the economy. As long as the pandemic is not fully overcome, governments may be inclined to extend support measures for businesses, given the risks to the real economy. If economic development normalizes, then claims in trade credit insurance will remain low. If economic development deteriorates, then business support measures could be extended, preventing a potential increase in losses.

In addition to the impact during the crisis, there could also be a long-lasting, persistent effect on the availability of credit risk insurance. The pandemic could fundamentally change the perception, modelling, and underwriting of trade credit risks. Future pandemics and political responses such as lockdowns are new potential sources of correlated defaults across industries. There is also a growing view that some industries are inherently vulnerable. Credit insurers may therefore see much higher credit risk in these industries than previously modelled. For example, business models that rely on physical contact, such as aviation, retail stores, bars and restaurants, or event organizing, could be persistently viewed as higher-risk than was thought before the Covid-19 pandemic. This could lead to permanently lower coverage in these sectors.

41 Atradius Payment Practices Barometer Western Europe – November 2020

2.3. SOLVENCY

Solvency positions for life insurers deteriorated after the Covid-19 outbreak, while those of non-life insurers improved (Figure 2.13). Throughout 2020, the risk-free interest rate declined and due to the longer nature of life insurers' liabilities the value of technical provision increased more than the value of assets, hence eroding the capital buffer. The median of the SCR ratio for life insurers, slightly recovered in the second half of the year (217% from 212% in Q2 2020) driven by positive market performance. However, it did not reach the initial levels observed at the end of 2019 (236%)[42]. On the other hand, the median of the SCR ratio for non-life insurers improved over the year (218% in Q4 2020 from 212% in Q4 2019[43]). When observing the development of the median of the EEA SCR ratio, where individual insurers contributions are weighted by size (the SCR), the increase in the eligible own funds driven by the largest groups in the sample, increases the overall SCR ratio for life insurers. Conversely, the SCR ratio for composites weighted by SCR, dropped in the last half of 2020.

The number of life and composite insurance undertakings with SCR ratios below 100% increased from zero in Q4 2019[44] to two in Q4 2020, while the number of non-life insurance undertakings with SCR ratios below the 100% threshold reduced from seven in Q4 2019 to zero in Q4 2020 (Figure 2.14). In addition, non-life undertakings seem to be better capitalized after the Covid-19 crisis than in Q4 2019 as the number of undertakings with SCR ratios above 150% increased, while the same number of life undertakings decreased.

The impact of Covid-19 outbreak on capital position is heterogeneous across EEA states members (Figure 2.15). The Covid-19 crisis has negatively impacted the capital positions of insurers in numerous EEA member states, although the different specificities and initial levels of the SCR ratios among countries along with the dissimilar impact of the pandemic, generates different degrees of resilience across the EEA countries to the hit. Heretofore, the capital positions of insurers remain positive and comfortable. In particular, those countries with lower SCR ratios could face stronger difficulties compared to those better capitalized.

Looking ahead, the solvency positions for insurers could deteriorate even further, in particular for life undertakings. The persistent low yield environment and the uncertainty regarding the successful and prompt implementation of the vaccination campaign poses difficulties to maintain solid solvency positions, in particular for life insurers. A potential deterioration of insurers' balance sheets could be driven by a further increase of liabilities and new drops in assets values during 2021; in fact, in case governments' support measures will be interrupted, the economic consequences of the pandemic might hit non-financial corporations and households with a delay, increasing default rates and unemployment with a potential negative impact on financial markets. However, the slight increase of the interest rates observed at the beginning of 2021 and the positive development related to the vaccines could partially ease the negative environment for the insurance business.

The impact of the long-term guarantee (LTG) and transitional measures varies considerably across member states. The 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 to the new regime.[45] 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 provisions. The impact of applying these measures is highest in DE and the UK, where the distribution of SCR ratios is significantly 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 financial stability cushion by reducing overall volatility.

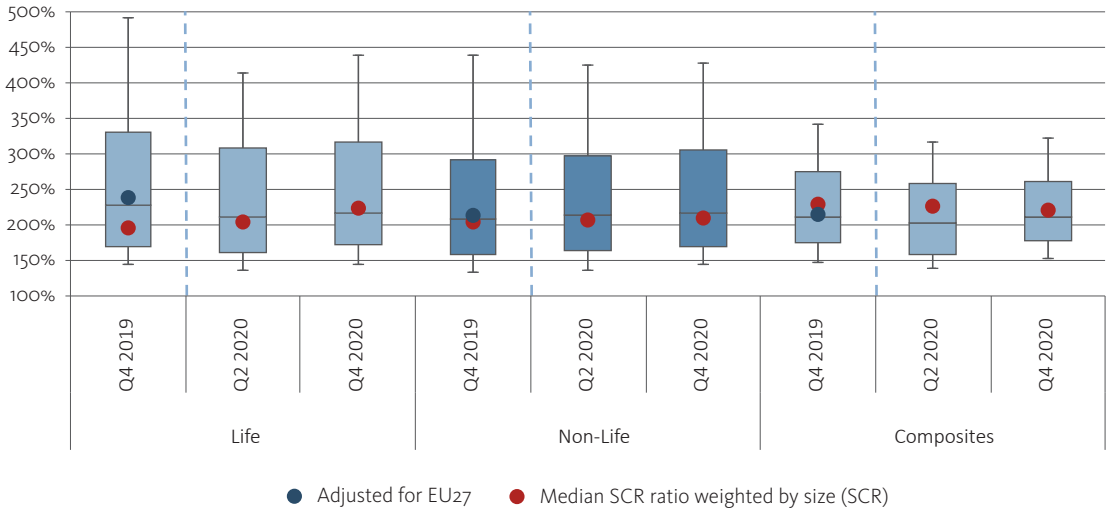
42 The figure related to Q4-2019 excludes United Kingdom for comparison purposes with 2020 figures.

43 Please see 42 footnote.

44 Pleasee see 42 footnote.

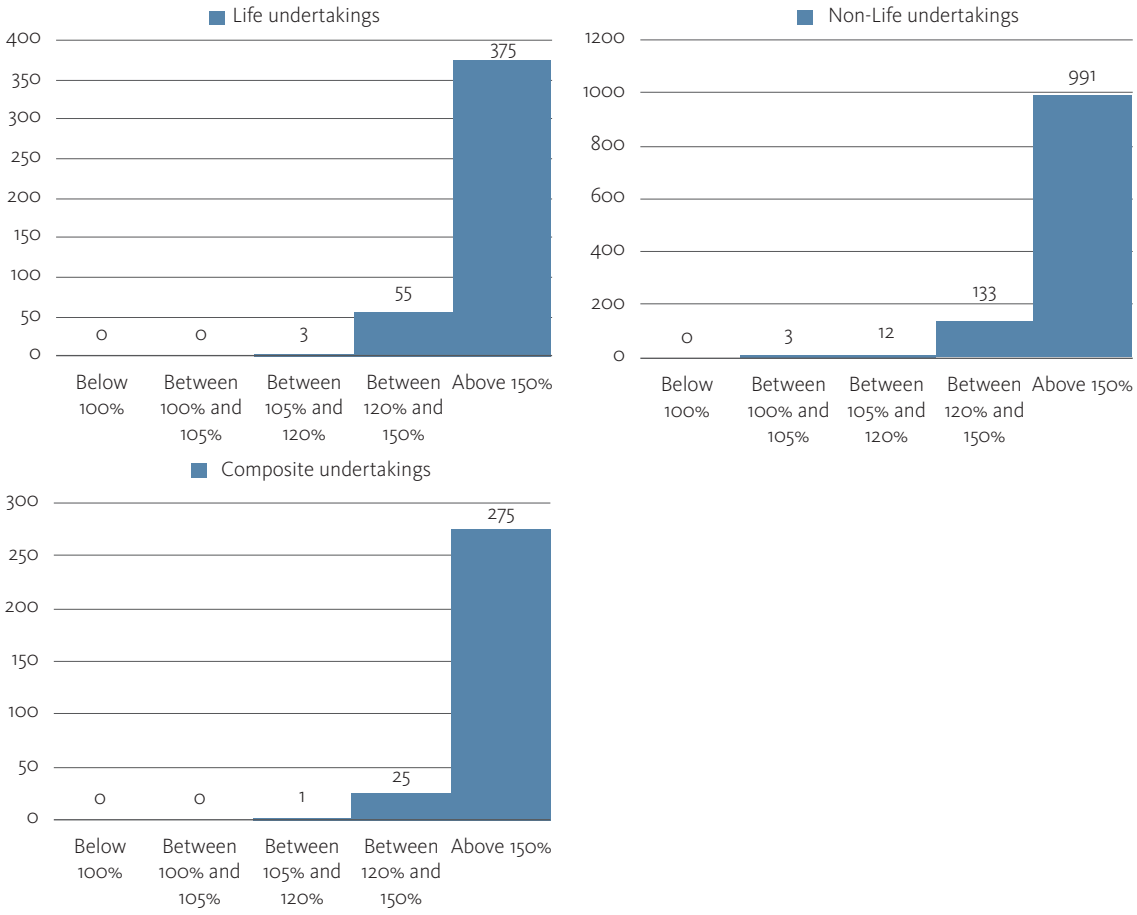
45 Please refer to the annual LTG report for more information on the LTG and transitional measures.

Figure 2.13: SCR ratio (in %; median, interquartile range and 10th and 90th percentile) in 2019



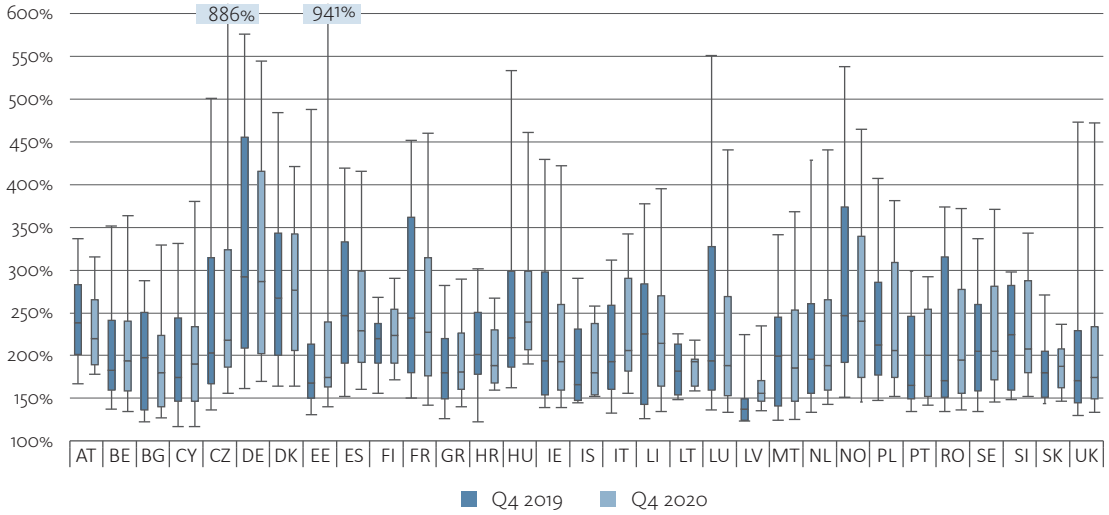
Source: EIOPA Quarterly Solo
Note: The figures prior 2020 do include United Kingdom (UK), additionally the median values before 2020 are also reported adjusted for EU27 (excludes UK).

Figure 2.14: Intervals of SCR ratios for solo undertakings as of Q4 2020 by type of undertaking



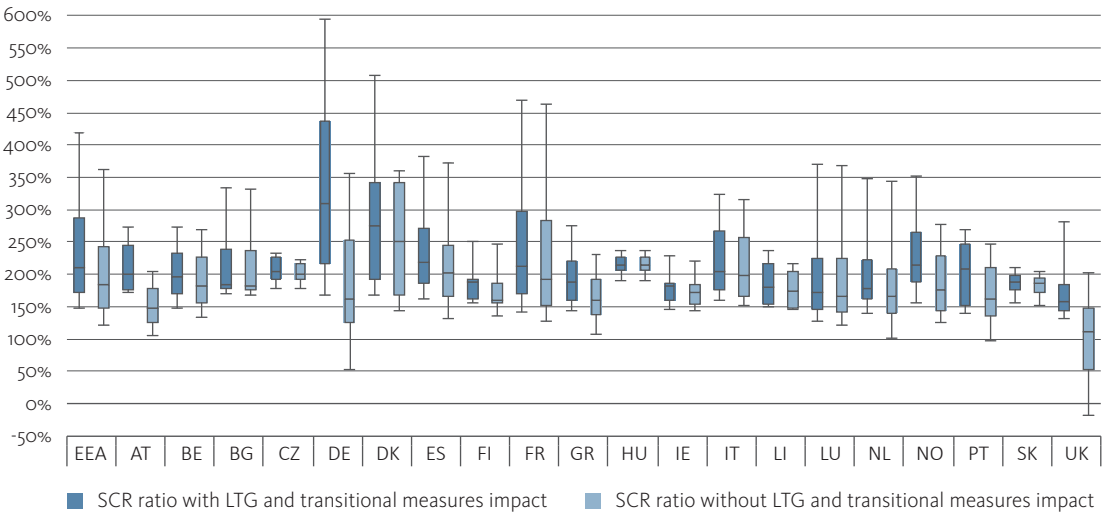
Source: EIOPA QRS
Reference rate: Q4 2020

Figure 2.15: SCR ratio by country (in %; median, interquartile range and 10th and 90th percentile)



Source: EIOPA QRS
Reference date: Q4 2019 and Q4 2020

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



Source: EIOPA ARS
Reference date: 2020
Note: Sample based on 694 solo insurance undertakings in EEA that use transitional and/or LTG measures. EEA weighted average excludes United Kingdom

2.4. REGULATORY DEVELOPMENTS

For what concerns the 2020 Solvency II review EIOPA submitted its technical advice to the European Commission in the form of an Opinion on December 17, 2020. Overall, three broad themes of the review emerge from the prudential and economic context. Firstly, the need for proper recognition of the economic situation, notably with respect to the capital requirement for interest rate risk. Secondly, that apart from the correction of the capital requirement for interest rate risk the updating of the current regulatory framework should be overall balanced in its European impact consistent with the belief that the Solvency II framework has so far been effective.

Thirdly, the need to supplement the current macroprudential framework with the macroprudential perspective (including the introduction of specific tools and measures), as well as the need to develop a minimum harmonized recovery and resolution framework and achieve a minimum harmonization in the field of insurance guarantee schemes. From a prudential perspective, EIOPA is of the view that overall the Solvency II framework is working well and no fundamental changes are needed at this point in time, but a number of amendments are required to ensure that the regulatory framework continues as a well-functioning risk based regime. EIOPA's Opinion considered the 19 topics of the call for advice from the European Commission, including the long-term guarantees measures, the risk margin, the SCR standard formula, the MCR, group supervision, reporting and disclosure, proportionality, macro-prudential issues, recovery and resolution and insurance guarantee schemes.

In June 2020, the European Commission consulted publicly on **draft Delegated Regulation amending Delegated Regulation (EU) 2015/35 as regards the integration of sustainability risks in the governance of insurance and reinsurance undertakings**[46] (adoption pending). The Commission's draft integrated EIOPA's advice[47], to include in the Solvency II Delegated Regulation, as part of the prudent person investment principle, the requirement for (re)insurance undertakings to take into account the potential long-term impact of their investment strategy and decisions on sustainability factors. This reflects the role, which insurers, as important long-term investors, can play in mitigating and adapting to the impact of climate change and facilitating the transition to a more sustainable and resilient economy, more commonly known as the 'stewardship approach'. From a prudential point of view, this can contribute to the management of sustainability risks, such as transition, physical or liability risk. The resilience of the real economy and the stability of the financial system, fuelled by integrating sustainability considerations in the investment strategy and decisions, has the potential to impact on the risk-return characteristics of a portfolio, as other factors.

In July 2020 and February 2021, EIOPA issued two papers addressing the insurance protection gap for the coverage of business interruption risk, in light of the COVID-19 pandemic crisis. In its first **Issues paper on resilience solutions for pandemics**[48], EIOPA identified issues and options for developing what EIOPA calls 'shared resilience solutions'. These solutions build on four key elements: risk assessment, risk prevention, product design and risk transfer. While acknowledging that such solutions can only insure against a portion of economic costs, a shared resilience solution would require central coordination, the sharing of costs and responsibilities across the public and private sector and any solution would be conditional upon the implementation of prevention and adaptation measures. In its **Staff Paper on measures to improve the insurability of business interruption risk in light of pandemics**[49], EIOPA analysed in further detail issues and options to reduce losses through prevention measures, to support capital market risk transfer and to implement multi-peril solutions for systemic risk, beyond pandemic risk.

Regarding Brexit, the EU and the UK concluded by end of 2020 a Trade and Cooperation Agreement, accompanied by a joint declaration on financial services regulatory cooperation. Following the latter, the EU and the UK started discussing a Memorandum of Understanding (MoU) for establishing the framework for this cooperation. In parallel, EIOPA has monitored the impact on the sector of the end of the transitional period, based on the 2019 Recommendation and Opinion. The finalisation of the transitional period and the conclusion of the agreement have not affected financial stability, and so far do not seem to have triggered consumer protection issues. With the finalisation of the transitional period, the 2019 MoUs between EIOPA, all national competent authorities of the European Economic Area and the UK authorities apply. The MoUs ensure cooperation in the fields of insurance prudential and conduct supervision, for mutual assistance and regular exchange of information.

46 COMMISSION DELEGATED REGULATION (EU) .../... amending Delegated Regulation (EU) 2015/35 as regards the integration of sustainability risks in the governance of insurance and reinsurance undertakings https://eur-lex.europa.eu/legal-content/DE/ALL/?uri=PI_COM:Ares(2020)2955224

47 See EIOPA's Technical advice on the integration of sustainability risks and factors in Solvency II and the Insurance Distribution Directive (April 2019) https://www.eiopa.europa.eu/sites/default/files/publications/advice/technical_advice_for_the_integration_of_sustainability_risks_and_factors.pdf

48 https://www.eiopa.europa.eu/sites/default/files/publications/shared-resilience-issues-paper-27july2020_0.pdf

49 https://www.eiopa.europa.eu/sites/default/files/publications/eiopa-staff-paper-on-measures-to-improve-insurability.pdf

3. THE EUROPEAN REINSURANCE SECTOR[50]

The European reinsurance sector remains resilient one year after the Covid-19 outbreak, albeit signs of deterioration are visible at end-2020. The pandemic has negatively affected the life of European citizens in several ways and has had an impact on both insurance and reinsurance. The reinsurance sector has been subject to unprecedented uncertainty both in the loss environment and in the broader economy. In addition, 2020 has been a year characterized by high worldwide catastrophe activity.

Against this background, the sector shows signs of deterioration with a reduction of gross written premiums for life reinsurance and a worsening of underwriting profitability for non-life business. On the capital side, Solvency positions of reinsurers lowered in the first half of 2020, but then partially recoverd again at the end of the year. A growth in global reinsurance capital was observed. This was driven by an increase in both traditional capital and alternative capital, reaching pre-pandemic levels; the issuance of new insurance-linked securities (ILS) in 2020 was higher than in the previous year.

Looking ahead, the higher expected frequency and severity of natural disasters combined with a potential reduction in reinsurance coverage, aimed at reducing potential unknown losses arising from the pandemic, could lead to negative implications in the EU market, ultimately affecting the insurance protection gap.

3.1. MARKET SHARE AND GROWTH

In 2020, non-life reinsurance gross written premiums (GWP) increased, while life reinsurance GWP fell. Reinsurance GWP comprises 14% of the total in the EEA in 2020, standing at EUR 161 bn (Figure 3.1). Within this category, non-life reinsurance represents 10% of total GWP (EUR 116 bn), while life reinsurance accounts for 4% (EUR 45 bn). Overall reinsurance premiums increased by 1% from 2019, due mostly to an increase in non-life proportional reinsurance (Figure 3.2) and more specifically, due to an increase of premiums written for line of business such as fire and other damage to property insurance, general liability and medical expense insurance (Figure 3.3). This could indicate that insurers have transferred part of the risk covered to benefit from reinsurance as a risk mitigating technique with the aim of preserving solvency levels. On the other hand, motor vehicle liability insurance reinsurance premiums decreased by end-2020. GWP for life reinsurance, a smaller part of the reinsurance market, decreased by EUR 4 bn in 2020 from 2019. A reduction of GWP for the primary life business (see Chapter 2) could further challenge the growth of premiums for reinsurers.

End of September 2020 the global reinsurance capital returned to its pre-pandemic high of 625 bn USD (YE 2019: 625 bn USD).[51] Reinsurance capital consists of capital of traditional reinsurers and alternative capital. Since 2010, reinsurance capital grew by 33 percent, split into an increase of 88 bn USD in traditional capital and 66 bn USD in alternative capital. Capital of traditional reinsurers rose in 2020 by 3 bn USD to 533 bn USD (YE 2019: 530 bn USD), although the reinsurers earnings were generally down, driven by the impact of Covid-19 on both sides of the balance sheet. Over the first 9 months of 2020 alternative capital fell by 4 percent to 92 bn USD. Largely, this is caused by a reduction in collateralized reinsurance[52], which still represents the bulk of the alternative capital.

The property catastrophe bond market performed strongly and reached an all-time high in 2020. The alternative reinsurance market remains attractive due to the diversifying nature for catastrophe-exposed businesses and the relatively high returns. Total outstanding insurance linked securities (ILS) amounts to 46 bn USD at YE 2020 with new issued ILS of 16 bn USD, both figures[53] represent an all-time high.

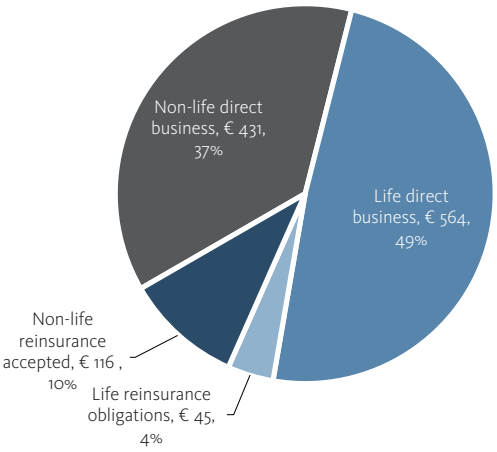
50 The figures from 2020 provided in this Chapter have been adjusted for EU27 (i.e. UK is excluded) following the Brexit withdrawal agreement. Additionally, adjusted EU27 figures for years prior 2020 have been added in order to reflect variations due to the structural break in the sample. The sample structural break as of Q1 2020 is marked with a dashed line.

51 See AON Benfield: Reinsurance Market Outlook January 2021, page 4.

52 See AON Benfield: Reinsurance Market Outlook January 2021, page 11

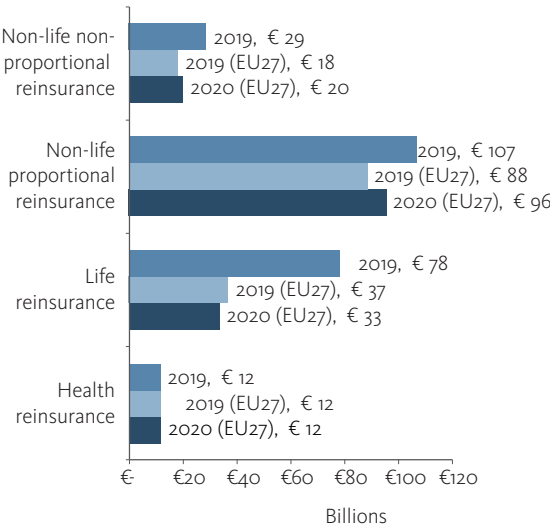
53 See ARTEMIS Website: http://www.artemis.bm/dashboard/

Figure 3.1: Gross Written Premiums in the EEA (in EUR billion and %)



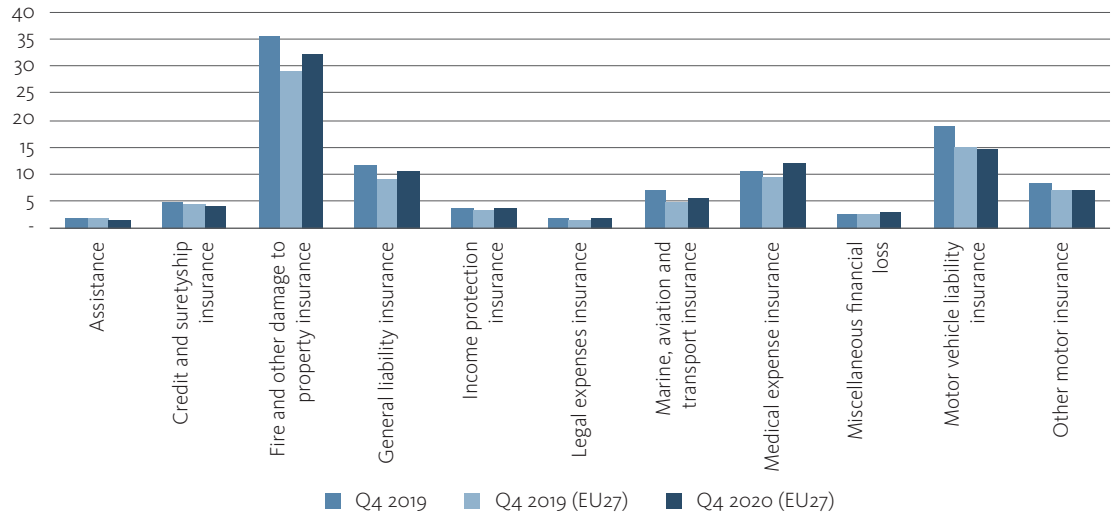
Source: EIOPA Quarterly Solo
Reference date: Q4 2020

Figure 3.2: Reinsurance Gross Written Premiums in the EEA (in EUR billion)



Source: EIOPA Quarterly Solo
Reference date: 2019 and 2020
Note: Year-to-date amounts. Non-life reinsurance accepted includes proportional and non-proportional reinsurance. Life reinsurance obligations include life reinsurance and health reinsurance. The figures for 2020 do not include United Kingdom (UK), additionally the figures before 2020 are also reported adjusted for EU27 (excluding UK).

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



Source: EIOPA Quarterly Solo
Note: The figures for 2020 do not include United Kingdom (UK), additionally the figures before 2020 are also reported adjusted for EU27 (excluding UK).

Reflecting these market conditions, average reinsurance rates increased moderately in renewals in 2020 and January 2021 compared to initial expectations. Lower investment yields, another above-average loss year, higher loss cost trends, concerns over climate change and high uncertainty over eventual losses from the Covid-19 pandemic helped rates to accelerate across most commercial lines in 2020 and January 2021 renewals.[54] Especially lines of business and regions affected by high losses saw double-digit rate increases. In addition, retrocession renewals, always a more competitive and often a more challenged area of reinsurance, saw significant pricing rise.

However, there were also some regions with a benign catastrophe activity in 2020 such as in Europe. Here, consequently only low-single digit increases were seen widely at the January 2021 renewals. Most notably capacity in the market was again more than sufficient.[55] Overall, reinsurance rates increased in the mid to high-single digits, moderately compared to initial expectations.[56]

3.2. PROFITABILITY

In 2020, the global insurance industry catastrophe losses were considerably higher than in the previous year and equal to 2018 figures. According to estimates[57], natural catastrophes caused worldwide economic losses of 210 bn USD, an increase of 27 % compared to the previous year (166 bn USD). The insured losses amounted to 82 bn USD and nearing the 2018 figure of 86 bn USD, against a total of 57 bn USD in the previous year. The overall economic losses as well as the insured losses increased well above the long-term average. The number of fatalities decreased even further from 9,435 in 2019 to about 8,200 in 2020, significantly lower than the long-term average.

As in the previous year, weather-related catastrophes in the USA dominated the statistics. A series of thunderstorms in the American Midwest, major wild-fires in California and a severe hurricane season lead the US share of losses increase to 45% in terms of economic losses and to 82% in terms of insured losses. The long-term average of the US share of losses is about 35% in terms of economic losses and about 60% in terms of insured losses.

The costliest natural disaster of 2020 was the severe flooding in China during the summer monsoon rains. Overall losses from the floods amounted to approximately 17 bn USD, only around 2% of which was insured. In terms of insured losses the year´s costliest natural disaster was the category 4 hurricane Laura, which caused substantial storm surge damage and triggered wide-spread flooding that extended far inland. Overall losses came to 13 bn USD, with insured losses of 10 bn USD.

Table 3.1: The five largest natural catastrophes in 2020, ranked by insured losses

Date	Event	Region	Fatalities	Overall losses (USD bn)	Insured losses (USD bn)
26–28/08	Hurricane Laura	USA	33	13.0	10.0
Aug – Nov	Wildfires California	USA	32	11.0	7.0
8-12/8	Severe storm	USA	4	6.8	5.0
30/7-5/8	Hurricane Isaias	North America, Caribbean	18	5.4	4.1
12-16/9	Hurricane Sally	USA	8	6.3	3.5

Source: Munich Re, NatCatSERVICE.

54 See Reinsurance News Website: https://www.reinsurancene.ws/jan-1-renewals-yield-sharpest-price-changes-in-recent-memory-howden/

55 See AON Benfield: Reinsurance Market Outlook January 2021, page 4

56 See Reinsurance News Website: https://www.reinsurancene.ws/ample-capital-levels-moderated-price-increases-at-jan-1-guy-carpenter/

57 See Munich RE NatCatSERVICE, Website: https://www.munichre.com/en/company/media-relations/media-information-and-corporate-news/media-information/2021/2020-natural-disasters-balance.html

In Europe, the natural disaster figures for 2020 were relatively benign. Overall losses came to 12 bn USD, with insured losses of 3.6 bn USD.

Reinsurance underwriting profitability has slightly deteriorated but the sector remained profitable in 2020. The median gross combined ratio for EEA reinsurers for non-life direct business and accepted proportional reinsurance has increased from 90.7% in 2019 to 92% in 2020. Likewise, the median gross combined ratio for EEA reinsurers for accepted non-proportional reinsurance has increased from 67% in 2019 to 71% in 2020.

The amount of claims for reinsurers reported a noticeable increase at the end of 2020. For non-life reinsurance business, some line of business suffered an increase in claims during 2020: workers' compensation (+67%), medical expenses (+61%), casualty (+49%), credit and suretyship (+38%), property (+31%), general liability insurance (+19%) and fire and other damage to property insurance (+6%), while for motor vehicle liability and other motor insurance the number of claims decreased (-15% and -9%). The significant increase in claims for some line of businesses was partially offset by a raise in the premiums, in particular for fire and other damage to property insurance, casualty, general liability insurance, workers' compensation and medical expenses insurance line of businesses. For life reinsurance business, an increase by 12% in the claims at the end of 2020 was also reported in comparison with Q4 2019.

3.3. SOLVENCY

Solvency positions of EEA reinsurers slightly deteriorated during 2020. The median solvency ratio decreased by 18 percentage points in the first half of 2020 (223%), and then slightly improved by the end of the year (225%) (Figure 3.6). The positive developments in the equity market after the sharp fall in March 2020 helped reinsurers to partially recuperate their pre-pandemic capital positions.

Increased claims, as well as the potential economic slowdown could add further pressure to reinsurers' solvency positions. Capital positions remain resilient against the negative economic impact of the Covid-19 by end 2020. However, concerns remain due to the persistent low interest rates, the prolonged economic slowdown, the uncertainty over eventual losses from the Covid-19 pandemic and the potential implications of climate change. The success of the vaccination campaigns and the extension of fiscal measures to support the economy are crucial factors. A further economic slowdown and a financial market correction could lead to a further increase claims and reduction of gross written premiums for the reinsurance businesses.

Figure 3.4: 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)

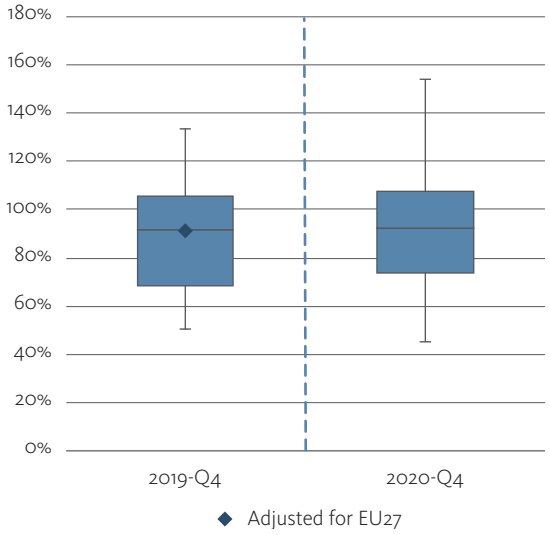
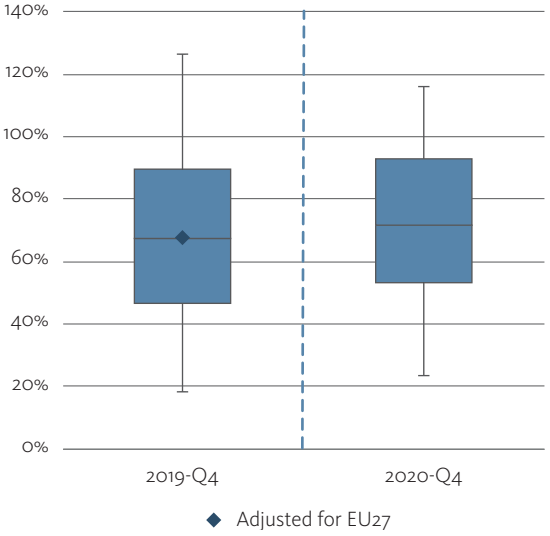
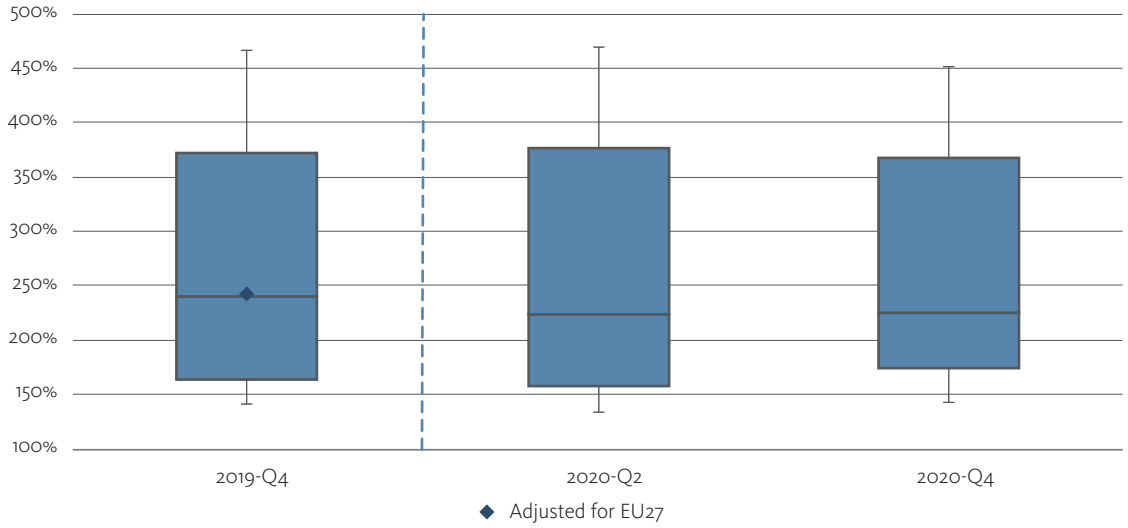


Figure 3.5: Gross Combined Ratio for accepted non-proportional reinsurance of EEA reinsurance undertakings (in %; median, interquartile range and 10th and 90th percentile)



Source: EIOPA Quarterly solo
Note: The figures for 2020 do not include United Kingdom (UK), additionally the figures before 2020 are also reported adjusted for EU27 (excluding UK).

Figure 3.6: Solvency ratio of EEA reinsurance undertakings (in %; median, interquartile range and 10th and 90th percentile)



Source: EIOPA Quarterly Solo
Note: The figures for 2020 do not include United Kingdom (UK), additionally the figures before 2020 are also reported adjusted for EU27 (excluding UK).

The competitive pressure in the reinsurance sector remains high and to cope with decreased underwriting profitability reinsurers are reacting by moderately increasing rates[58]. The following box is devoted to a timely aspect regarding the pricing of reinsurance.

58 According to Peel Hunt, an investment bank, the January 2021 renewals are the first one since the market began firming where "rates are having a compounding positive effect on un-derwriting margins." See ARTEMIS Website: https://www.artemis.bm/news/not-classic-hard-reinsurance-market/

BOX 3.1: IS CATASTROPHE RISK GETTING MORE EXPENSIVE TO REINSURE?

Protection from peak risks like catastrophes is one of the key functions of reinsurance. Reinsurance markets have a comparative advantage over primary insurance due to the ability to diversify across perils, geographies and lines of business. Moreover, reinsuring peak risks is capital intensive. Solvency II data from 2019 shows that the share of non-proportional reinsurance (widely used for catastrophe coverage) in non-life reinsurance business was almost double in terms of claims provisions compared to the share in terms of premiums.[59]

Due to the important functions played by reinsurance, understanding the pricing mechanisms is important not only for market participants, but also for supervisors. In practice, pricing can be volatile in reaction to extreme events. The conventional view of the reinsurance pricing cycle has been that peak losses reduce reinsurers' capi-

59 Reinsurers consider this aspect when pricing cat risks (see e.g. Froot (2007)). Froot, Kenneth, "Risk Management, Capital Budgeting and Capital Structure Policy for Insurers and Reinsurers", NBER Working Papers 10184 [link]

tal base, requiring them to increase prices ("hard" market), while prolonged periods of low losses lead to reserve releases, more capacity and low prices ("soft" market). Although limited correlation between reinsurance prices and prior year losses was evident between 1990 and 2006 (29%), it appears to be non-existent as of 2020 (8%) (Figure B.3.1.). It is therefore not sufficient to consider the incurred losses alone while trying to draw inferences on the movement of prices.

Identifying a more nuanced relationship between reinsurance pricing and losses has been more elusive, partly due to general lack of availability of relevant data to the industry outsiders. Importantly, indicators like rate on line index published by Guy Carpenter capture pricing trends but do not say anything about corresponding expected losses.

Catastrophe bonds (or cat bonds) provide a unique opportunity to shed more light on reinsurance pricing. Since they are traded by a broad set of investors in capital markets, there is a market price associated with these bonds. The investors are also presented with a risk analysis, which informs them about, inter alia, specific perils/ risks covered and a quantitative measure of associated expected loss. Lane and Mahul (2008)[60] used this information to express the spread at issue of a cat bond over LIBOR (equivalent of reinsurance premium) using a simple linear model:

$$\text{Premium Spread} = a + b*(\text{Expected Loss}) \quad \text{--- (1)}$$

If a = 0[61] and b >1, then the spread contains a load (above expected loss), which is an indicator of the amount of capital required by the bond.

Using data on cat bonds issued between 2004-2020[62], we estimated the above model for various time windows. For a preliminary analysis, we focussed on the 10 year time period leading to 2020 because it goes sufficiently back in time to capture multi-year pricing cycles in the reinsurance market while excluding older issues from the time when the cat bond market was relatively less mature. This period captures 432 data points[63]. In the 10 years leading to 2020, the value of b is 2.06 while in the last two years (105 data points) it is 2.24. Therefore, the 10 year average capital load required by cat bond investors (in this case the ultimate reinsurers) is 1.06 times the expected loss[64]. The same multiple for the last two years is 1.24. In other words, for the same level of expected loss, the capital load charged by cat bond investors in the last two years is 17% higher than the long-term average.

In order to test the robustness of this observed increase, we strip out the cyclical effects of reinsurance pricing using the rate on line index[65] as another independent variable:

$$\text{Premium Spread} = a + b*(\text{Expected Loss}) + c*(\text{Rate on Line Index}) \quad (2)[66]$$

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60 Lane, Morton; Mahul, Olivier. 2008. Catastrophe Risk Pricing: An Empirical Analysis. Policy Research Working Paper; No. 4765. World Bank, Washington, DC [link]

61 Economic intuition suggests that if all risk drivers are zero, there should not be any spread on the bond. Similar reasoning is regularly applied for empirical tests of asset-pricing models (e.g. Fama and French, 1993).

62 The Artemis Catastrophe Bond & Insurance-Linked Securities Deal Directory [link]

63 Each of the 432 data points represents a single tranche of cat bond. For example, three tranches of notes issued through a single bond are treated as three separate data points. Frequency of issue per year varies between 30 and 74.

64 In simplest terms, reinsurance pricing consists of two main components – expected loss and a loading to compensate the reinsurer for holding the requisite amount of capital. In equation (1), capital load is the amount over and above one unit of expected loss.

65 Guy Carpenter Global Property Catastrophe Rate-On-Line (ROL) Index is a measure of the change in dollars paid for coverage year on year on a consistent program base. The index reflects the pricing impact of a growing (or shrinking) exposure base, evolving methods of measuring risk and changes in buying habits, as well as changes in market conditions. Unlike risk-adjusted measurements, the index is not dependent on the model or method used to measure the amount of perceived risk in a program, which can vary widely. [link]

66 The estimates presented are based on an OLS pooled regression

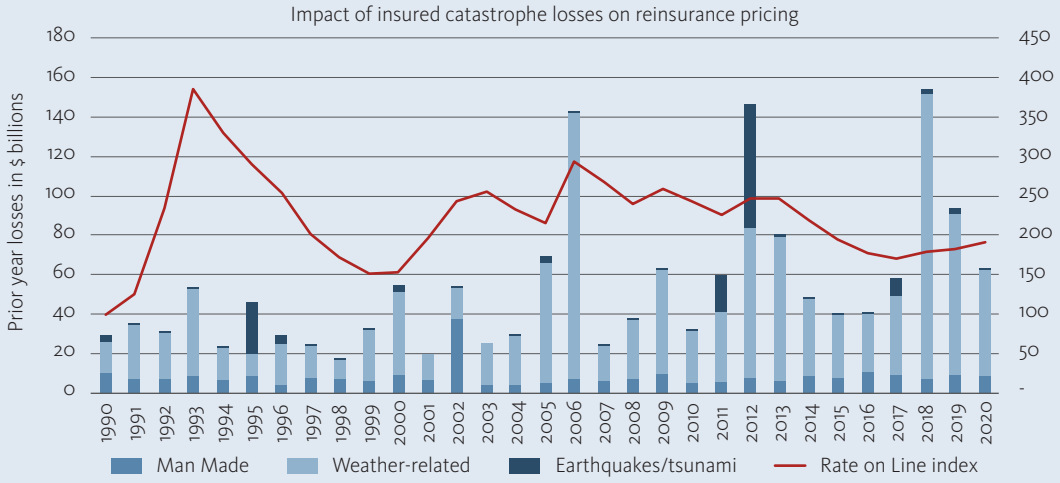
Table B.3.1 Regression estimates for models 1 and 2

Model Number	Time period	Intercept (a)	Expected Loss coefficient (b)	Rate on Line Index coefficient (c)	Number of observations	Adjusted R-squared
1	2019-2020	0	2.241***		105	87%
1	2011-2020	0	2.063***		432	83%
2	2019-2020	0	1.460***	0.0002056***	105	94%
2	2011-2020	0	1.358***	0.0001811***	432	93%
Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1						

We note that c is both positive and significant, implying that the spreads tend to move in the same direction as the traditional reinsurance prices. This is to be expected and is a clear indication that pricing in the cat bond and traditional reinsurance markets follows the same pattern. It also provides more confidence in using the spread of cat bonds as a proxy for prices in the broader reinsurance market. The coefficient of the rate on line index has been interpreted as a capital load factor that is unrelated to expected loss and varies with time. Stripping out the cyclical effects, and assuming a = 0, the 10 and two year coefficients of expected loss are 1.36 and 1.46 respectively, i.e. the capital load associated with expected loss is 28% higher in the last two years as compared to the long-term average.

While this analysis naturally does not capture all the risk drivers that determine the cat bond spreads[67], it still clearly illustrates how readily available data on cat bonds can be used to monitor the pricing of catastrophe risks in a manner that is difficult to do using regulatory data or aggregate reinsurance data alone. As of 2020, insurance linked securities represent 7.9%[68] of the total reinsurance capital available globally. The corresponding figure 10 years ago was less than half of it (at 3.2%). As the significance of cat bonds as a mechanism of risk transfer and an asset class grows, so does the availability of data pertaining to the underlying risks and their pricing. Increased transparency bodes well for not just investors and market practitioners, but also supervisors and the end consumer.

Figure B.3.1.: Impact of insured catastrophe losses on reinsurance pricing



Source: Swiss Re publications [link]

67 Academic literature has analysed the topic in detail in the recent years. Braun (2016), for instance, found that expected loss, covered territory, sponsor, reinsurance cycle, and BB corporate bond spread are major drivers of the cat bond *spreads*. Braun, Alexander, "Pricing in the Primary Market for Cat Bonds: New Empirical Evidence", Working Papers on Risk Management and Insurance, No. 116 – August 2014 [link]

68 Estimated using ILS outstanding and global reinsurance capital reported by Artemis.

4. THE EUROPEAN PENSION FUNDS SECTOR

Following the development of one comprehensive reporting framework for Institutions for Occupational Retirement Provisions (IORPs), which information requirements are aligned with other European and international reporting standards, EIOPA is now in a position to enhance its assessment of exposures and financial situation of the European IORP sector. The analyses presented here rely on quarterly IORPs data for a specific number of countries.[69]

4.1. SIGNIFICANCE OF THE SECTOR AND GROWTH

There are considerable differences relating to the size and significance of the national IORP sectors within the EEA. European IORPs hold in total EUR 2.5 trn of assets, of which EUR 1.7 trn of assets are held by IORPs in NL. The second biggest IORP sector, in terms of assets held, is DE with EUR 238 bn, followed by SE with EUR 166 bn and IT with EUR 161 bn. (Figures 4.1 and 4.2).

The significance of the IORPs - as investors and managers of pension savings - for the individual countries can be illustrated via penetration rates. The penetration rate reflects the value of the IORPs' total assets in relation of the country's GDP. Whereas the asset holdings of Dutch IORPs represent more than 200% of NL GDP in 2020, the second biggest IORP sector – DE – represents, in terms of asset values, only 7% of the country's GDP. The penetration rate for IT is 10% and the one for SE is 35% (Figures 4.3 and 4.4). Not only due to their absolute size in terms of asset holdings, but also relative to the country's economy, Dutch IORPs play an important role in their economy and obviously are the most important provider of occupational retirement income in NL. To the opposite, German IORPs, whilst holding significant asset values of EUR 238 bn, are taking a relatively modest role in the DE economy.

One year after the outbreak of the pandemic, financial markets have recovered from the shock waves of March and April 2020. However, due to the unpredictable nature of the pandemic, leading to severe restrictions on business activities and consumer behaviours, risks of corporate defaults, increases in risk premia, market volatility and the fear of increases in inflation are looming. The recovery over the course of 2020 can be illustrated by the total assets' quarterly development of a sample of 950 IORPs, for which quarterly data were available. The asset value at Q3 and Q4 2020 exceeded Q4 2019 levels. (Figure 4.5).

4.2. INVESTMENT ALLOCATION, EXPOSURES AND FUNDING LEVELS

The IORP's investment allocation and the exposure to market risks determines - to a significant extent - if and how the IORPs may be affected by the materialisation of risks relating to corporate failures, increases in risk premia and financial market volatility. EEA IORPs' predominant investment class is debt instruments - via bonds and investments in bond investment funds. This represents almost 50% (unweighted) of the total assets. Within the debt investments, the investments are mostly (61%) sovereign bonds and the remainder mostly corporate bonds (Figures 4.6 and 4.7). Considering these high exposures to sovereign debt, IORPs are potentially most affected by the pertaining low yields in sovereign exposures, but will also be affected should corporate failures materialise and risk premia significantly increase.

69 Figures may be subject to revision, as they could not cover all Member States due to missing submissions (CY, IE, GR and LV). Nineteen EEA countries (EEA) reported fourth quarter-2020 data: AT, BE, BG, DE, DK, ES, FI, FR, HR, IT, LI, LU, NL, NO, PL, PT, SE, SI and SK. There are not any pension funds in scope of the IORP II Directive in RO, EE, CZ and LT. HU and MT only report annual data and therefore could not be included in this analysis relating to Q4 2020 information. IE has a significant IORPs sector in terms of assets, however no quantitative information has been submitted to EIOPA by the time of finalising this report.

Figure 4.1: Total Assets (in EUR bn)

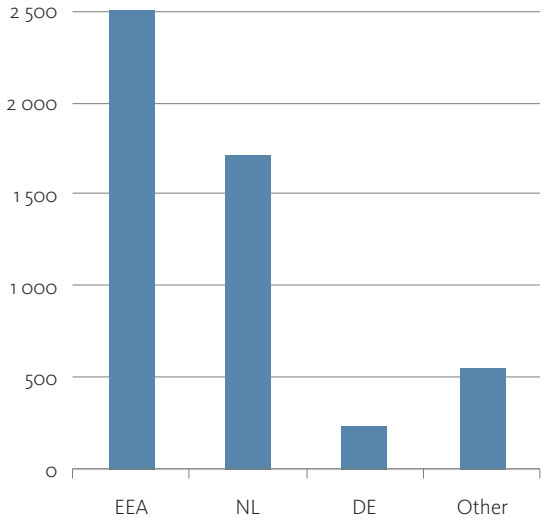
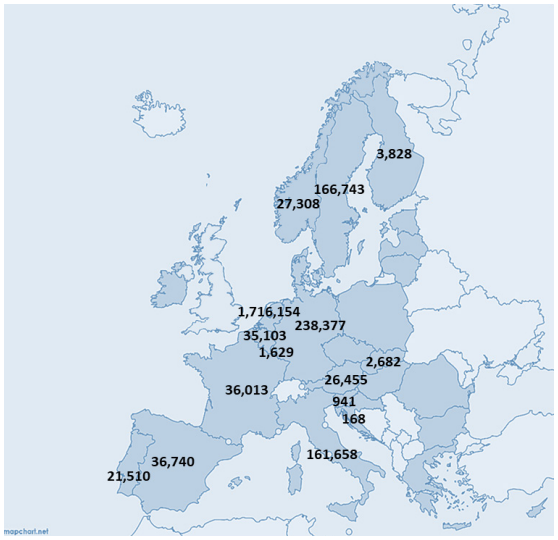


Figure 4.2: Total assets (in EUR million)



Source: EIOPA IORPs reporting
Date: Q4 2020
Note: Figures may be subject to revisions, as they could not cover all Member States due to missing submissions. See Footnote 69. Figures 4.2 and 4.3 exclude four member states (BG, DK, LI and PL) with a small number of IORPs in at least one scheme (DC/DB)

Figure 4.3: Penetration rates (total assets as % of GDP)

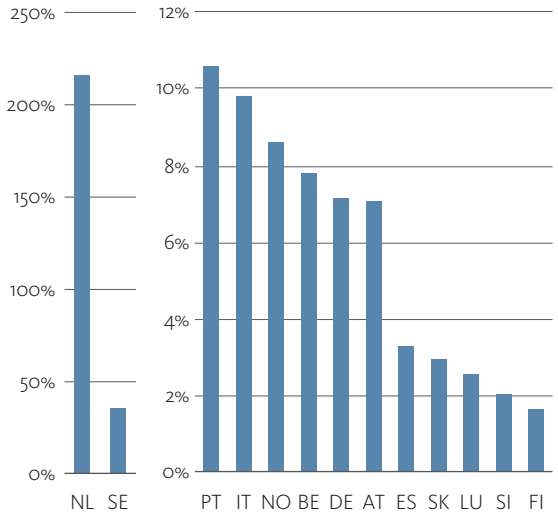
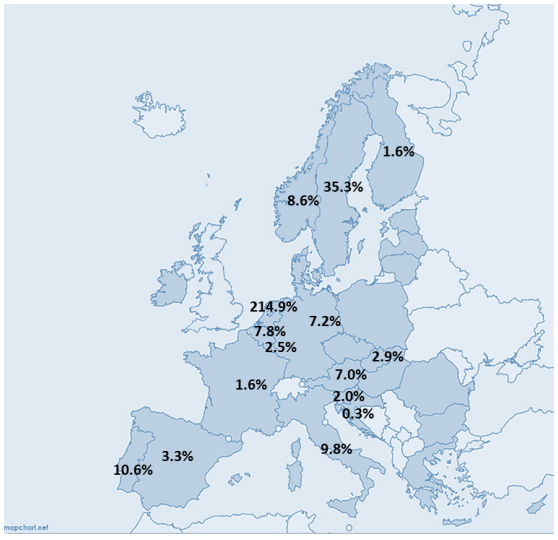
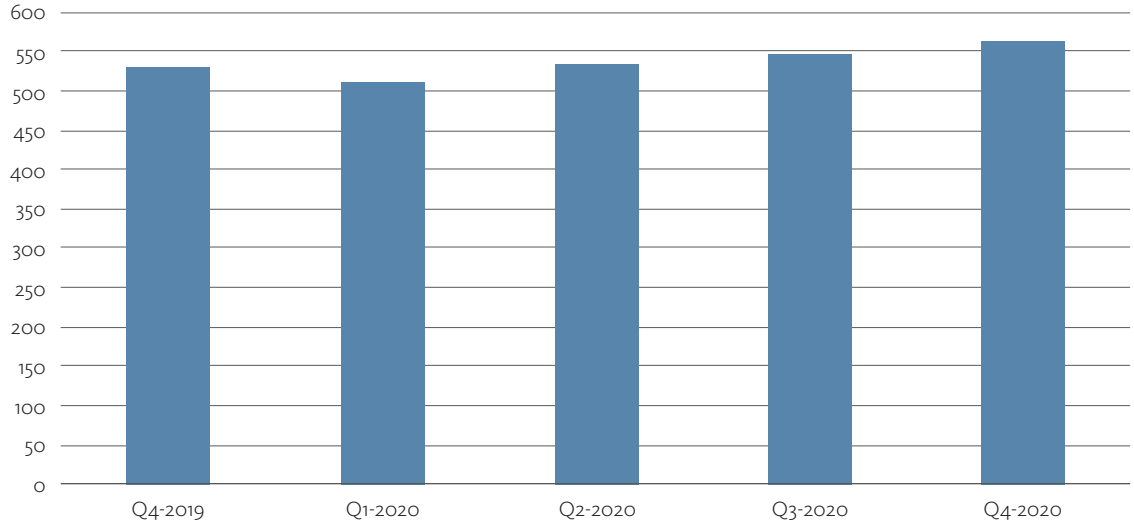


Figure 4.4: Penetration rates (total assets as % of GDP)



Source: EIOPA IORPs reporting and Eurostat for the GDP
Date: Q4 2020
Note: Figures may be subject to revisions, as they could not cover all Member States due to missing submissions. See Footnote 69.
For figure 4.3, penetration rates for HR and BG are lower than 1%. Figure 4.3 and 4.4 exclude four member states (BG, DK, LI and PL) with a small number of IORPs in at least one scheme (DC/DB)

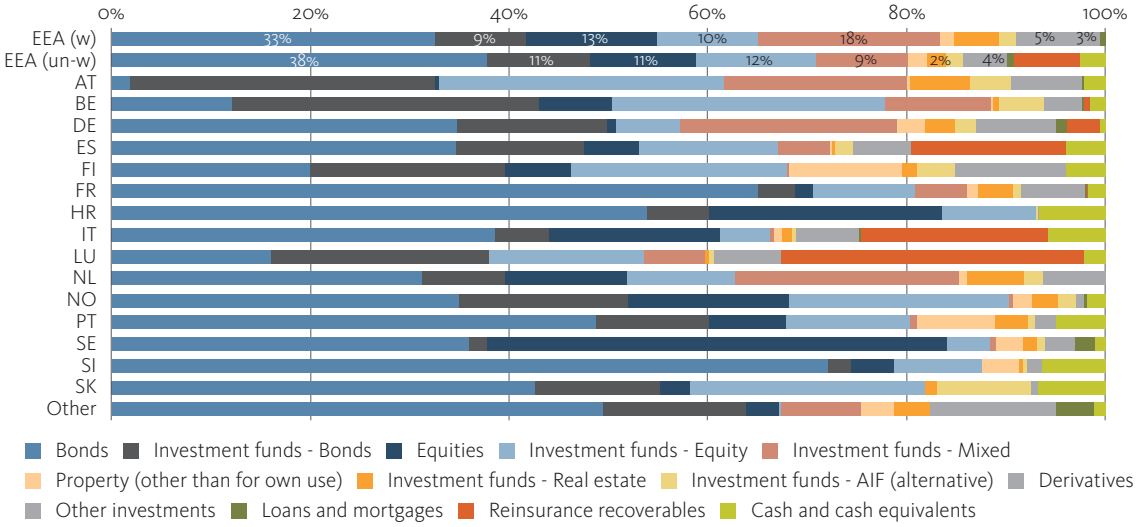
Figure 4.5: Assets development from Q4 2019 to Q4 2020 for specific countries (in EUR billion)



Source: EIOPA IORPs reporting
Date: Q4-2019, Q1-Q2-Q3-Q4 2020
Note: See Footnote 69. Figure 4.5 includes specific member states in order to ensure consistency of the sample across quarters (AT, BE, BG, DE, DK, ES, FI, HR, IT, LI, PL, NL, NO, SI and SK).

At EEA level, the next most important asset class are equity investments, directly and indirectly, amounting to 24% (unweighted) of the total assets, almost 70% of which are listed shares and over 30% unlisted equity investments (Figures 4.6 and 4.8). Listed shares benefit from transparency through listing requirements at stock exchanges and market valuation, yet may be exposed to increased market price fluctuations, as a consequence of potentially increased market volatility. Unlisted equity investments may be more challenging to value, in particular in times of market distress, yet are expected to be equally exposed to market risks and impairment.

Figure 4.6: Asset allocation of all IORPs (in %)



Source: EIOPA IORPs reporting
Date: Q4 2020
Note: Figures may be subject to revisions, as they could not cover all Member States due to missing submissions. See Footnote 69.
"Other" category aggregates four member states (BG, DK, LI and PL) with a small number of IORPs in at least one scheme (DC/DB). EEA (w) is the weighted average, while EEA (un-w) is the un-weighted average.Other investments comprise investment funds and direct invetsments.

Figure 4.7: Breakdown of direct bond holdings

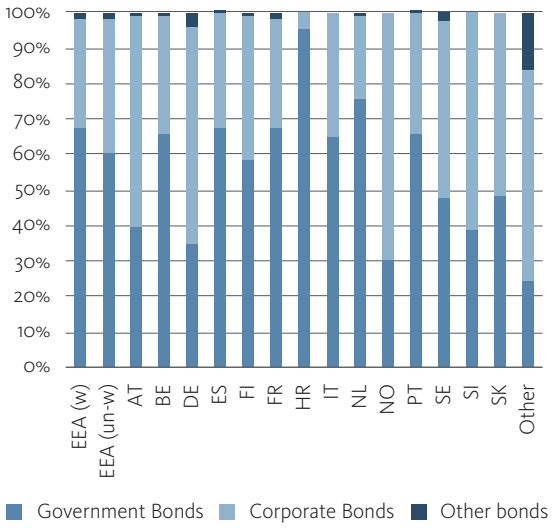
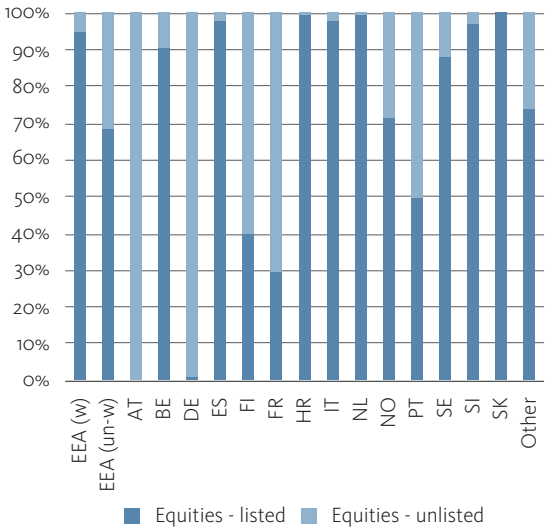


Figure 4.8: Breakdown of direct equity holdings



Source: EIOPA IORPs reporting
Date: Q4 2020
Note: Figures may be subject to revisions, as they could not cover all Member States due to missing submissions. See Footnote 69.
"Other" category aggregates four member states (BG, DK, LI and PL) with a small number of IORPs in at least one scheme (DC/DB). Collective investments are excluded.

In terms of total assets, defined benefit (DB) IORPs and schemes are the predominant IORP and scheme type in the EEA, whereas defined contribution (DC) IORPs and schemes are becoming the predominant IORP and scheme type in terms of numbers of members. It is interesting to note that, presumably due to the different types of pension obligations and the differences in member structure and preferences, there are distinctly different allocations to investment classes.

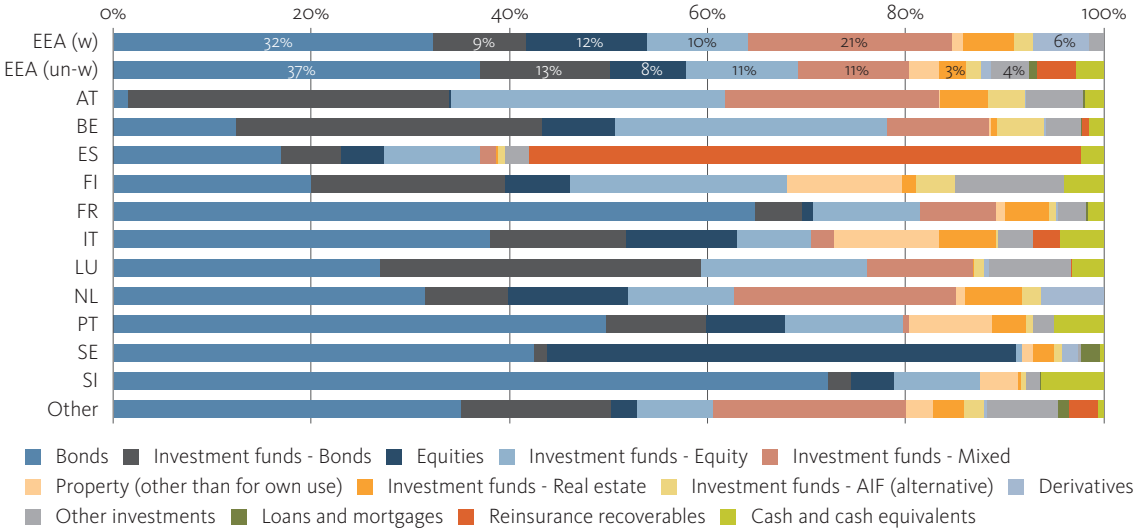
Assessing the (unweighted) asset allocation at EEA level, DB IORPs and schemes mostly invest in debt instruments (50% of total assets); DC IORPs and schemes invest in debt instruments to 44% of total assets. DB IORPs and schemes tend to invest less in equity, 19% of total assets, where DC IORPs and schemes hold more equity investments, 28% of total assets. Investments in real estate and in real estate investment funds is more significant in DB IORPs and schemes than in DC IORPs and schemes. DC IORPs and schemes tend to use insurance contracts to 're'-insure their obligations with insurance undertakings to a higher extent than DB IORPs and schemes.

The use of derivatives, to hedge interest rate and currency exposures, are more common in DB IORPs and schemes than in DC IORPs and schemes, and are significant in a few countries, such as DK and NL. Derivatives require appropriate risk and liquidity management to manage margin calls in cash, in particular, where there is central clearing, from which IORPs and other pension scheme arrangements are temporarily exempted (Figures 4.9 and 4.10).

DB IORPs and schemes manage occupational retirement obligations that entail certain guarantees, for example: a certain level of future retirement income, linked to the paid-in contributions, indexed to inflation or a minimum return on the paid-in contributions. Such long-term obligations are sensitive to the low interest rate environment, due to potential duration mismatches between investments and pension obligation reinvestments and the resulting reinvestment risks at lower rates. Capital and funding requirements, as well as underlying valuation approaches, are determined at national level and are not necessarily comparable. The analyses here refer to the results at country level, strictly reflecting the individual national requirements.

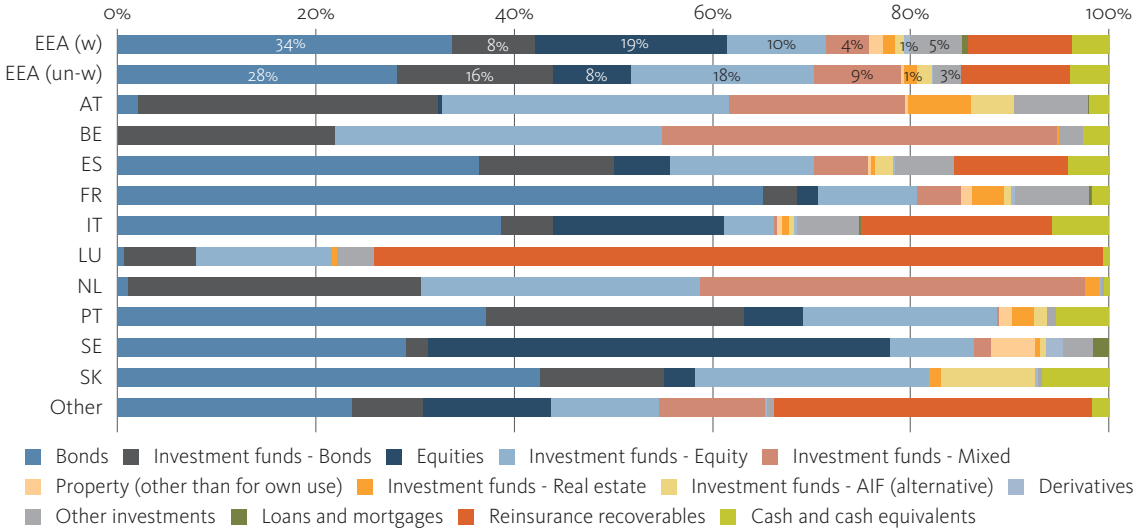
Despite the markedly decreasing – and recovering – market values of assets in 2020, the DB IORPs' and schemes' cover ratios, i.e. total assets covering total liabilities, reached around 100% at EEA level by the end of 2020. (Figure 4.11).

Figure 4.9: DB schemes: Asset allocation (in %)



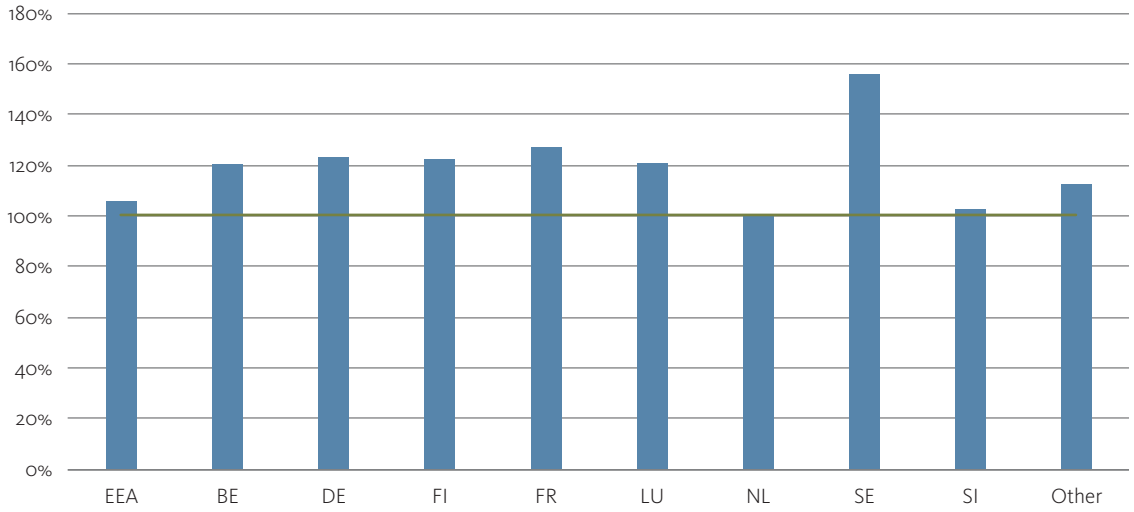
Source: EIOPA IORPs reporting
Date: Q4 2020
Note: Figures may be subject to revisions, as they could not cover all Member States due to missing submissions. See Footnote 69. "Other" category aggregates seven member states (BG, DE, DK, HR, LI, NO and PL) with a small number of IORPs in at least one scheme (DC/DB). EEA (w) is the weighted average, while EEA (un-w) is the un-weighted average. Other investments comprise investment funds and direct invetsments. The figures include assets allocated to the DB schemes of mixed IORPs. That allocation may be subject to judgment where assets of mixed IORPs' DB and DC schemes are pooled together.

Figure 4.10: DC schemes: Asset allocation (in %)



Source: EIOPA IORPs reporting
Date: Q4 2020
Note: Figures may be subject to revisions, as they could not cover all Member States due to missing submissions. See Footnote 69. "Other" category aggregates seven member states (BG, DE, DK, HR, LI, NO and PL) with a small number of IORPs in at least one scheme (DC/DB). EEA (w) is the weighted average, while EEA (un-w) is the un-weighted average. Other investments comprise investment funds and direct invetsments. The figures include assets allocated to the DC schemes of mixed IORPs. That allocation may be subject to judgment where assets of mixed IORPs' DB and DC schemes are pooled together.

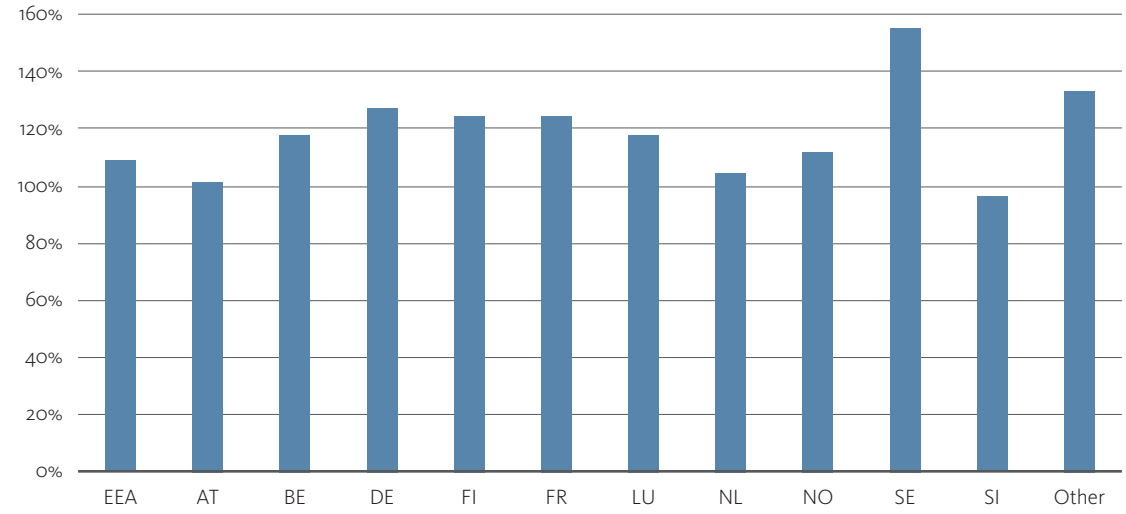
Figure 4.11: DB schemes: Assets covering liabilities for selected countries (in %)



Source: EIOPA IORPs reporting
Date: Q4-2020
Note: Figures may be subject to revisions, as they could not cover all Member States due to missing submissions. See Footnote 69. "Other" category aggregates six member states (BG, DK, HR, LI, PL and NO) with a small number of IORPs in DB scheme. For those countries that are subject to the reporting obligation, but for which there are reporting issues figures are not disclosed. The figures include assets allocated to the DB schemes of mixed IORPs. That allocation may be subject to judgment where assets of mixed IORPs' DB and DC schemes are pooled together.

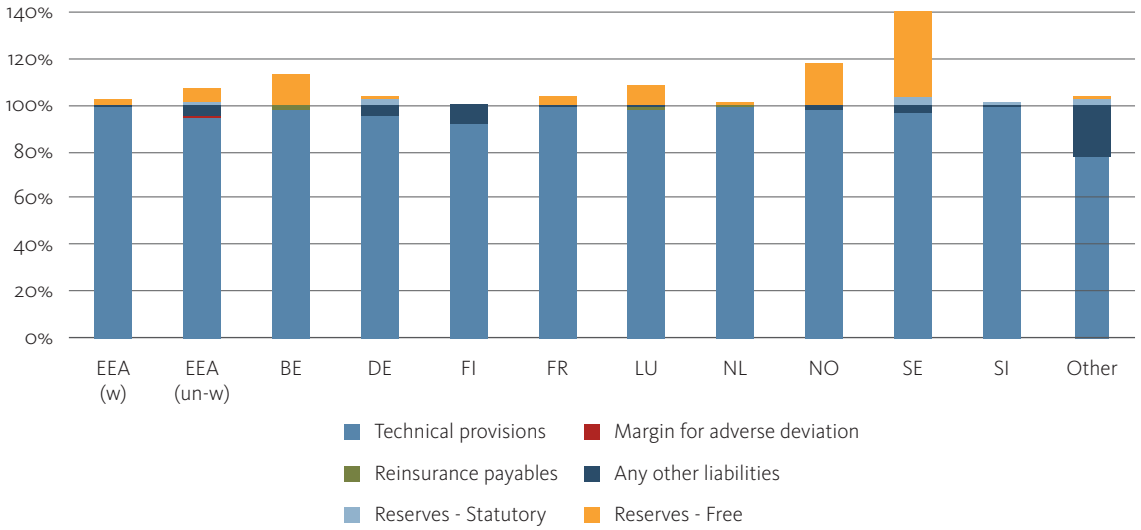
To understand the role of insurance for the pension obligations of DB IORPs and schemes, it is worthwhile to assess the ratio of assets covering the liabilities after (re-) insurance. The cover ratio net of reinsurance shows values above 100% at EEA level by the end of 2020 (Figure 4.12 vs. in Figure 4.11). Yet, in particular in countries where reinsurance is used to a significant extent, it provides insights in the stabilising effect of reinsurance and the impact of the severe market devaluation on the IORPs' own investments in the first and second quarter of 2020.

Figure 4.12: DB schemes: Investments covering technical provisions net of reinsurance (in %)



Source: EIOPA IORPs reporting
Date: Q4-2020
Note: Figures may be subject to revisions, as they could not cover all Member States due to missing submissions. See Footnote 69. "Other" category aggregates five member states (BG, DK, HR, LI and PL) with a small number of IORPs in DB scheme. For those countries that are subject to the reporting obligation, but for which there are reporting issues figures are not disclosed. The figures include assets allocated to the DB schemes of mixed IORPs. That allocation may be subject to judgment where assets of mixed IORPs' DB and DC schemes are pooled together.

Figure 4.13: DB schemes: Reserves in relation to liabilities (in %)



Source: EIOPA IORPs reporting
Date: Q4 2020
Note: Figures may be subject to revisions, as they could not cover all Member States due to missing submissions. See Footnote 69. "Other" category aggregates five member states (BG, DK, HR, LI and PL) with a small number of IORPs in DB scheme. For those countries that are subject to the reporting obligation, but for which there are reporting issues figures are not disclosed. The figures include balance sheet items allocated to the DB schemes of mixed IORPs. That allocation may be subject to judgment where mixed IORPs' DB and DC schemes are pooled together.

Finally, based on national requirements, it is worth noting that in some countries, BE, LU, NE and SE, DB IORPs and schemes have built reserves exceeding their liabilities, in some instances, to a significant extent. At EEA level (unweighted), even after the market turmoil in 2020, there are still reserves in excess of liabilities.

4.3. REGULATORY DEVELOPMENTS

In March 2020 EIOPA published two model IORP II Pension Benefit Statements: PBS1[70] and PBS 2[71]. The model statements provide clear information to members on their pension pot with a view to make more informed decision about their retirement savings. In this way, EIOPA gives practical guidance on how to implement the annual information document that IORPs are required to send to their members following the implementation of the IORP II Directive. Both models were developed in line with the principles identified by EIOPA in its Report on the IORP II Pension Benefit Statement[72]. They have been developed specifically for defined contribution schemes and, while containing the same information, reflect different communication styles. The PBS models are voluntary and may be further developed and adapted to the national specificities and/or characteristics of each pension scheme.

In August 2020, EIOPA delivered to the European Commission a set of draft Regulatory and Implementing Technical Standards and its advice on Delegated Acts to implement the framework for the design and delivery of the Pan-European Personal Pension Product (PEPP): EIOPA's proposed legal instruments follow the objective to unlock the potential of the European personal pension market by setting the right incentives for the creation of future PEPPs, as portable, simple and cost-efficient products. The regulatory provisions include clear and enforceable quality criteria for PEPP to be followed by providers and so to ensure that European consumers will be offered high-quality, safe, transparent and simple PEPPs. At the same time, EIOPA is leaving sufficient room for innovation and competition to reach good pension outcomes. Clear criteria for sound and robust investment strategies and risk mitigation techniques will help in delivering better long-term returns to savers and

70 See pension benefit statement available (pdf): https://www.eiopa.europa.eu/sites/default/files/publications/pension_benefit_statement_1.pdf

71 See pension benefit statement available (pdf): https://www.eiopa.europa.eu/sites/default/files/publications/pension_benefit_statement_2.pdf

72 See report: https://www.eiopa.europa.eu/sites/default/files/publications/reports/eiopa_pbs_guidance_and_principles_0.pdf

in managing investment risks to match the European citizen's risk appetite.

In this regard, EIOPA developed two mandatory consumer information documents: the PEPP Key Information Document (PEPP KID) and PEPP Benefit Statement. These standardised information documents will provide consumers with relevant information allowing for easier decision-making before entering into a binding contract and monitoring the savings' performance during the life of the contract.

The PEPP consumer information documents introduce a holistic approach for the assessment and analysis of the PEPPs' risk-reward profiles, with a 'summary risk indicator' in the PEPP KID that identifies the riskiness of the different PEPP investment options – as well as comparative information to understand the relative risk to the expected future PEPP retirement benefits. Further, projections of future retirement income are key for consumers to understand the characteristics of PEPPs and to enable the consumer to consider whether the product meets the individual retirement objectives.

Furthermore, online distribution will be one of the most important opportunities of PEPPs to attract the consumer's interest and to engage with the PEPP saver for the retirement planning. It will be particularly critical that consumers can easily access, understand and use the information presented in a digital format. The use of digital means is expected to bring important cost-efficiencies in the distribution process.

Cost-efficiency is one of the major goals for the success of the PEPP. In case of the Basic PEPP the annual cost will be limited to 1% of the PEPP saver's accumulated capital at the end of each year. The Basic PEPP – the core or default investment option – has been specifically regulated to offer a relatively high level of capital protection, which can be further extended to a capital guarantee. The cost of providing that guarantee is excluded from the cost cap but must be expressly disclosed.

5. RISK ASSESSMENT

5.1. QUESTIONNAIRES TO NCAS

In order to assess the risks and key vulnerabilities for the insurance sector, EIOPA conducted a survey, using a qualitative questionnaire, among national competent authorities (NCAs).

Macro, market and credit risks remain key risks for both the insurance sector and the IORP sector (Figure 5.1 and Figure 5.2). The economic outlook remains uncertain and the recovery will depend on how persistent the pandemic proves to be. While 2020 was already a challenge, respondent NCAs recognize that ongoing negative macroeconomic conditions coupled with the prolonged low interest rates could further deteriorate the situation for insurers (Figure 5.3). Furthermore, the economic slowdown following the Covid-19 pandemic could start fully materializing in the real economy during 2021, given the delayed impact of the pandemic on households and companies due to the phase out of governmental support and gradual depletion of financial reserves.

Among market risks, **interest rate risk** is indicated as the main concern (Figure 5.4). This is the result of the fact that insurers reinvest maturing fixed-income assets at lower yields and on the other side need to pay, in some member states, high interest rate guarantees. At the same time, respondents see a material risk of market corrections, given that valuations apparently exceed fundamental levels (possibly due to the supportive measures in place). This could directly impact insurers and IORPs that are highly exposed to equity through depreciation of asset prices. Furthermore, property risk remains a concern, due to downside risks in the prices of commercial real estate.

Figure 5.1: Risk assessment in terms of materiality for the insurance sector

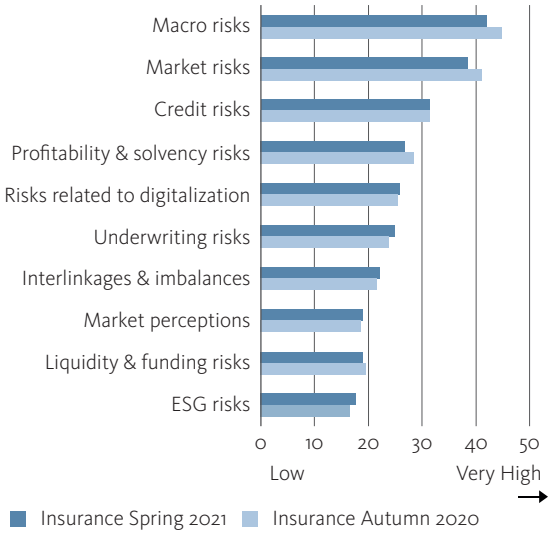
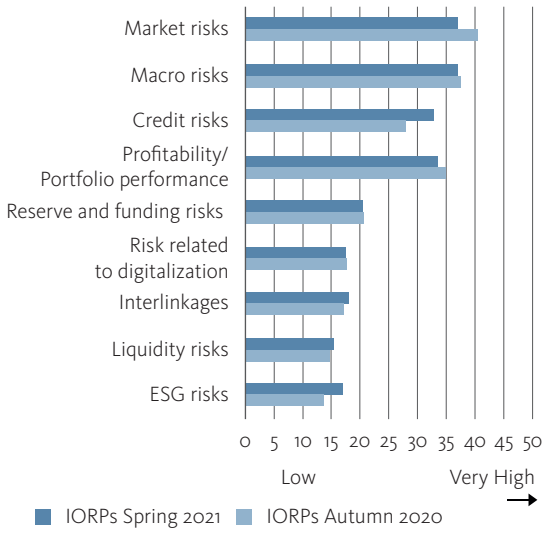


Figure 5.2: Risk assessment in terms of materiality for the IORP sector



Source: EIOPA Insurance Bottom Up Survey Spring 2021 and Autumn 2020
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

Together with interest rate risk, **credit risk** is also considered a key factor. Corporate bonds downgrades remain a concern, triggered by the prolonged economic slowdown. Moreover, in case of a reversal of the currently observed decoupling between financial markets' performance and the macroeconomic environment, prices of bonds issued by banks, non-financial corporations and sovereigns (Figure 5.5) could drop. This could have a severe impact on the balance sheets of insurers and IORPs that are highly exposed to more credit risky bonds.

Profitability and solvency risks remain a challenge for the insurance sector, standing in the 4th position of the risk assessment (Figure 5.1). Both investment and underwriting profitability remain a concern for insurers' profitability (Figure 5.6). Investment profitability decreases with turbulences of the financial markets. The impact on underwriting profitability is heterogeneous across lines of business. Solvency positions remain resilient for composite and non-life business, while life-business capital positions significantly deteriorated in the first half of 2020 and then partially recovered in the second half, without reaching the pre-Covid levels. The longer nature of life insurers' liabilities jointly with the prolonged low interest rate environment could partially explain the stronger impact on the life insurers' capital positions.

Risks related to shift away from guaranteed products are mentioned as a latent risk for the insurance sector. Not considered in the list of risks above but mentioned by the respondent NCAs as a consumer protection concern is the shift from guaranteed products to unguaranteed products such UL/IL. The concern is the shift of risk to policyholders, not only market risk, but also longevity risk. Moreover, more exotic and alternative investment products as a consequence of higher demand of UL/IL-products, could result in more illiquid insurers' portfolios.

Figure 5.3: Main drivers for macro risks[73] for the insurance sector

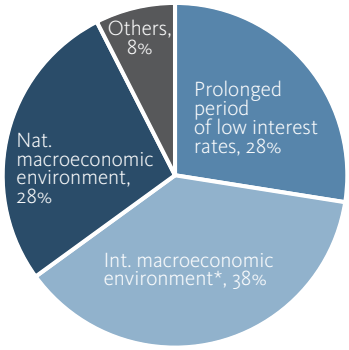


Figure 5.4: Main drivers for market risks for the insurance sector

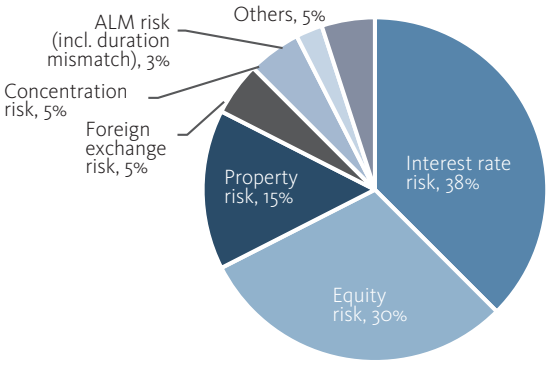
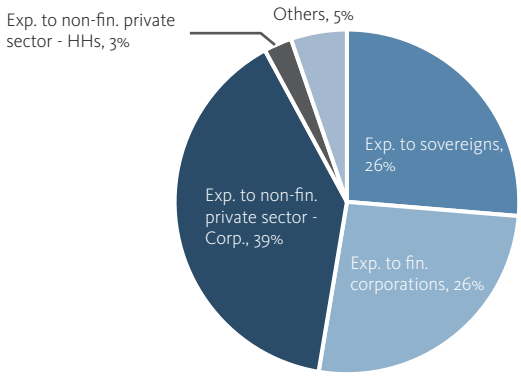


Figure 5.5: Main drivers for credit risks for the insurance sector



Source: EIOPA Insurance Bottom Up Survey Spring 2021
Note: Based on the responses received.

73 International and national macroeconomic environment drivers in macro risk category exclude prolonged low interest rates.

Figure 5.6: Main drivers for profitability and solvency risks for the insurance sector

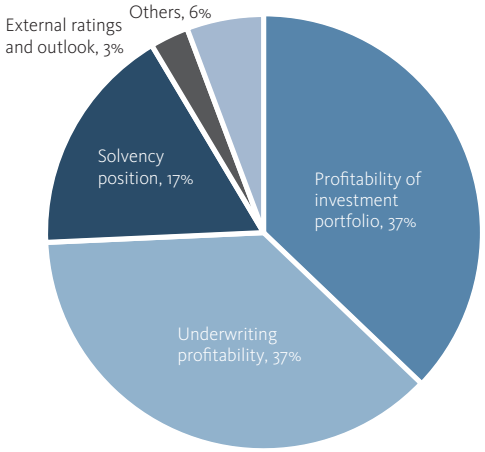


Figure 5.7: Main drivers for risks related to digitalization for the insurance sector

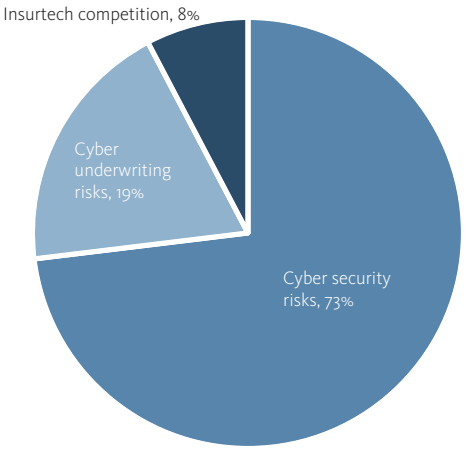
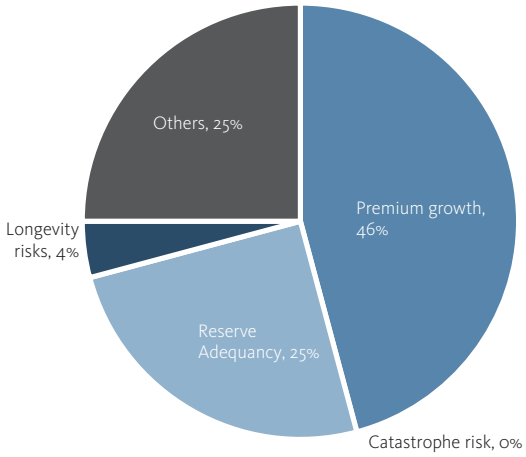


Figure 5.8: Main drivers for underwriting risks for the insurance sector



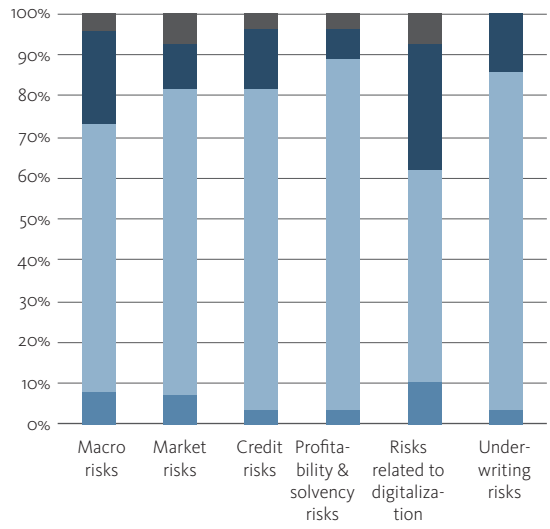
Source: EIOPA Insurance Bottom Up Survey Spring 2021
Note: Based on the responses received.

Risks related to digitalization are ranked in the 5th place of material risks for the insurers (Figure 5.1). The current home office set up established for already a year in many EEA undertakings has raised the concerns on cyber security, which is the main risk related to digitalization. The number of cyber-attacks has risen, not just in the insurance business but also in the financial sector and other sectors, and although the impacts are difficult to estimate, respondent NCAs fear that there will be more incidents. Going forward, a reputational risk for insurers may arise.

To withstand possible negative effects from the Covid-19 crisis, some undertakings maintain a closer communication with National Supervisory Authorities following conservative and prudent policies. Although insurers have already taken numerous measures (Figure 5.9) to deal with the Covid-19 crisis, the need to introduce and reinforce measures to mitigate risk is still perceived to be important. For macro risks, 23% of members consider it necessary to reinforce existing measures. Likewise for market and credit risks, 19% of the respondents consider the reinforcement of existing measures or the introduction of new ones. 32% of the respondents consider that reinforcing existing measures or introducing new measures for ESG risks is needed (not showed).

Profitability and solvency risks remain a concern for insurers going forward (Figure 5.11). The negative economic development might lower the demand of insurance products and impact insurers underwriting profitability, in particular for life insurance business, for which, by the end of 2020, signs of deterioration are more notable in terms of both collected premiums and capital positions.

Figure 5.9: The need of risk mitigation measures for the top 6 risks for the insurance sector



Source: EIOPA Insurance Bottom Up Survey Spring 2021
Note: Based on the responses received.

Figure 5.10: The need of risk mitigation measures for the top 6 risks for the IORP sector.

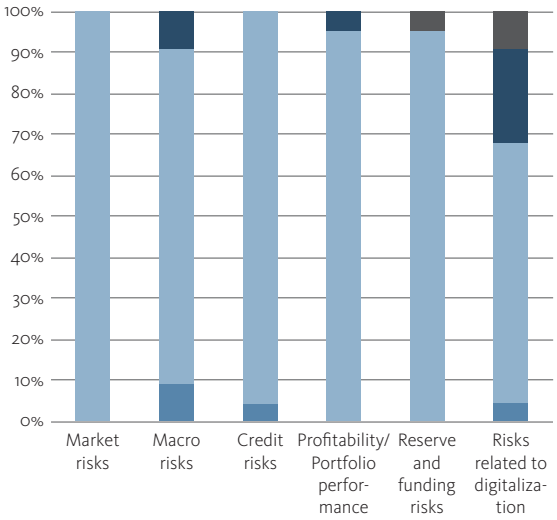


Figure 5.11: Risks with the highest expected increase in materiality over the next 12 months for the insurance sector

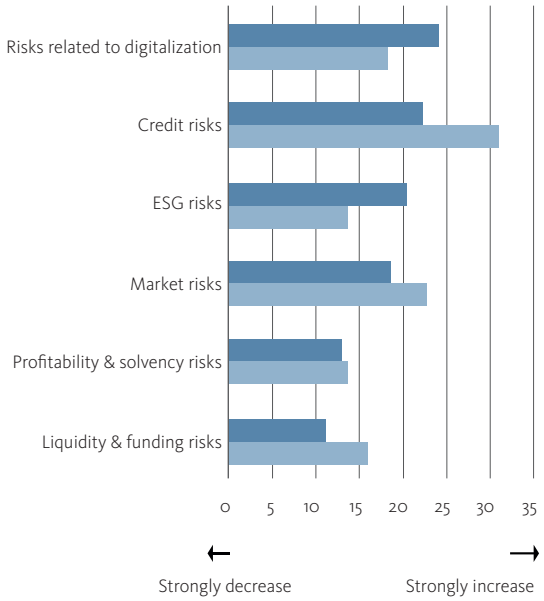
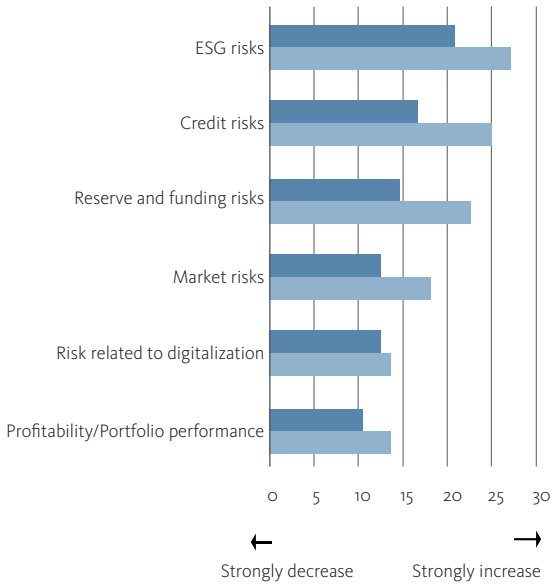


Figure 5.12: Risks with the highest expected increase in materiality over the next 12 months for the IORP sector



Source: EIOPA Insurance Bottom Up Survey Spring 2021
Note: Based on the responses received. Risks are ranked according to the expectation for the future movements of each exposure (from -2 indicating strongly decrease to +2 indicating strongly increase). The figure shows the aggregation of the average scores assigned to each risk. The results were subsequently normalised on a scale from -100 to 100.

Risks related to digitalization remain a challenge for insurers going forward (Figure 5.11). Undertakings are promoting more Insurtech solutions, including additional distribution channels and more automated claims process handling via web/smartphone interfaces. This may increase their vulnerability to cyber-attacks. At the same time, the number of cyber security products offered by insurers has increased, together with the number of claims covering these type of risks, mitigating the potential negative impact of cyber-attacks on financial stability. EIOPA is closely monitoring the developments related to digitalization and in October EIOPA published guidelines on information and communication technology security and governance.[74]

Looking ahead, credit risks remains in the top 2 in terms of the highest expected increase in materiality over the next 12 months (Figure 5.11 and Figure 5.12). These results are driven by the uncertainty about the persistence of the pandemic, by the risk of a re-emergence of the Euro area crisis in the upcoming months and by the potential further economic slowdown that could materialize during 2021, when supporting fiscal packages by governments and monetary policy measures activated in response to the situation come to an end.

5.2. QUALITATIVE RISK ASSESSMENT OF THE EUROPEAN INSURANCE AND IORPS SECTORS

This section further assesses the key risks and vulnerabilities for the European insurance and IORP sectors identified in previous parts of the report.

First, the breakdown of the investment portfolio and asset allocations is discussed with a focus on specific country and sectoral exposures, as well as home bias. In the second part, insurers' trading activity in government bonds, corporate bonds and equity during 2020 is analysed. The focus is on three aspects. First, on whether and to which extent insurers responded to the turbulent financial market developments during the Covid-19 pandemic. Second, on the interconnectedness between insurance and the banking sector; in this regard, results might show a de-risking trend of insurers' exposures. The third focus is an update of an analysis proposed in the December 2020 EIOPA Financial Stability Report on the impact of large-scale rating downgrades due to Covid-19 crisis and insurers' behaviour on downgraded bonds. The chapter concludes with two Boxes, one dedicated to an econometric analysis of the dynamics of life technical provisions and another dedicated to a sensitivity analysis of climate-change related transition risks.

INVESTMENTS HOLDINGS

Asset allocations for insurers remained broadly stable on aggregate, with dominant exposures towards fixed income assets and equities. Government and corporate bonds make up around two-thirds of the total investment portfolio whereas equities (listed and unlisted) follow in terms of materiality (Figure 5.13). This makes insurers' portfolios susceptible to interest rate risk, credit risk and equity risk. From an undertaking's perspective, composite and life insurers are highly exposed to government and corporate bonds, whereas non-life companies are mostly exposed to corporates, governments and, in addition, unlisted equities (mainly participations). Reinsurers have the highest exposure towards unlisted equities. However, this includes holdings in related undertakings, which account for most of the equities held. Reinsurers also have the largest holdings of cash and deposits (Figure 5.14).

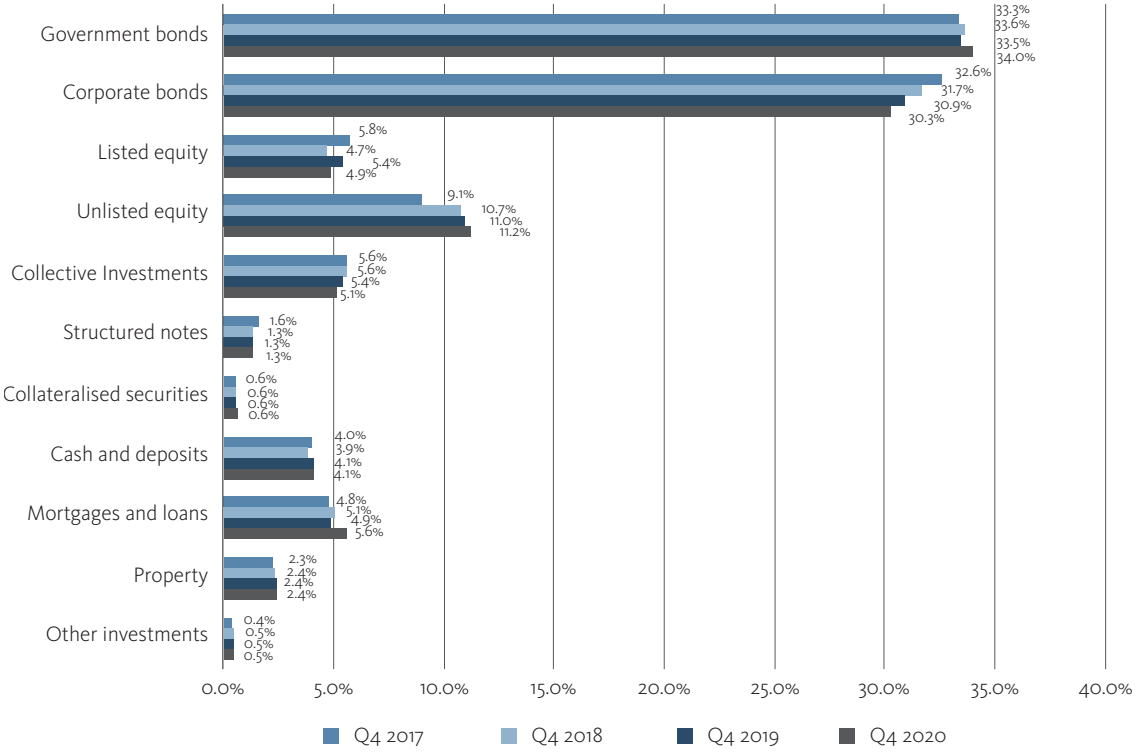
On the aggregate market level, there is a slight shift from corporate bonds to government bonds compared to the last year. The share of government bonds and unlisted equity slightly increased while the share of corporate bonds and listed equity decreased.[75] Nevertheless, these changes capture both changes in prices and changes in quantities. During the last year, there have been strong market movements. In particular, for equity prices there was a sharp drop in the first quarter with a recovery over the course of the year.

Asset allocations for IORPs differ from those of insurers. IORPs have lower exposures towards fixed income assets and higher exposures towards equity and property. EEA IORPs' predominant investment class is bonds which represents 42% of total assets (Figure 5.14). Consequently, IORPs are affected by the prolonged low yields in sovereign exposures, but also by the potential materialisation or corporate failures or significant increases of risk premia. The next most important asset class at EEA level are equity investments amounting to 23% of the

74 See EIOPA guidelines on information and communication technology security and governance https://www.eiopa.europa.eu/content/guidelines-information-and-communication-technology-security-and-governance, October 2020.

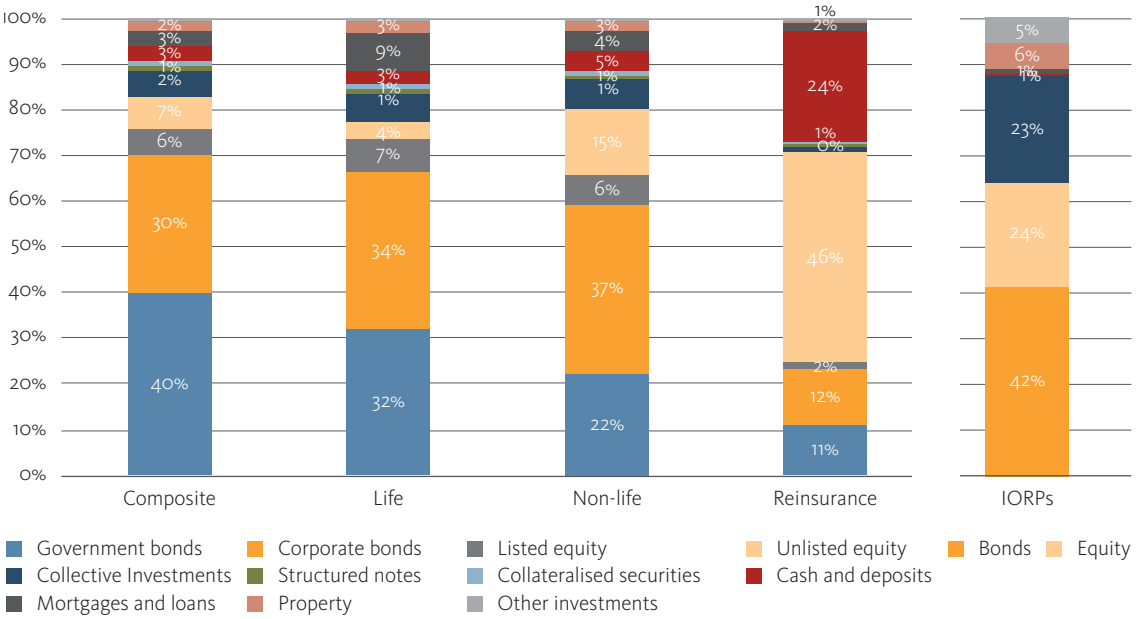
75 For more details on these shifts, please refer to subsection EEA insurers' trading activity during 2020.

Figure 5.13: Investment split in Q4 2020 compared to Q4 2019, Q4 2018 and Q4 2017 for the insurance sector



Source: EIOPA Quarterly Solo
Reference Date: Q4 2017, Q4 2018, Q4 2019 and Q4 2020.
Note: Look-through approach applied. Assets held for unit-linked business are excluded. Equities include holdings in related undertakings. Unlike for equity, in SII reporting data, exposures to corporate bonds cannot be further classified according to their liquidity.The figures for years from 2020 onwards have been adjusted for EU27 following the Brexit withdrawal agreement.

Figure 5.14: Investment split in Q4 2020 by type of undertaking



Source: EIOPA Quarterly Solo and EIOPA IORPs reporting
Reference Date: Q4 2020
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. The figures for years from 2020 onwards have been adjusted for EU27 following the Brexit withdrawal agreement. Split into government and corporate bonds and listed and unlisted equity for IORPs' collective investments is not available.

total assets, almost 70% of which are listed shares and over 30% unlisted equity investments. The exposure towards property in the form of mostly investment in real estate investment funds is of about 6%.

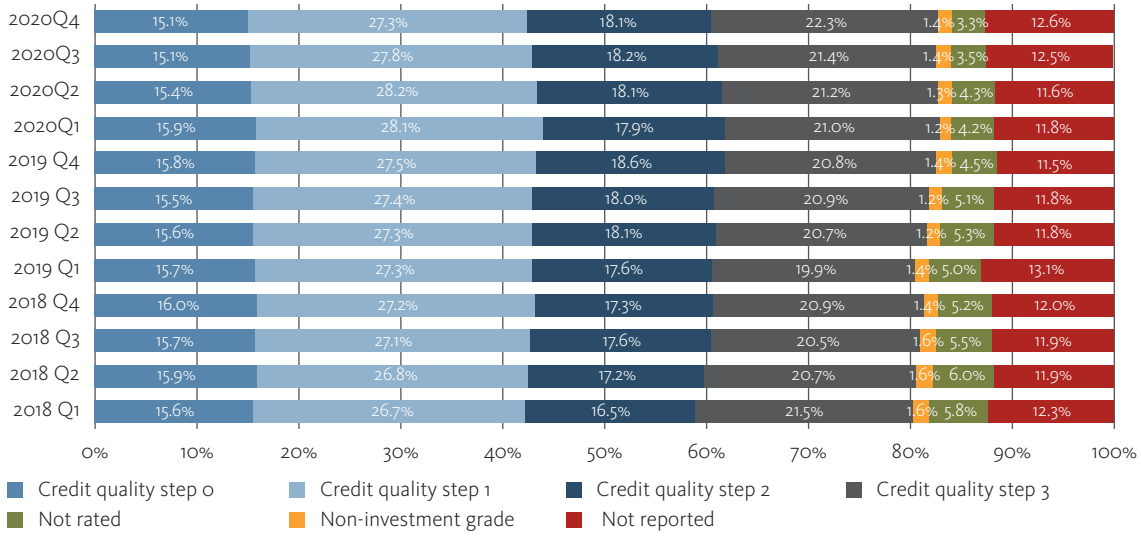
Investment decisions for insurers and IORPs are difficult amid the uncertainty in financial markets. Ultra-low interest rates, volatile credit spreads and potential increased need for liquidity challenge the asset allocation and needs to be factored in appropriately. This could increase the risk of assets not matching the liabilities' characteristics. Furthermore, the uncertainty regarding equity markets and its apparent different trajectory compared to economic outlook, as well as the uncertainty regarding alternative investments could increase investment risk when insurers and IORPs invest in these asset classes.[76]

The concentration to lower quality bonds could potentially be a risk transmission channel for the insurance sector for some countries. The uncertainty on the post crisis economic outlook could negatively affect the credit quality of insurer's bond portfolio. The vast majority of bonds held by European insurers are investment grade, with most rated as CQS1 (AA) (Figure 5.15). CQS3 (BBB) bonds amount approximately to 22% of the total bonds market value, a significant increase compared to last year[77]. These bonds are subject to the risk of rating downgrades below investment grade. A massive rating downgrade could significantly impact the market value of the asset portfolio and, at the same time, potentially increase the spread risk solvency capital requirement.

For the majority of bonds (66%) held by European IORPs the information on credit quality is missing in the reported data; data quality is expected to improve in the next rounds of reporting. For the reported part, 20% of the total is split between CQS0 (AAA) and CQS1 (AA) and 13% between CQS2 (A) and CQS3 (BBB) (Figure 5.16).

The country level concentration in terms of insurers' exposures to low quality bonds is shown in Figure 5.17. However, the effect of the materialisation of the above mentioned risks depends, as well, on the diversification within the credit quality steps of the bond portfolio.

Figure 5.15: Credit quality of bond portfolio for the insurance sector

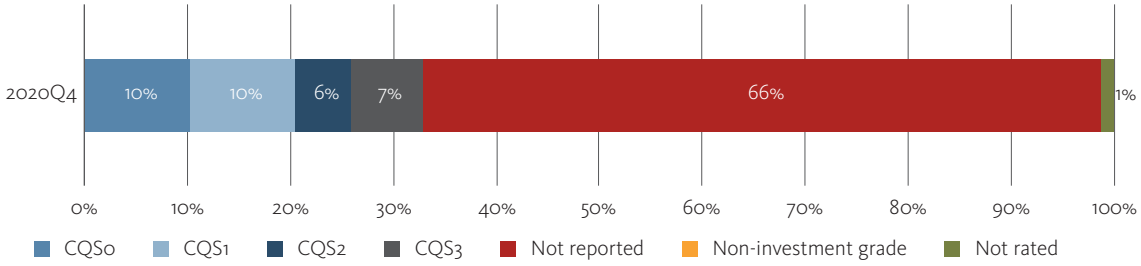


Source: EIOPA Quarterly Solo
Reference date: Q4 2020
Note: Government and corporate bond portfolios combined. Assets held for unit-linked are included. The figures for years from 2020 onwards have been adjusted for EU27 following the Brexit withdrawal agreement.

76 More focused analysis in terms of investment allocation and behavior could be found in the EIOPA report "Impact of ultra low yields on the insurance sector, including first effects of COVID-19 crisis" published in July 2020 https://www.eiopa.europa.eu/content/impact-ultra-low-yields-insurance-sector-including-first-effects-covid-19-crisis_en

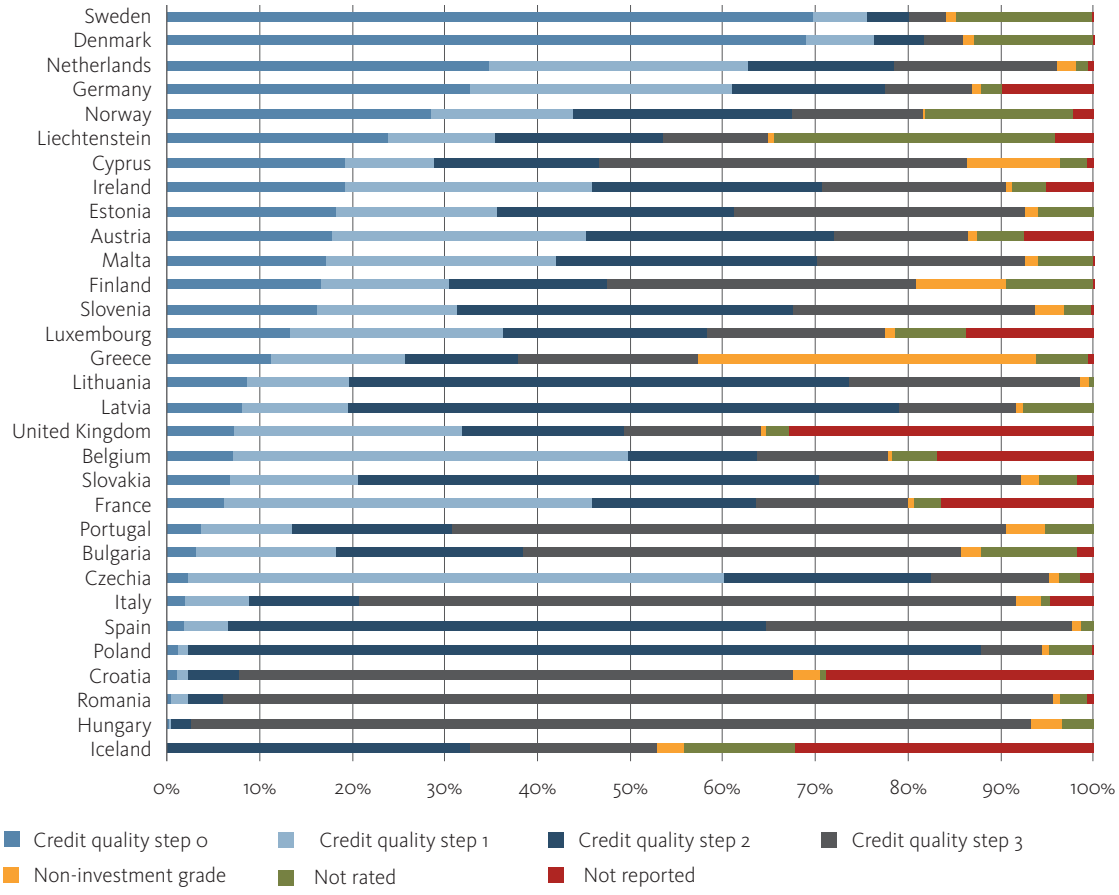
77 Increases in specific rating categories are determined by a combination of four factors: valuation effects, rating transitions (i.e. upgrades or downgrades), trading activity and/or bonds reaching maurity. Trading activity is discussed later on in the chapter.

Figure 5.16 Credit quality of bond portfolio for the IORP sector



Source: EIOPA IORPs reporting
Reference date: Q3 2019
Note: Government and corporate bond portfolios combined. Assets held for unit-linked are included. The figures for years from 2020 onwards have been adjusted for EU27 following the Brexit withdrawal agreement.

Figure 5.17: Credit quality of bond portfolio across countries for the insurance sector



Source: EIOPA Quarterly Solo
Reference date: Q4 2020
Note: Government and corporate bond portfolios combined. Assets held for unit-linked are included.

BOX 5.1 SECTORAL EXPOSURES

This section outlines the possible "new normal" after the end of the Covid-crisis. It aims to identify those segments expected to be outperforming and examines the asset allocation by insurers towards these sectors.

Analysts forecast that the Covid-19 pandemic could reach a turning point in Europe in Q3 2021[78] – provided that the announced vaccination speed can be maintained in practice. There are two effects to be distinguished: first, some parts of the economy will fully return or even exceed to pre-Covid levels; while, secondly, other sectors will not recover fully immediately or not at all.

Past experience has shown that crises leave persistent structural changes, both of economical as well as sociological nature.[79] Some of the habits developed during the crises will continue to stay and will continue to drive the supply for specific products or services. Among those habits developed during the pandemic and expected to stay beyond are online shopping and virtual consultations; the latter may concern health issues but also remote engagement with peers and colleagues.[80]

Looking even further long term, some analysts argue that the crisis will unleash further technological innovation across a variety of sectors. Some expect that in particular 3D printers, artificial intelligence, surveillance technologies and mobile data will play a key role in these technological advancements in the future.[81]

The overview below depicts both sectors that are expected to outperform as well as those anticipated to recover more slowly or not reaching pre-Covid levels at all.

Firstly, the following sectors are expected to be outperforming beyond the end of the Covid crisis:

- **eCommerce** (incl. e-grocery and food delivery) – eCommerce has been the sector that has grown most rapidly during the pandemic. The amended consumer habits of ordering online rather than going out are anticipated to persist and it is therefore expected that the eCommerce will remain outperforming for a longer period to come.
- **Pharmaceuticals** - Turning the gaze towards market indicators, stock price developments indicate several potential winners of the crisis; most notably the pharma companies that successfully engaged in the development and roll out of the vaccine. Their stock prices have increased overall since the start of the pandemic in Q1 2020 (a recent exception being AstraZeneca)[82] signalling investors' trust into continued revenue in 2021/22.
- **Telecommunications** – During the pandemic and lockdowns, remote means of communication have played an essential role in enabling people to remain in contact both in professional and private situations. While private encounters with friends and family are likely to return to physical face-to-face ones, numerous employers are likely to decide to further pursue work in hybrid (i.e. partly physical face-to-face

78 https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/when-will-the-covid-19-pandemic-end.

79 Please see also p. 3 available at https://assets.ey.com/content/dam/ey-sites/ey-com/fi_fi/pdf/beyond-covid-19-what-will-define-the-new-normal.pdf

80 See for example https://www.accenture.com/us-en/insights/consumer-goods-services/coronavirus-consumer-trends-impacting-cpgs, https://www.bbc.com/news/business-51706225, and https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Risk/Our%20Insights/COVID%2019%20Implications%20for%20business/2021%20updates/March%2024/COVID-19-briefing-note-47-March-24-2021.pdf?shouldIndex=false for further details.

81 https://assets.ey.com/content/dam/ey-sites/ey-com/fi_fi/pdf/beyond-covid-19-what-will-define-the-new-normal.pdf, p.6ff.

82 Source: Refinitiv as of on 27 Aril 2021.

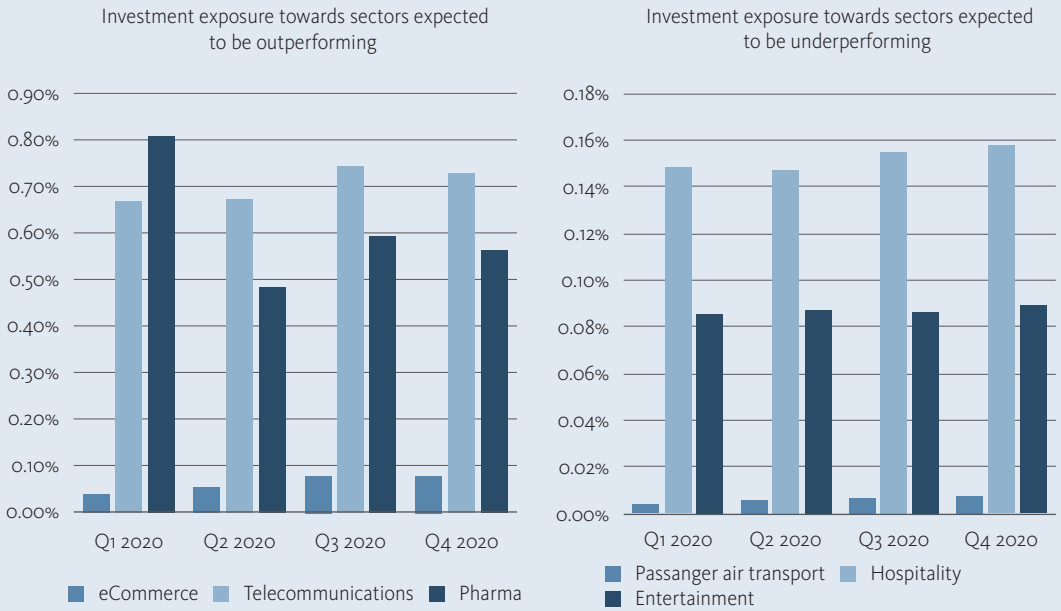
and partly remote) teams and meetings. To facilitate this, efficient and reliable means of communicating remotely will remain of utmost importance.

Secondly, the following sectors are expected to be recovering more slowly and/or not reaching pre-Covid levels at all:

- **Air travel** – The pandemic has showed the possibilities of digital communication in a business environment therefore the number of meetings held physically and the associated air travel could be expected not to reach back its pre-Covid levels.
- **Entertainment** – Home entertainment has been the norm for many months. It is expected that this consumer behaviour will be shifting more gradually to pre-Covid standards even after e.g. cinemas and theatres opened their doors again.
- **Hospitality** – Hospitality has been among those sectors hit the hardest by the Covid-19 due to lockdowns and other restrictions. Once these are lifted, the sector will recover although it might take place gradually as some form of hygiene requirements or restrictions on number of guests could remain in place even after the Covid pandemic has passed.

Insurers' investment exposure towards these sectors has been very low in the past; the total reaching 1.37% in Q4 2020 for the three 'outperforming' sectors and 0.25% for the 'underperforming'.

Figure B.5.1.1: Investment exposure towards sector expected to be outperforming and underperforming



Source: EIOPA Quarterly Solo. List of assets S.06.02. NACE code is used for the breakdown (additional aggregations performed). Includes different types of instruments such as equity but also covered bonds and other instruments.

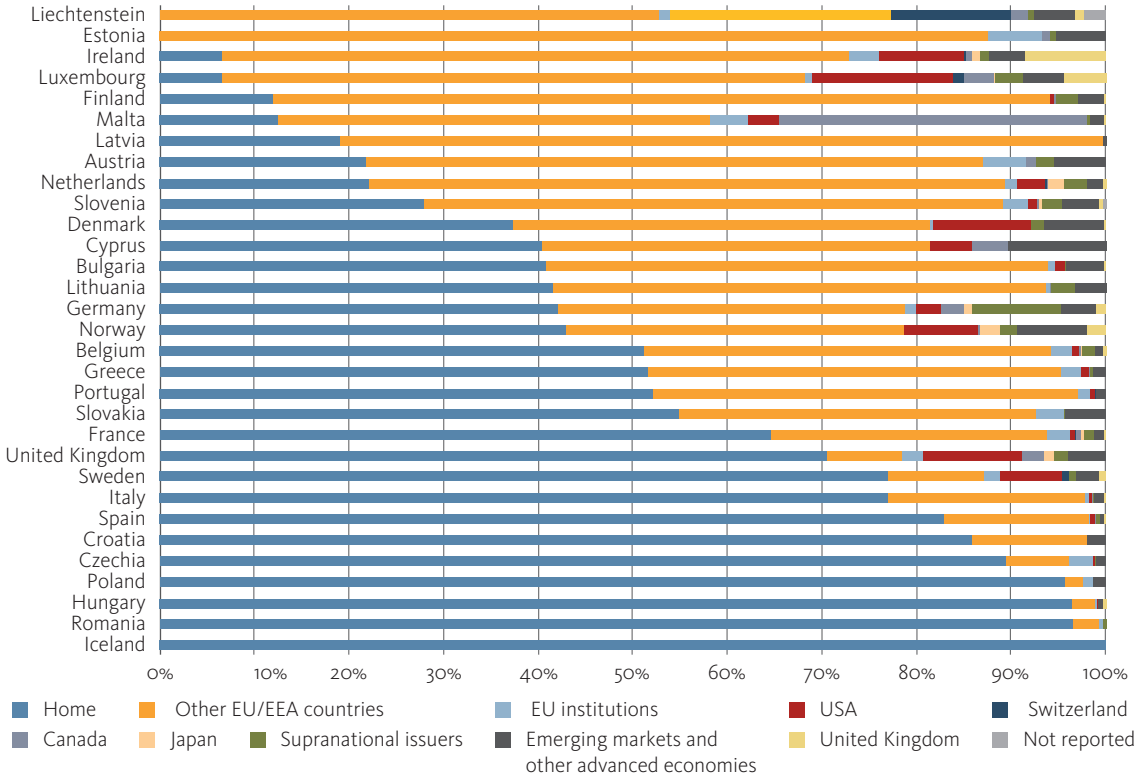
HOME BIAS

The risk that certain countries are more affected by the pandemic amplifies the concentration risk of the insurance and the IORP sector, both of which have significant home bias in bond investments. Looking through the government bond portfolio, holdings of insurers' government bonds continue to show significant home bias (Figure 5.18 and 5.19). IORPs also invest a large share in domestic government bonds (Figure 5.20). For the two countries with the largest IORPs sectors, Netherlands and Germany, the share of the home country is respectively 17 and 55% percent; not much different than in the insurance sector. The uneven impact of Covid-19 across countries could affect the asset value of those insurers that invest predominantly in a hard-hit home country.

Most government bonds held by insurers are from EU/EEA countries. The share of investments in emerging markets is only 2.4%, slightly decreased year-on-year (Figure 5.19). Although emerging markets could be explored in the search for higher yields, these could be a potential source of risk looking forward due to higher volatility and lower stability of the economies, in particular, as a consequence of the Covid-19 outbreak.

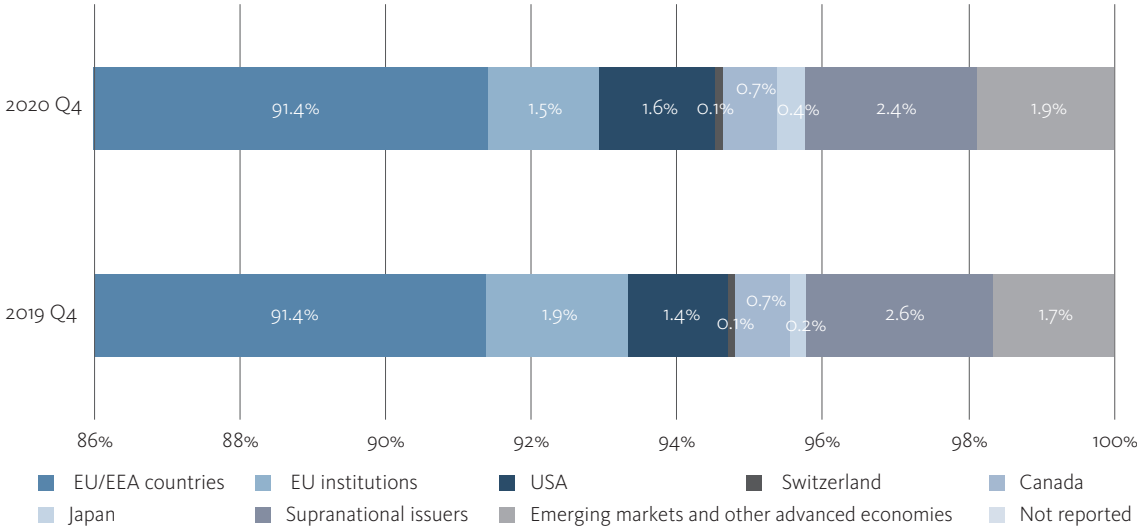
Home bias for corporate bonds is lower compared to government bonds. This holds for most countries (Figure 5.21). Insurers invest approximately 80% of the aggregate portfolio in EEA/EU countries and 12% in US markets, the largest and most liquid corporate bond market in the world. The share of the U.S. has slightly increased (5.22). Again, for the two countries with the largest IORPs sectors, Netherlands and Germany, domestic investment in corporate bonds is not much different than for insurance sector (Figure 5.23).

Figure 5.18: Holdings of government bonds by issuer country for the insurance sector



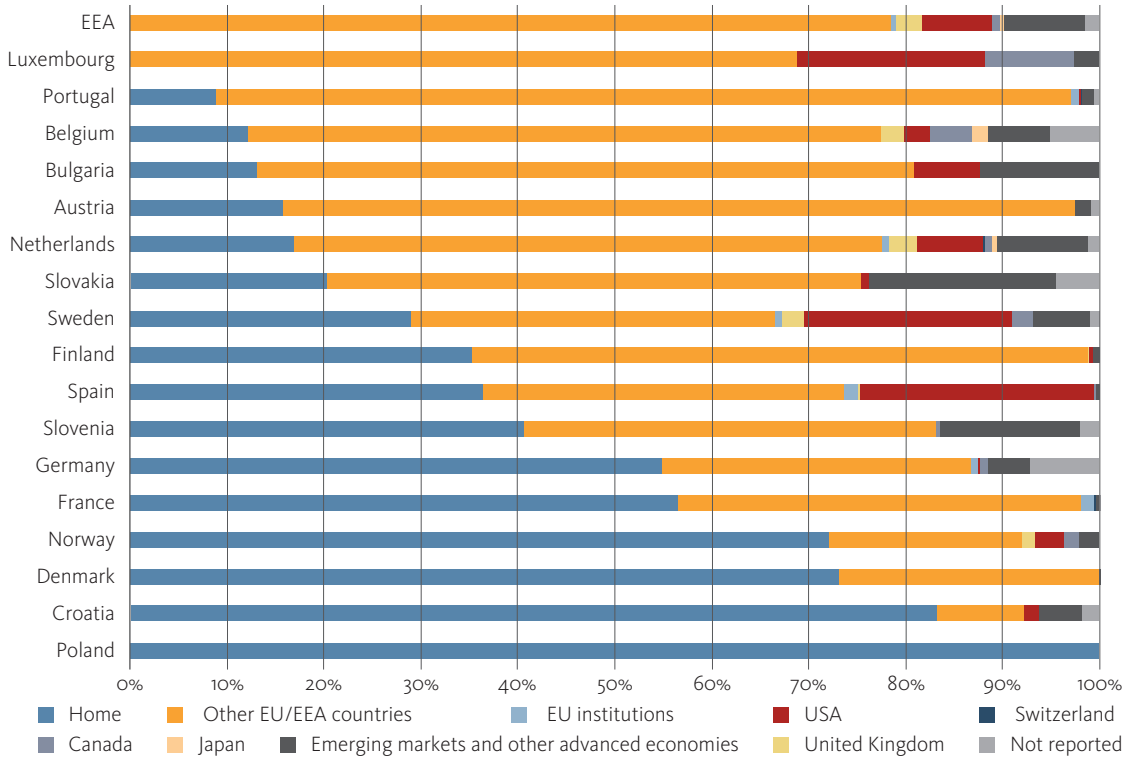
Source: EIOPA Quarterly Solo
Reference Date: Q4 2020
Note: Look-through approach is not applied. Assets held for unit-linked business are included.

Figure 5.19: Overall government bonds exposures to different countries for the insurance sector



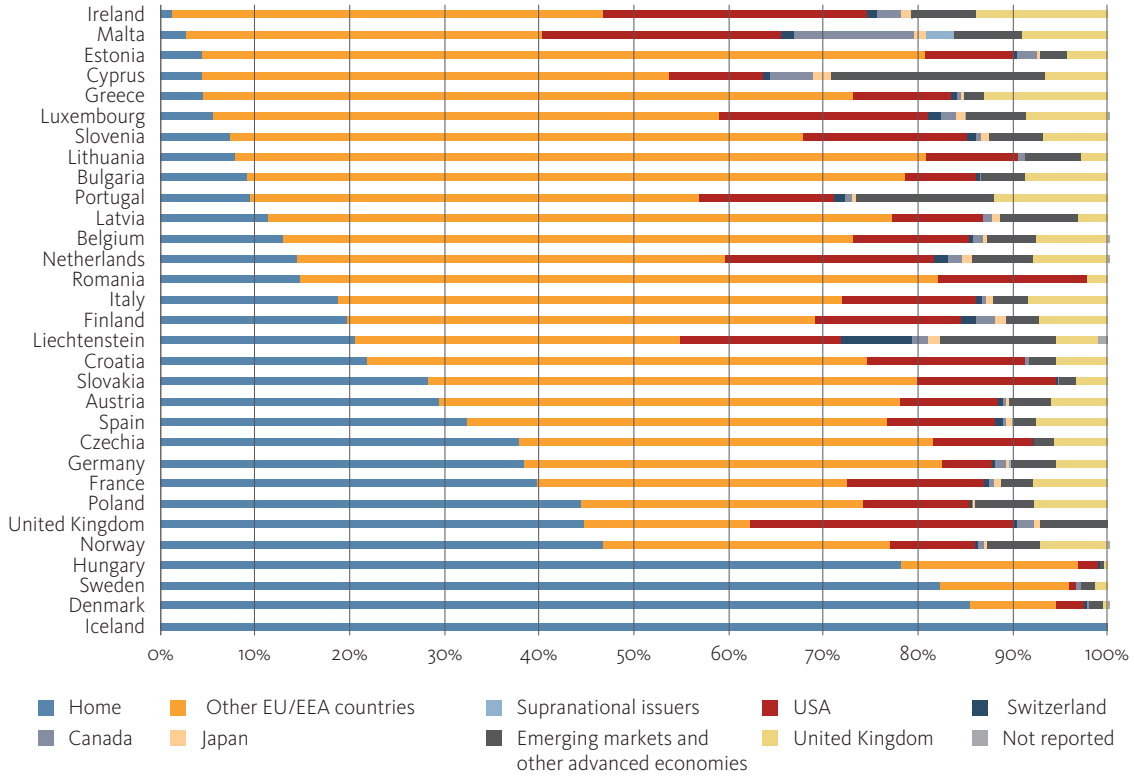
Source: EIOPA Quarterly Solo
Note: Look-through approach is not applied. Assets held for unit-linked business are included. The figures for years prior 2020 have been adjusted for EU27 following the Brexit withdrawal agreement.

Figure 5.20: Holdings of government bonds by issuer country for the IORP sector



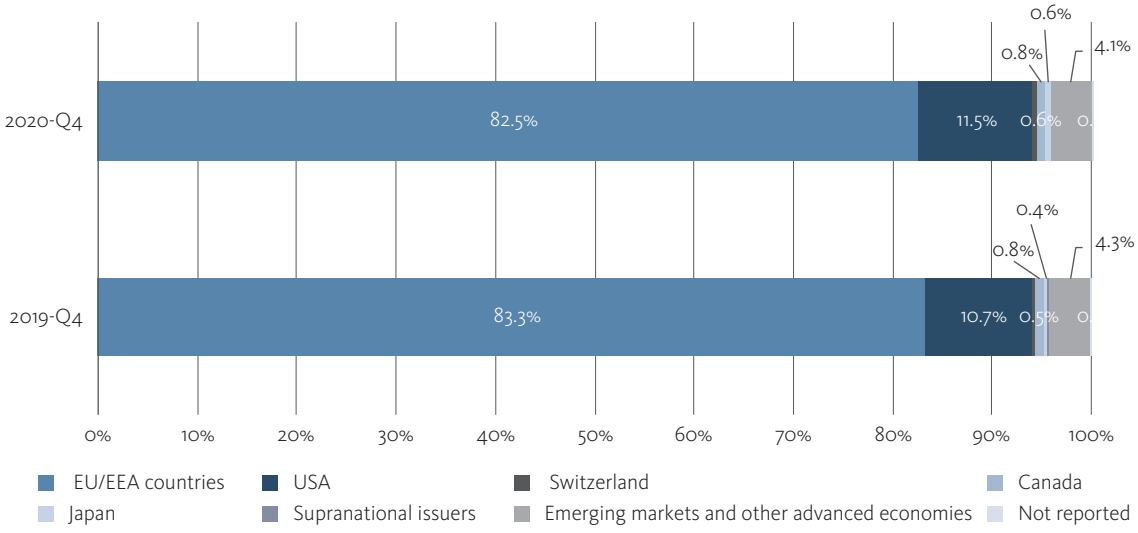
Source: EIOPA IORPs reporting
Reference Date: Q4 2020
Note: Not reported figures includes supranational issuers.

Figure 5.21: Holdings of corporate bonds by issuer country for the insurance sector



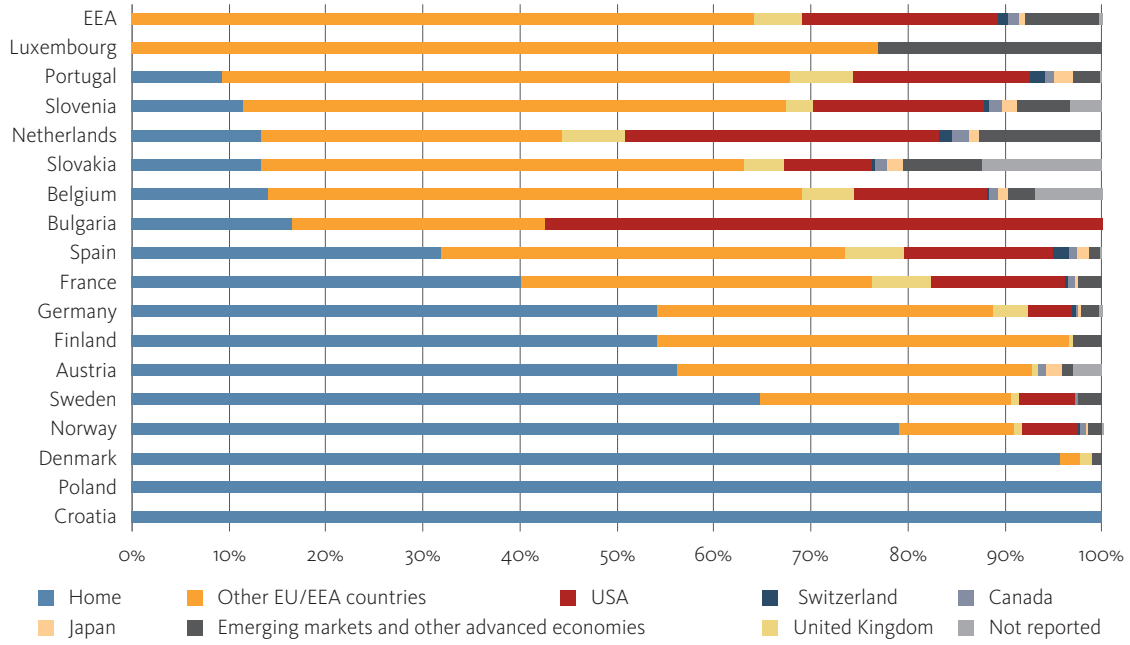
Source: EIOPA Quarterly Solo
Reference Date: Q4 2020
Note: Look-through approach is not applied. Assets held for unit-linked business are included.

Figure 5.22: Overall corporate bonds exposures to different countries for the insurance sector



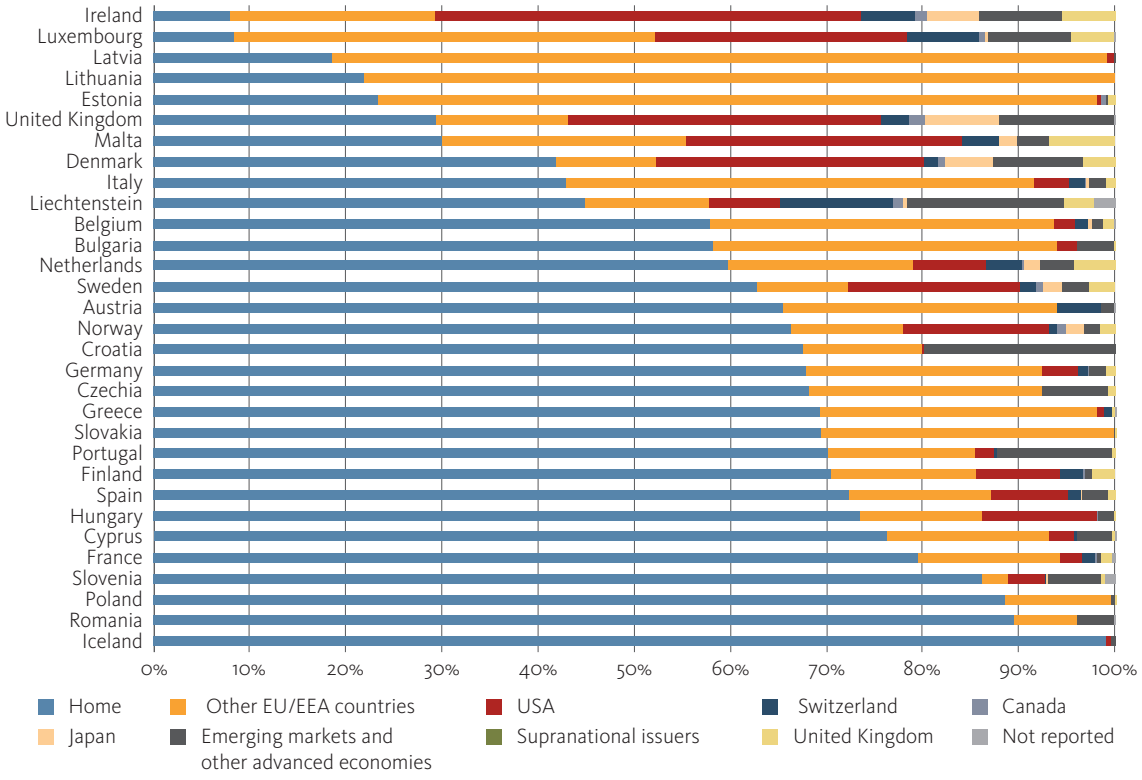
Source: EIOPA Quarterly Solo
Note: Look-through approach is not applied. Assets held for unit-linked business are included. The figures for years prior 2020 have been adjusted for EU27 following the Brexit withdrawal agreement.

Figure 5.23: Holdings of corporate bonds by issuer country for the IORP sector



Source: EIOPA IORPs reporting
Reference Date: Q4 2020
Note: Not reported figures includes supranational issuers.

Figure 5.24: Holdings of equity by issuer country for the insurance sector

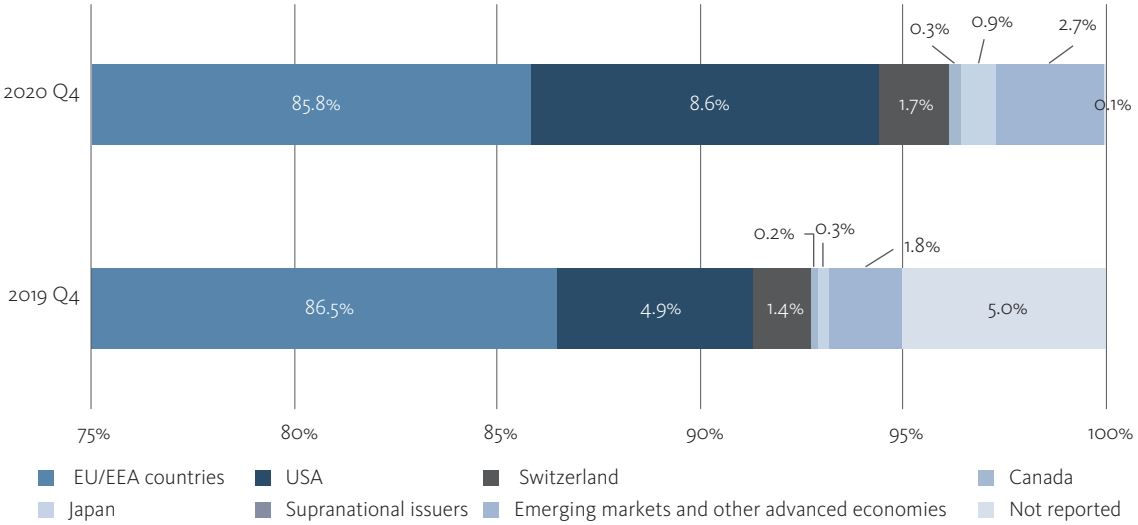


Source: EIOPA Quarterly Solo
Reference Date: Q4 2020
Note: Look-through approach is not applied. Assets held for unit-linked business are included.

Insurers' and IORPs' equity investments also show high degree of home biased behaviour (Figure 5.24 and Figure 5.26). The share of domestic investments is for equity even higher than for bonds. For insurers, equity exposures towards EU/EEA countries remained stable compared to last year (Figure 5.25).

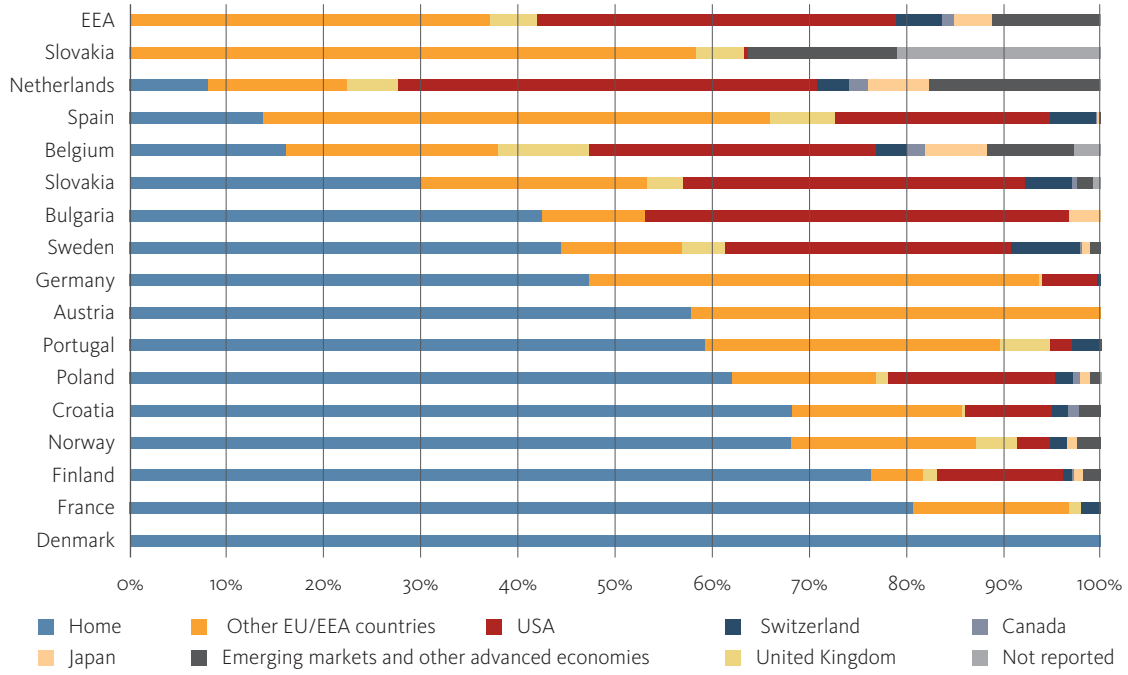
When looking at IORPs' equity investments it stands out markedly that the share of US equity to total is very high, 40% of the total; this is much more than in the case of insurers (8.6% in Q4 2020, see figure 5.26). This might be related to a more favourable treatment of currency risk in the determination of capital requirements.

Figure 5.25: Overall equity exposures to different countries for the insurance sector



Source: EIOPA Quarterly Solo
Note: Look-through approach is not applied. Assets held for unit-linked business are included. The figures for years prior 2020 have been adjusted for EU27 following the Brexit withdrawal agreement.

Figure 5.26: Holdings of equity by issuer country for the IORP sector



Source: EIOPA IORPs reporting
Reference Date: Q4 2020
Note: Not reported figures includes supranational issuers.

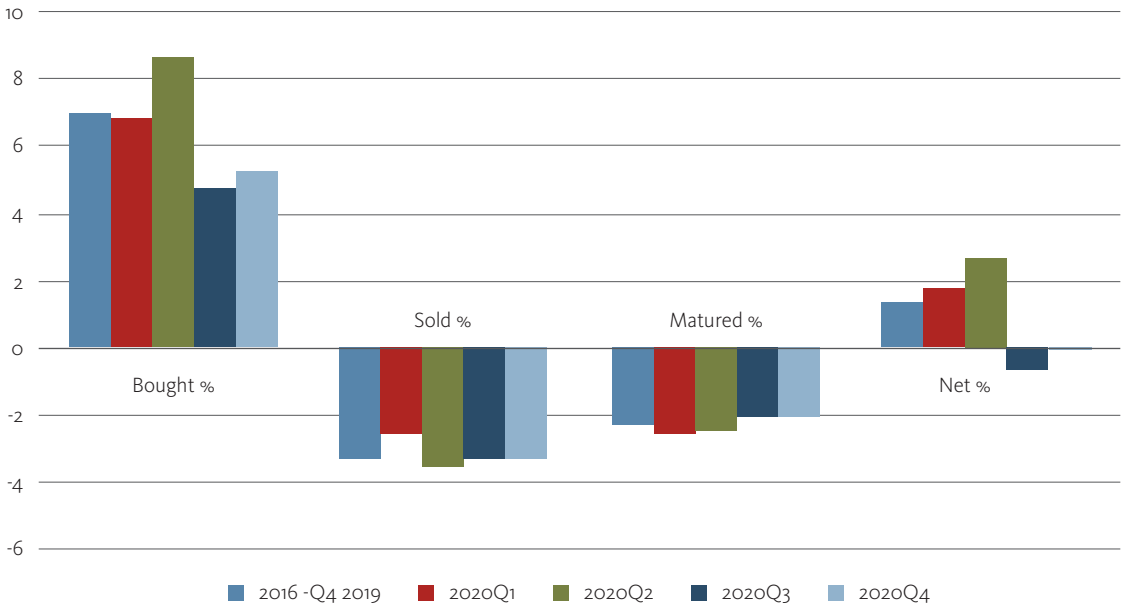
EEA INSURERS' TRADING ACTIVITY DURING 2020

In the first half of 2020 insurers increased net buyings of corporate bonds issued by non-banks. Historically, insurers tend to be net buyers of corporate bonds (Figure 5.27).[83, 84] Throughout the sample, up to Q4 2019, average quarterly corporate bond net purchases are EUR 13.0 bn. (+0.8% of initial quarter positions). Among these, the majority of net buys is in corporate bonds issued by non-banks with average net purchases of EUR 12.2 bn. (+1.4% of initial quarter positions). Net buys of corporate bonds issued by banks are on average EUR 0.8 bn.[85] In the first half of 2020, insurers remain net buyers of non-bank corporate bonds, to an even larger extent than the historical average (EUR 16.8 bn. in Q1, 1.7% of the initial quarter position; EUR 24.8 bn. in Q2, 2.7% of the initial quarter position).

Insurers bought less government bonds in the first half of 2020. Historically, insurers tend to be net buyers of government bonds (Figure 5.28). Up to Q4 2019 average quarterly government bond net purchases are EUR 18.0 bn. (+0.9% of initial quarter positions). This decreased in Q1 2020 to EUR 3.1 bn. (0.1% of the initial quarter position). Notably, in Q2 2020 insurers even net sold government bonds (EUR -2.2 bn., -0.1% of the initial quarter position). Net selling is driven by bond reaching maturity and not being rolled over.

The trends reverted in the second half of 2020, when insurer bond portfolios shifted from corporate bonds back to government bonds. Insurers net sold non-bank corporate bonds issued for an amount of EUR 6.3 bn. in Q3 2020 and EU 0.4 bn. in Q4 (-0.6% and -0.0% of initial quarter positions). The net selling of corporate bonds is, mostly, a result of reduced buying activity. Net buys of government bonds are EUR 6.8 bn. in Q3 and EUR 22.4 bn. in Q4 (0.3% and 1.1% of initial quarter positions).

Figure 5.27 Quarterly trading activity of corporate bond issued by non-banks for the insurance sector.



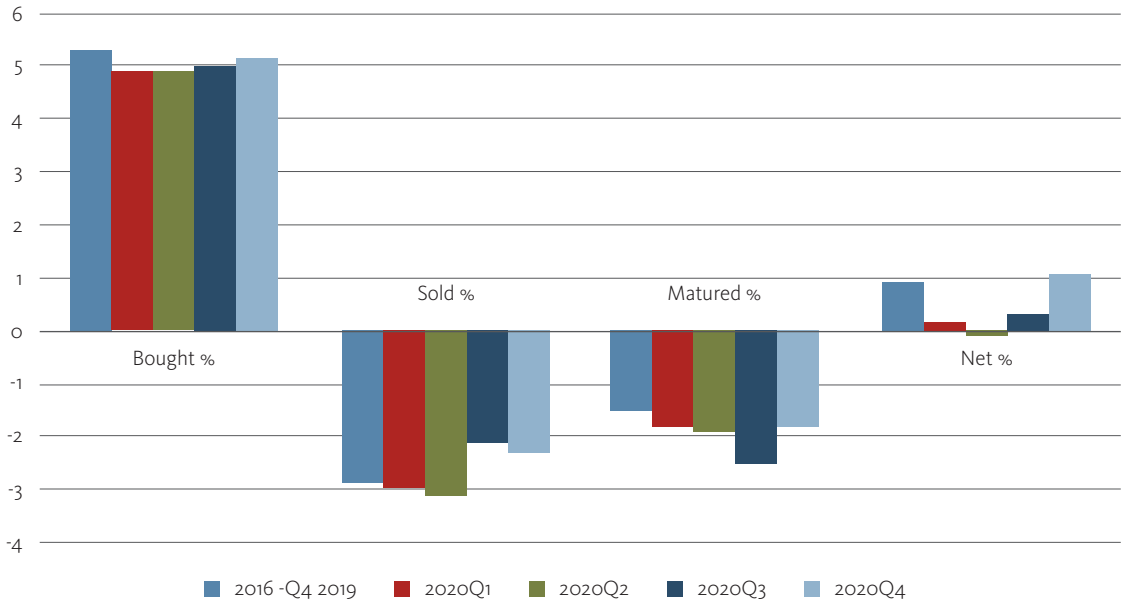
Figures are in % with respect to the initial quarter Solvency II market value of the positions.

83 Net buying is calculated as the difference between purchased, sold and matured bonds.

84 In the analysis of trading activity, no-look-through is applied and only direct holdings are considered because only for these purchased and sold quantities can be calculated using item-by-item Solvency II reporting data. The analysis is based on quarter-end asset holdings, transactions within the quarters which are not reflected at the quarter-end cannot be observed. All aggregate numbers exclude the United Kingdom and therefore differ from the numbers reported in the Financial Stability Review December 2020. For the methodology see also EIOPA Financial Stability Review December 2020 chapter 2.

85 For details on bank bonds please refer to subsection on insurers' exposure to the banking sector.

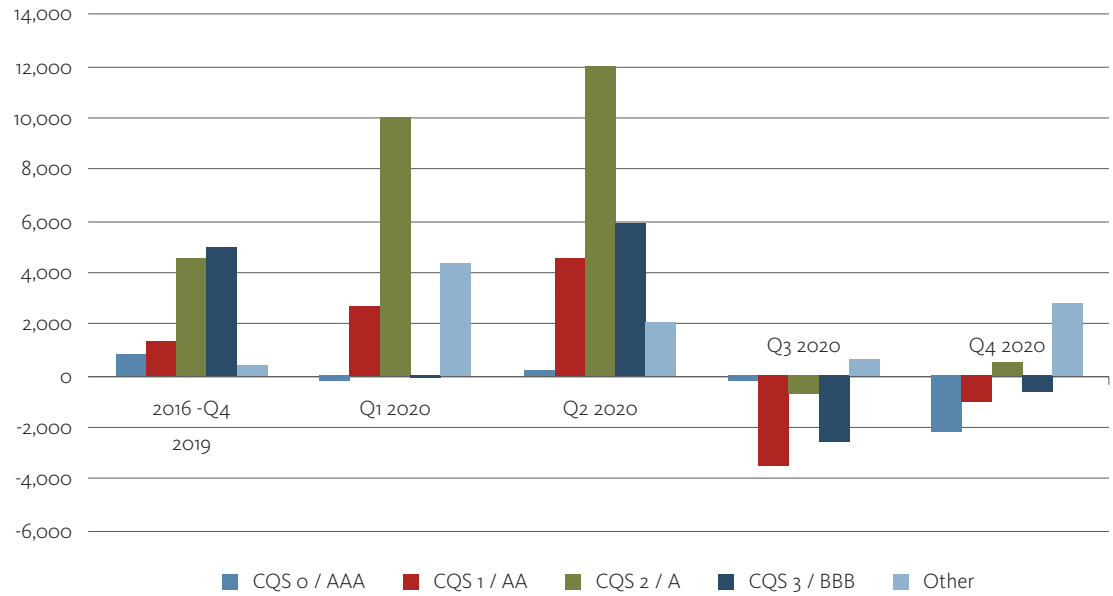
Figure 5.28 Quarterly trading activity of government bonds by for the insurance sector.



Figures are in % with respect to the initial quarter Solvency II market value of the positions.

With regards to ratings, insurers have reshuffled their non-bank corporate bond portfolios in 2020. In the years 2016-19, non-bank corporate bonds net purchases have mostly an A or BBB rating. Accordingly, these rating classes dominate in insurers' portfolios. In the first half of 2020, insurers increased their holdings of AA and A bonds, relative to the average buying in 2016-19 (Figure 5.29), with a notably decrease in buying activity for AAA rated bonds. Regarding BBB bonds, after the inactivity during Q1 2020, insurers strongly net bought them in Q2. In the second half of 2020 insurers net sold bonds of all investment grade ratings but, compared to the historic average, the reversion to net-selling for the lower rated bonds stands out. In fact, a significant change compared to the average is for BBB bonds of which insurers net sold EUR 2.6 bn. in Q3 and EUR 0.6 bn. in Q4 compared to average net buys of EUR 4.9 bn. before the pandemic.

Figure 5.29 Quarterly net-buying or selling of non-bank corporate bonds by rating class for the insurance sector



Figures are in million Euros.

Insurers preferred low-risk government bonds in 2020. Insurers did not change much their government bond portfolio in Q1, while in Q2 they strongly net sold A and BBB-rated government bonds and strongly net bought AA-rated bonds. Then, in the second half of 2020 insurers loaded-up AAA-rated government bonds and sold those rated BBB.

The reduction of credit risk in the second half of 2020 might have been guided by the perception that bearing credit risk became less attractive. Spreads decreased and reached at the end of the year 2020 the pre-pandemic level. This is remarkable in light of the vulnerabilities in corporate sector - the risk of rating downgrades and of bankruptcies remains elevated and the outlook has downside risks. In the perception of insurers, spreads might no longer reflect the risk situation and other asset classes became relatively more attractive.

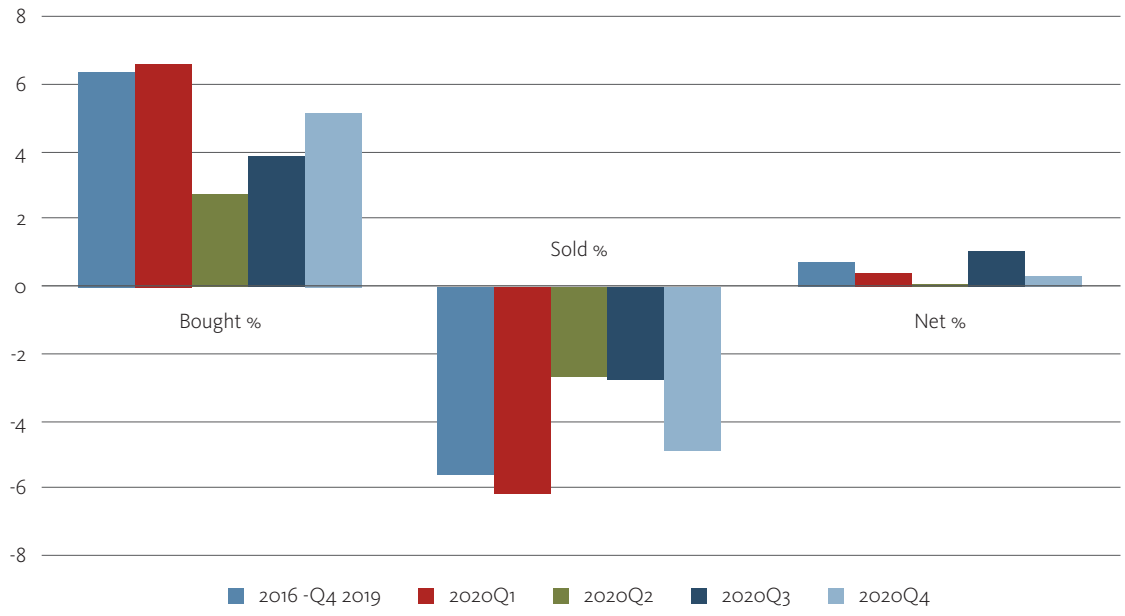
Another explanation may be on the supply side. There have been record issuances of corporate bonds in Q2 2020 with a significant reduction in issuances over the course of the year. In parallel, purchases of non-bank corporate bonds peaked in Q2. It could be the case that insurers used the record issuances in Q2 to load-up corporate bonds and in this process they reached or increased their target holdings. The reduction in Q3 and Q4 could be a re-adjustment.

Insurers are net buyers of equity in 2020 (Figure 5.30). Up to 2019 average equity net purchases are EUR 4.7 bn. (+0.7% of initial quarter positions). Insurers also remain net buyers of equity in the first half of 2020, but the net buys are lower than the historical average. Insurers also remain net buyers of equity in the second half of 2020, with net buys slightly above the historical average.

EXPOSURE TOWARDS THE BANKING SECTOR

Insurers are interconnected with the banking sector through investments in assets issued by banks, whose risk is affected by the pandemic. At the end of 2020 on average approximately 14% of insurers total investment is concentrated towards banks (Figure 5.31). Over the course of last year insurers have reduced their exposure by approximately two percentage points (16% in 2019). A significant exposure towards the banking sector could potentially become a channel of risk transmission and contagion. At the same time, insurers could have a stabilizing effect on the bank sector as they usually long-term investors and tend to trade less to short-term market fluctuations as other investors. Spreads of European bank debt fluctuated strongly over the course of the year. They jumped-up at the beginning of the pandemic and peaked at the end of March 2020. Since then they have declined substantially. However, spreads were in Q4 2020 still above pre-pandemic levels, in particular those of subordinate bonds.

Figure 5.30 Quarterly trading activity of equity for the insurance sector.



Figures are in % with respect to the initial quarter Solvency II market value of the positions.

Figure 5.31: Exposures towards banks as a percentage of total investments at country level for the insurance sector

Country	% Exposure to banks	Country	% Exposure to banks
EU/EEA average	**14%**	ITALY	7%
AUSTRIA	15%	LATVIA	18%
BELGIUM	7%	LIECHTENSTEIN	25%
BULGARIA	12%	LITHUANIA	17%
CROATIA	8%	LUXEMBOURG	18%
CYPRUS	24%	MALTA	17%
CZECHIA	17%	NETHERLANDS	16%
DENMARK	26%	NORWAY	21%
ESTONIA	42%	POLAND	9%
FINLAND	18%	PORTUGAL	13%
FRANCE	12%	ROMANIA	14%
GERMANY	17%	SLOVAKIA	18%
GREECE	11%	SLOVENIA	12%
HUNGARY	6%	SPAIN	11%
ICELAND	20%	SWEDEN	29%
IRELAND	19%	UNITED KINGDOM	9%

Source: EIOPA Quarterly Solo
Reference Date: Q4 2020
Note: The data presented is obtained by restricting the issuer with the NACE codes K64.1.9 and K64.9.2. Unit-linked and index-linked data have been excluded. Exposures refer to the following banks' assets: equity, bonds, cash and deposits, structured notes, collateralised securities, mortgages and loans and other investments. Notice that only for direct investment holdings it is possible to identify bank exposures; hence exposures towards banks via investment funds are not included. The blue colour highlights the lowest exposures towards banks while the red colour highlights the highest exposures towards banks. Look-through approach is not applied.

The IORPs sector is smaller than the insurance sector, but its exposure towards the banking sector is also material; this holds especially for some specific countries. At the end of 2020, on average approximately 12% of IORPs total investment is concentrated towards banks (Table 5.32).

Figure 5.32: Exposures towards banks as a percentage of total direct[86] investments at country level for the IORPs sector

Country	% Exposure to banks	Country	% Exposure to banks
EEA (w)	12%	HR	2%
EEA (un-w)	22%	LU	15%
AT	53%	NL	6%
BE	8%	NO	30%
DE	41%	PL	19%
DK	50%	PT	17%
ES	17%	SE	18%
FI	13%	SI	17%
FR	14%	SK	33%

Source: EIOPA IORPs reporting
Reference Date: Q4 2020
Note: The data presented is obtained by restricting the issuer with the NACE codes K64.1.9 and K64.9.2. EEA (w) is the weighted average, while EEA (un-w) is the simple average. Exposures refer to all banks' assets: equity, bonds, cash and deposits, structure notes, collateralised securities, mortgages and loans and other investments. Notice that only for direct investment holdings it is possible to identify bank exposures; hence exposures towards banks via investment funds are not included. The blue colour highlights the lowest exposures towards banks while the red colour highlights the highest exposures towards banks.

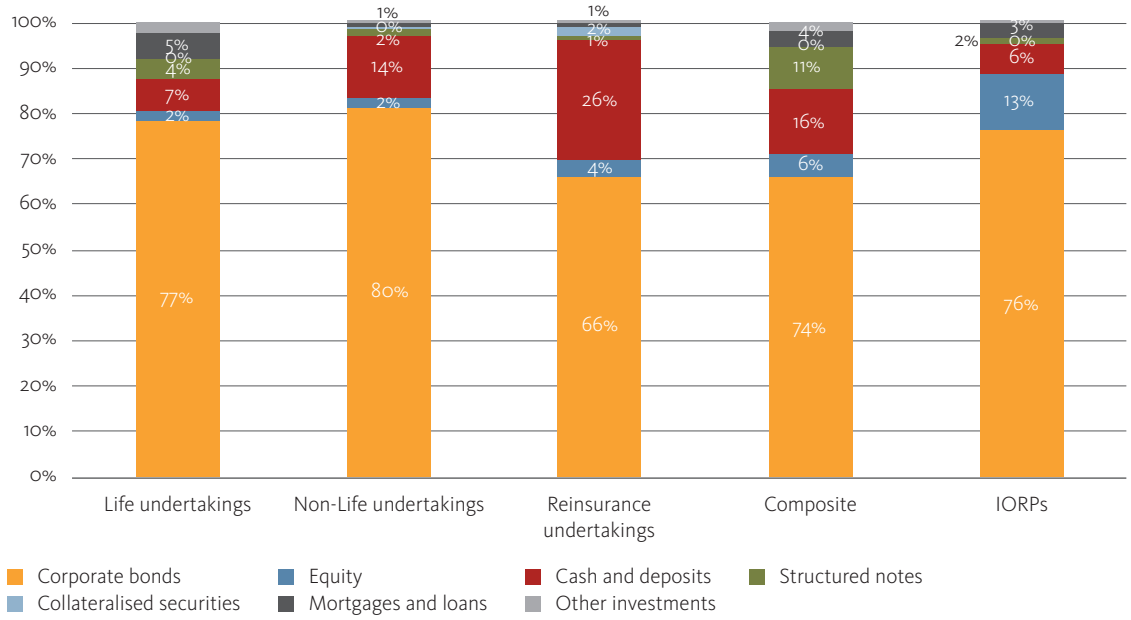
86 Investments via investments funds are excluded.

Bank bonds are the most important asset class issued by banks in which insurers invest (Figure 5.33). The risk between the various types of bank bonds differs widely. Covered bonds (i.e. secured bonds) is the largest subcategory of bank bonds with a share of 47% of total bank bonds (Figure 5.34); these bonds are characterised by low risk. The second largest subcategory is the one of corporate bonds senior unsecured, which at the end of 2020 were accounting for approximately 43% of the bank bonds. It is the most junior bonds that are first in line to be facing the losses when creditors are "bailed in". Junior bonds include subordinated bonds, hybrid bonds and convertible bonds, which amount to 8% of the total bank bonds exposure. Finally, undertakings have substantial cash and deposit exposures. An additional type of exposure is the one on derivatives with positive SII values (where the bank owes to the insurer).

Bonds are also the most important asset class issued by banks in which IORPs invest, similarly to insurers. The second largest subcategory is the one of equity, which at the end of 2020 were accounting for approximately 13% of the bank assets held by IORPs, which is significantly higher than insurers' investment in bank equity.

Negative effects could be amplified for insurers with high concentration of subordinated bank bonds. The breakdown of the bond portfolio by country reveals some degree of concentration of subordinated bonds (Figure 5.35). This could be a potential risk transmission channel, if the banking sector for certain countries faces severe challenges.[87]

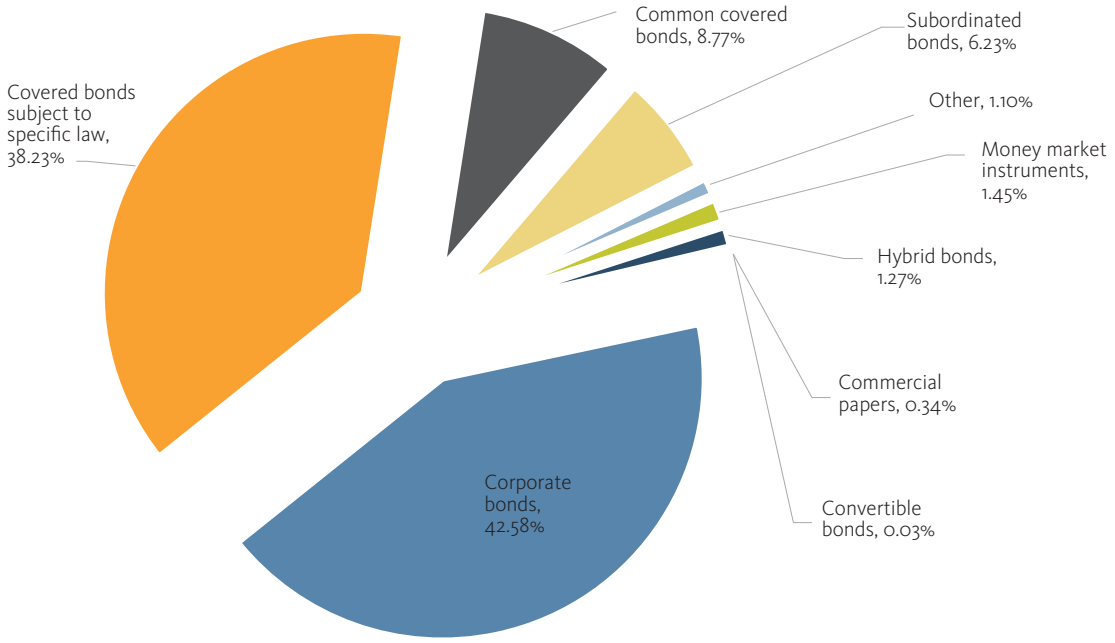
Figure 5.33: Exposures to banks by type of instruments and type of business



Source: EIOPA Quarterly Solo and EIOPA IORPs reporting
Reference Date: Q4 2020

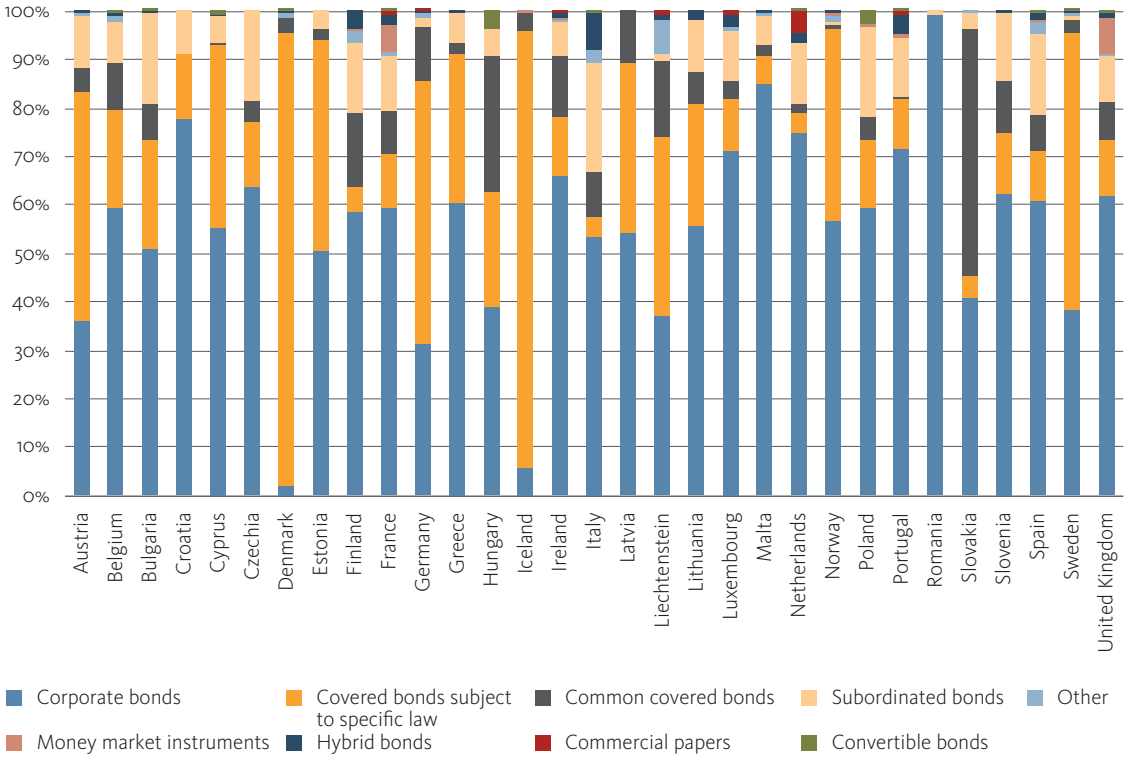
87 To better shed light on this risk, EIOPA is planning to devote in the Fall 2021 Financial Stability Report a topical focus on the interconnectedness between the insurance and the banking sector.

Figure 5.34: Breakdown of exposures to bank corporate bonds for the insurance sector



Source: EIOPA Quarterly Solo
Reference Date: Q4 2020

Figure 5.35: Breakdown of exposures to bank corporate bonds by country in Q4 2020 for the insurance sector



Source: EIOPA Quarterly Solo
Reference Date: Q4 2020

Insurers' trading activity shows that insurers moved away from the banking sector. Trading activity on bank bonds shows a trend of reducing exposures from the second quarter of 2019 onwards. This trend has gained momentum in 2020 as European insurers moved out of banks bonds during the pandemic (Figure 5.36). In Q1 they net sold bank bonds amounting to EUR 8.7 bn. (-1.0% of initial quarter positions).[88] This increases to net sales of EUR 10.6 bn. in Q2, EUR 21.9 bn. in Q3 and EUR -18.6 bn. in Q4 (-1.3%, -2.6% and -2.3% of initial quarter positions). The net sales are the result of both, reduced buying and of increased selling. These net sales revert the trend of previous years, European insurers have been net buyers of bank bonds between the years 2016 to 2019 albeit only to small extent.

The reduction of bank bond exposure in 2020 could be the result of de-risking through sector rotation. The financial turmoil in the beginning of the year highlights the vulnerabilities in the banking sector – in particular when compared to those corporate bonds issued by sectors less affected by the pandemic. In this situation insurers might have shifted from bank bonds to other corporate bonds guided by the aim to reduce sectoral risk. Another explanation may be on the supply side. There have been record issuances of corporate bonds issued by non-financial firms which is not observed for issuances of bank bonds.[89]

Figure 5.36 – Quarterly trading activity of corporate bonds issued by banks for the insurance sector

Figures are in % with respect to the initial quarter Solvency II market value of the positions.

88 All numbers are neither unit-linked nor index-linked and excluding the United Kingdom. In the analysis of trading activity, no-look-through is applied and only direct holdings are considered because only for these purchased and sold quantities can be calculated using item-by-item Solvency II reporting data.

89 ECB Statistical Data Warehouse, Net issues of debt securities by euro area non-financial corporations vs. Net issues of debt securities by euro area MFIs.

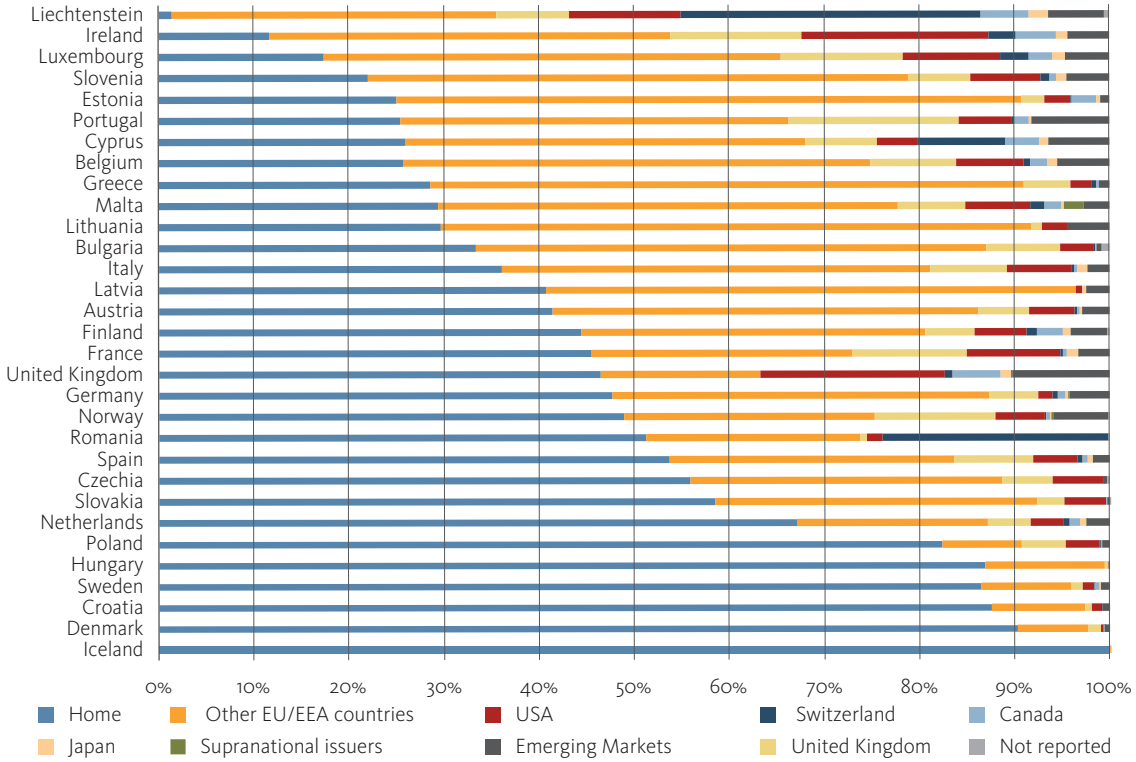
Insurers tend to invest predominantly in the domestic bank sector, albeit with a declining share. The share of the domestic bank sector differs across countries (Figure 5.37). A comparison of the aggregate holdings of assets of the domestic banking sector relative to assets of cross-border banks reveals that over the last four years the share of assets invested in the domestic bank sector decreased. Investment in the domestic banking sector could have the effect that if a specific country is heavily impacted by the pandemic, the effect could be amplified for an insurer with a high concentration in the banking sector of that specific country. It is noteworthy that insurers hold also large amounts of domestic government bonds and that the creditworthiness of the banking sector is tightly linked to the one of the local government and vice versa (the so called "sovereign bank nexus"). For this reasons, in some countries, potential materialisation of risk exposures to the banking sectors could potentially be amplified.

THE IMPACT OF RATING DOWNGRADES DUE TO COVID-19 CRISIS

Capital requirements under Solvency II could increase, if corporate bonds in insurer portfolios are downgraded to a lower credit quality step. Lower valuations on the asset side would take place contemporaneously with an increase in capital charges; the prevailing effect of the latter would result in an increase of the spread risk SCR. Therefore, widespread downgrades could lead to pressure to sell the downgraded bonds to ease capital requirements. This could exacerbate existing upward pressure on credit spreads.

In 2020 the number of rating downgrades in insurers' corporate bond portfolios was significantly elevated compared to pre-pandemic levels. A higher number of rating downgrades occurred in the first, second and the fourth quarters, while the number in the third quarter was

Figure 5.37: Exposure towards the banking sector, domestic versus cross-border in % for the insurance sector



Source: EIOPA Quarterly Solo
Reference Date: Q4 2020
Note: The data presented is obtained by restricting the issuer with the NACE codes K64.1.9 and K64.9.2. Unit-linked and index-linked data have been excluded. Exposures refer to the following banks' assets: equity, bonds, cash and deposits, structure notes, collateralised securities, mortgages and loans and other investments. Notice that only for direct investment holdings it is possible to identify bank exposures; hence exposures towards banks via investment funds are not included.

below the historical average. This implies that, after some easing over the summer, vulnerabilities in the corporate sector were again under greater scrutiny at the year end. While rating upgrades were more common than rating downgrades before the pandemic, this reversed in 2020. Over the course of the year, the number of downgrades was roughly twice as high as the number of upgrades.

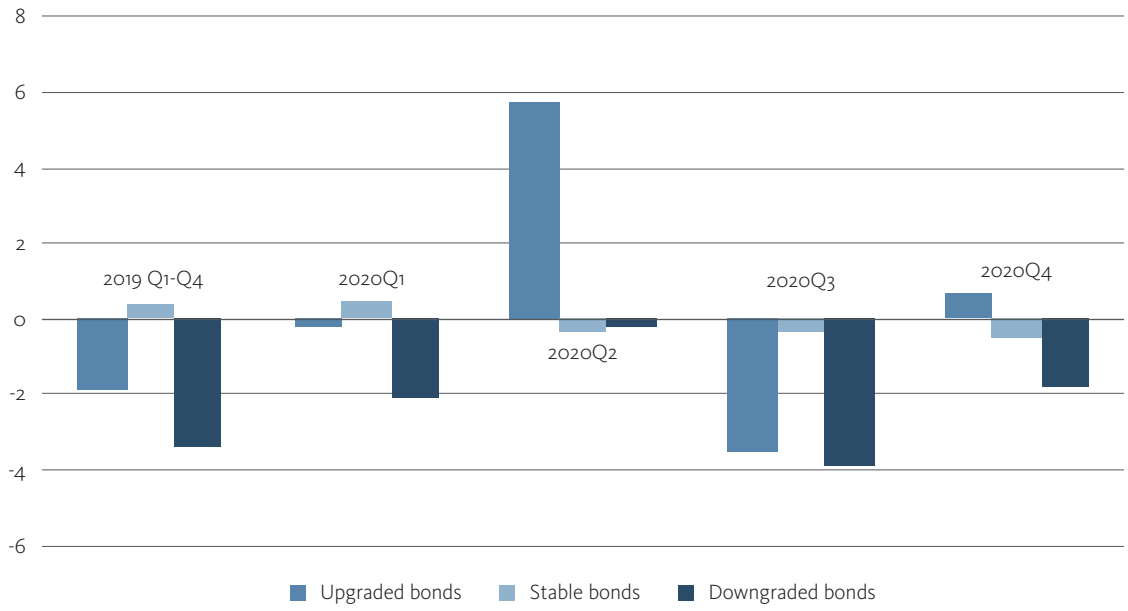
The market turmoil in the first quarter and the increased uncertainty can be seen in the rating level of downgraded bonds. This normalized over the course of the year. In Q1, most of the downgraded bonds were BBB. This is notable because in 2016-19, BBB-rated bonds were downgraded infrequently (5% of downgrades, with A-rated bonds accounting for the lion's share at 52%). The number of BBB bond downgrades then declined during 2020, reaching levels below the pre-pandemic average by year-end. In Q3 2020, all rating segments AAA to BBB are well represented in downgrades. In Q4, almost all rating downgrades occur in the AAA to A range.

Both in the pre-pandemic period and in 2020, insurers tend to net-sell proportionally more downgraded bonds compared to bonds with stable ratings. Net sales of downgraded bonds are not more pronounced in 2020 in relative terms compared to before the pandemic (Figure 5.38). However, the absolute amount of downgraded bonds sold is significantly higher because more bonds were downgraded. Net selling of downgraded bonds is particular pronounced for BBB-rated bonds which became BB, the so-called fallen angels, because a rating of BBB is often considered the threshold of an investment grade rating. Fallen angels are sold heavily throughout the year: From 5.6% of downgraded BBB bonds net sold in Q1 to 5.1% in Q2, 8.2% in Q3 and finally 10.1% in Q4. This shows that insurers are sensitive to visible thresholds in ratings and are willing to reduce risks by selectively selling bonds.

In any case, the magnitude of the observed selling of downgraded corporate bonds remains largely contained without evidence suggesting significant pro-cyclical effects triggered by insurers' response to the crisis.

Within the challenging environment discussed in the section above, it is also useful to account for effects on the liability side of insurers. Some perspectives on this matter are included in Box 5.2. The analysis lies on the aggregate view of the market, but, yet, the stylised insights can be useful to understand some elements of the life technical provisions dynamics.

Figure 5.38. Insurers' % net selling of corporate bonds across quarters: Breakdown by bonds that have stable CQS, bonds that are upgraded and downgraded by one notch



Note: This chart excludes holdings of UK insurers and therefore data displayed differs from the data in a similar chart in the December 2020 FSR. Trading activity is calculated in relation to rating changes ignoring the starting rating category. Net is obtained as buy minus sell (ignoring bonds that mature) for the purpose of capturing activity.

BOX 5.2 THE DYNAMICS OF LIFE TECHNICAL PROVISIONS: AN ECONOMETRIC PERSPECTIVE

The guaranteed rate as well as profit participation are both relevant determinants of the dynamics of technical provisions (TPs).

This box attempts to differentiate in a simple way the characteristics of TPs that affect their sensitivity towards the discount rate and market factors. For this purpose, guaranteed rates can serve as a simple and meaningful classification mechanism to identify two different types of undertakings. On the one hand, insurers characterized by TPs with high guaranteed rates are expected to have higher sensitivity towards interest rates. On the other hand, for insurers with TPs with low guaranteed rates, the profit participation aspect kicks in, therefore their TPs are expected to be sensitive to the discount rate as well as to equity and credit spreads fluctuations.

As of Q3 2020, EEA undertakings submitting for financial stability purposes have EUR 9.4 trn. of total assets and EUR 7.4 trn. of total TPs. Non unit/index-linked (non-UL/IL) life TPs represent a share of 65% of total TPs and tend to have long durations; the sample weighted average Macaulay duration is 14.6 years. UL/IL life TPs represent 27%, while non-life TPs 8% of the total. For UL the risk is borne by policyholders. Furthermore, non-life TPs are relatively small and have shorter durations, therefore the focus of this Box is on non-UL/IL life TPs only.

Individual insurers' life TPs exhibit a strong degree of co-movements. In fact, a Principal Component Analysis[90] shows that the 1st extracted principal component alone explains 50% of the TPs variance, while the second 12%. The first principal component is shown to capture closely the dynamics of the average changes in TPs (Figure 1, upper left chart) and it is strongly correlated with the discount rate (Figure 1, upper right chart). In addition, the second principal component strongly correlates with equity return and credit spreads (Figure 1, lower left chart).

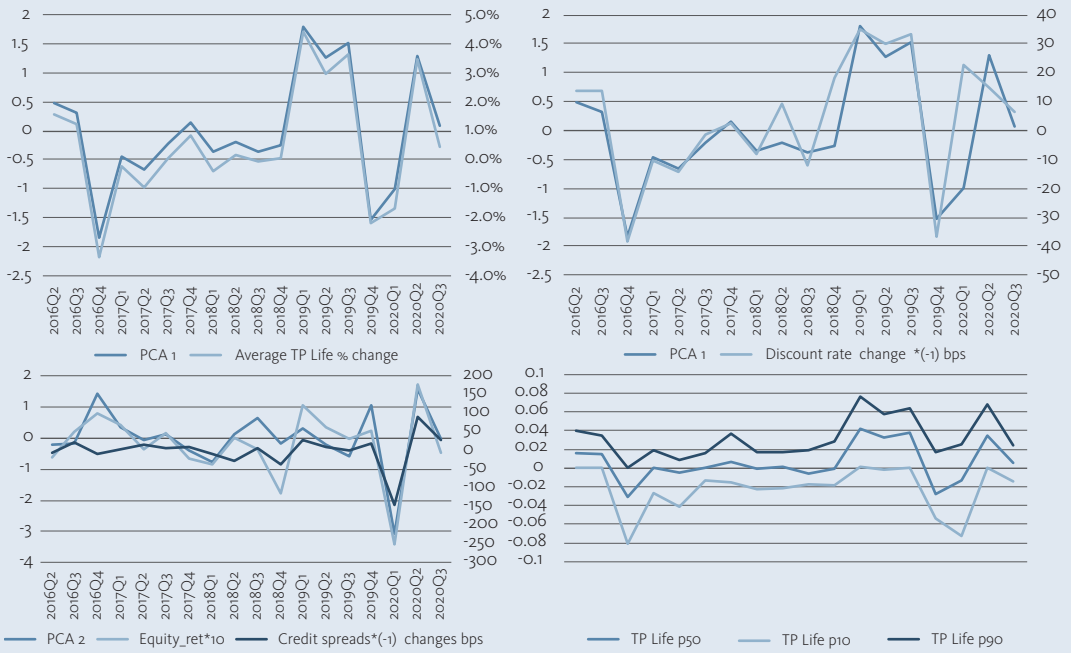
Overall, this preliminary descriptive analysis highlights the importance of both the discount rate movements and the equity and credit spreads dynamics to understand the changes in the TPs.

Apart from the co-movement stressed above, the heterogeneity of the changes in insurers' TPs throughout the quarters (Figure B.5.1., lower right chart) is noteworthy. The return differential between the top 10th and 90th percentile ranges between 4% and 10%. For example in Q1 of 2019, whereas the median change in TPs was 4%, the top 90th percentile show a change of almost 8%, while the bottom 10th percentile shows almost 2%.

A regression analysis provides empirical results of changes in TPs (in %) driven by some explanatory factors, based on the intuition discussed above (Table B.5.2.1). In addition, an illustrative example is included to enhance the interpretation of the results. As expected, the estimated effective duration is negative meaning that when the discount rate decreases TPs increase. In addition, the results show that insurers with low interest rate guarantees (IRGs) (Column B) tend to be less sensitive to the discount rate compared to insurers with high IRGs (Column A) (coefficient -7.9 vs. -10.5). It further suggests that insurers with lower guaranteed rates have TPs more sensitive to the dynamics of equity and credit spreads. The marginal higher sensitivity of high IRGs insurers towards the discount rate is measured by mean of a dummy (0/1) that is capturing the high IRGs of insurers; this is also interacted with the Macaulay duration as a control variable (model 2, rightmost column).

90 Principal component analysis is a statistical procedure that allows to extract the important information from the data and to express this as a set of summary indices called principal components. It helps to measure the degree of commonality in the data and to uncover the relationships between observations and variables.

Figure B.5.2.1 Time series dynamics



Note: Figures include the 1st and 2nd principal components, mean and key percentiles of changes in life TPs NUL (in %), the discount rate, equity index returns and credit spread changes. The data used in this analysis are from the EIOPA Central repository that collects reporting data for EEA insurers subject to Solvency II. The sample consist of the large groups submitting information for financial stability purposes. Observations are quarterly and cover the period from Q1-2016 to Q3-2020.

Model (2) adds further insights. In fact, the coefficient capturing convexity is positive for discount rate declines (i.e. TPs increase more) and negative for discount rate increases (i.e. TPs decrease more than in the linear case), suggesting that larger discount rate changes affect TPs more proportionally. This result implies that if the convexity aspect is not taking into account when modelling the dynamics of the life TPs, projected values might either be overestimated (this would be the case for small discount factor changes) or underestimated (this would be the case for large discount factor changes).

Table B.5.2.1: Results of the model

	Depedent varaible: % ΔTP Life (excl.UL)					
	(1)				(2)	
	(A)		(B)			
	Group High IRG (>1.7%)		Group Low IRG (<1.7%)		All Insurers	
Δ(GWP)	0.0014		0.0003		0.0004	*
	(0.0014)		*(0.0002)*		*(0.0002)*	
Δy	-10.5255	***	-7.8897	***	-5.1147	***
	(0.6176)		*(0.5543)*		*(1.2065)*	
Δy × Macaulay Duration × Dummy IRG>1.7%					-0.1152	***
					(0.0381)	
Δy^2 × Dummy Δy<0					742.8832	**
					(311.50)	
Δy^2 × Dummy Δy>0					-1068.2200	***
					(412.90)	
Equity Returns × Share equity × Dummy IRG>1.7%	-0.0067				0.0040	
	(0.0100)				*(0.0098)*	
Equity Returns × Share equity × Dummy IRG<1.7%			0.0051	***	0.0053	***
			(0.0014)		*(0.0014)*	
Δ Credit spread × Share corp bonds × Dummy IRG>1.7%	0.0079				0.0093	
	(0.0208)				*(0.0210)*	
Δ Credit spread × Share corp bonds × Dummy IRG<1.7%			-0.0399	***	-0.0388	***
			(0.0127)		*(0.0126)*	
Insurer Fixed Effect	Yes		Yes		Yes	
R-squared overall	54%		42%		47%	
Groups included	24		49		73	
Observations	432		882		1314	
	(Standard Error) ***p<0.01, ** p<0.05, * p<0.1					

The table reports results from a panel regression with fixed-effects of %TP changes on some explanatory factors. Model 1 is estimated for two sub-samples: in (A) insurers with low guaranteed rates, while in (B) insurers with high guaranteed rates are included; the cut-off is considered to be 1.7%. **GWP** are Gross written premium % changes q-o-q. **y** is the discount rate (basis points) as measured by the EIOPA risk-free rate + VA adjustment for undertakings for which this is relevant. **Dummy IRG** is a dummy variable 0/1 capturing insurers belonging to the group of those having high guaranteed rates (i.e. higher than 1.7%) interacted with **Macaulay duration** (in years). **Equity index returns** are in % and **credit spreads changes** in basis points.
Note: The data used in this analysis are from the EIOPA Central repository that collects reporting data for EEA insurers subject to Solvency II. The sample consist of the large groups submitting information for financial stability purposes. Observations are quarterly and cover the period from Q1-2016 to Q3-2020 (18 quarters).

Illustrative example

This example sheds some light for what regards the sensitivity of TPs, in particular, towards the discount rate; the discount rate is assumed to decreases by 30bps, the Macaulay duration of the liabilities is assumed to be 15 years and everything else to remain equal.

$$\%\Delta TP = \quad -D\Delta y \quad + D\Delta y \times Macaulay \times Dummy\ High\ IRGs \quad + \frac{1}{2} C\Delta y^2 \times Dummy\ \Delta y < 0$$

=	−5.11 × −0.0030	−0.11 × − 0.0030 × 15	+742 × 0.00009
=	+1.53%	+0.50%	+0.67%
=	+2.70%		

Results of the estimates of Model (2) indicate that, life TPs of insurers belonging to the high IRGs group would increase by 2.70%, while TPs of an insurer belonging to the low IRGs group would increase by the smaller 2.20% (=1.53%+0.67%).

With ESG one of the focal points for the insurance sector, as introduced in Chapter 1, is climate-change, and the policies taken to limit it, to mitigate its consequences or adapt to it; these could be transformative drivers of change in the 21st century. In this context, understanding climate change transition risks (the energy transition away from fossil fuels and greenhouse gas intensive industries and consumption, together with the development of new technologies) and its consequences on the insurance business is key for financial regulators and supervisors. EIOPA has established a comprehensive strategy and work-plan to this effect under the umbrella of sustainable finance[91] and the report "Sensitivity analysis of climate-change related transition risks"[92] contributes to this work. Box 5.3 below presents a summary of the main findings in the above mentioned report.

BOX 5.3 SENSITIVITY ANALYSIS OF CLIMATE-CHANGE RELATED TRANSITION RISKS

In order to explore climate change transition risks, EIOPA carried out a Sensitivity analysis of climate-change related transition risks. The paper explores holdings of corporate bonds and equity that can be related to key climate-policy relevant sectors such as fossil fuel extraction, carbon-intensive industries, vehicle production and the power sector. Furthermore, it quantifies potential climate-change related transition risks and presents insights into possible impacts on these investments as economies transition away from fossil fuel-dependent energy production and carbon-intensive production.

The sensitivity analysis of climate-change related to transition risks carried out by EIOPA employs a "what-if" scenario analysis based on the investments in high and low-carbon industries that are considered highly climate-policy relevant. Holdings of government bonds were also included to provide insights into possible values at risks (VaRs) under the scenarios and assumptions employed. The "what-if" scenarios draw input from several external sources and combine them in a consistent narrative calibrated on the current holdings of European insurers.

91 See www.eiopa.europa.eu/browse/sustainable-finance_en

92 See https://www.eiopa.europa.eu/content/sensitivity-analysis-of-climate-change-related-transition-risks_en?source=search

In terms of methodology, the exercise maps individual securities (equity and corporate bonds) to physical production[93] in key climate-relevant sectors. The methodology is described in detail in the report[94]. Investments were sourced from regulatory reporting under Solvency II[95]. These investment holdings were subsequently mapped using information about group ownership structure and detailed production level data available to 2° Investing Initiative. For government bond holdings, Solvency II reporting data was used and similarly to what was done for corporate bonds and equity, a climate scenario was considered where emissions concentration targets were set to ensure a reasonable likelihood of meeting a 2 degree outcome. In particular, following the application in Battistion et al (2019), the reaction of the whole economy is modelled using economic sectors based on Climate Policy Relevant Sectors (CPRS Rev 2) and NACE sectors for the government bonds.

Based on the identified exposures, a "what-if" sensitivity analysis was carried out. This sensitivity analysis assessed possible impacts on investment holdings if economies were required to re-align and transition away from CO2-dependent production and consumption. Under the assumption that climate risk may not be fully reflected in asset prices so far and, and in line with previous studies on the topic, the sensitivity analysis considered a policy shock that would have an impact on market prices that can be interpreted as a change in price compared to current levels.

The asset price adjustments for equity and corporate bonds **were considered to be a function of the change in production that would be required if the economy were to align with two scenarios prepared by the International Energy Agency's (IEA), namely the Sustainable Development Scenario (SDS, often referred to as a "2 degree scenario")**[96] and the "Beyond 2 degrees" (B2DS) scenario, which requires slightly stronger policy action. The second scenario can be interpreted as a scenario that is likely to have a higher probability of limiting global warming to 2 degrees (or below).

The exercise was carried out at on a top-down basis and it contains a number of important caveats that should be noted. First, it was not possible to map the full portfolio of European insurers, so the results represent a subset. Second, certain sectors that may also react to a typical "policy shock", most notably the agriculture and real estate sectors are not considered due to data limitations. Third, effects stemming from shocks to GDP or other macroeconomic variables were not included in the assessment. Fourth, the calibrations of the price adjustments rely on extrapolations and sometimes somewhat limited data, and consider changes that might stem from events that might happen by the end of this decade. These calibrations are naturally fraught with intense uncertainty.

In terms of **findings**, looking at the corporate bond and equity investments (and those via funds), Figure B.3.1 shows the change in value of the affected investments when compared to their initial value. Taken at face value, equity holdings vulnerable in the type of "what-if" scenario assessed in this report may be quite sensitive to the transition and loose more than 25% of their value. The impact on bonds are lower, reflecting the fact that profitability declines are likely to impact equity prices first (and in line with the assumptions for corporate bonds employed and described in [Ref. to methodological section]). However, in terms of overall impact, the insurance sector also stands to potentially gain from the transition through investments in renewable power generation (and somewhat in electric/hybrid vehicle production). In this context, however, it is key to bear in mind that the price adjustment for renewable power generation assumes that capacity can be built sufficiently fast. The positive price adjustment was quite high in the calibrations employed – the main reason for that is that the sector as a whole needs to dramatically increase output to meet the sustainable development scenario. It is likely easier to reduce capacity (i.e. lose money on high-carbon assets) than to expand capacity, so this balance might be more difficult to achieve in practice.

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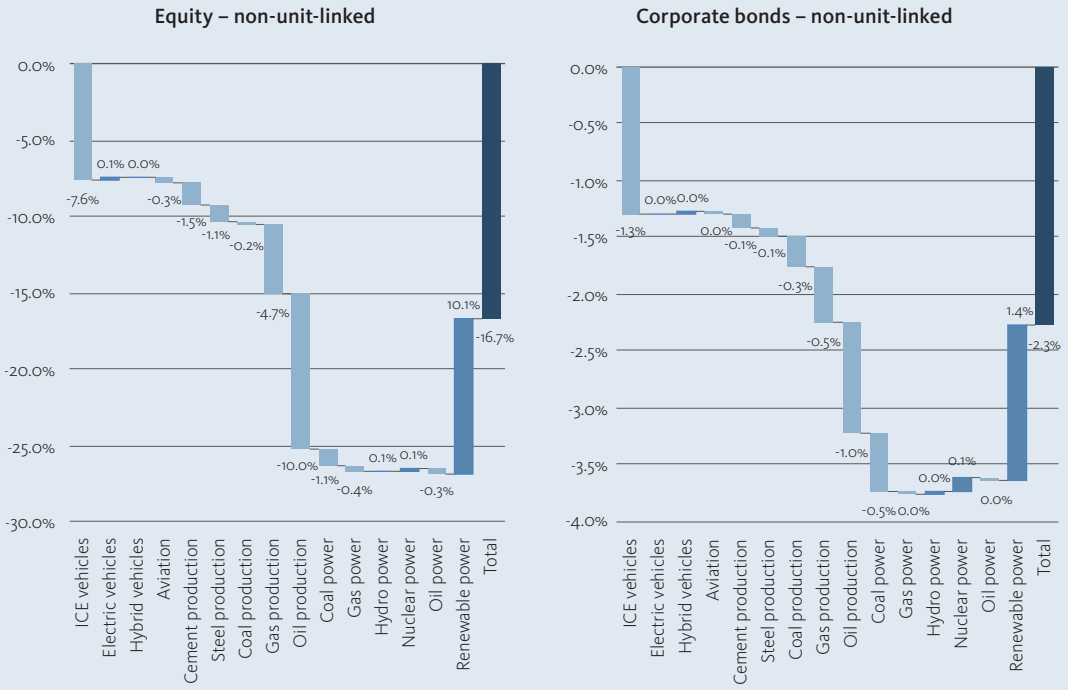
93 Physical production refers to what individual firms are producing (for instance, Gigawatts for electricity production).The data was matched to the insurers' asset holdings via the tools developed by 2° Investing Initiative (2DII), i.e. the PACTA toolsets.

94 https://www.eiopa.europa.eu/sites/default/files/publications/reports/sensitivity-analysis-climate-change-transition-risks.pdf

95 Data source: EIOPA. The analysis is based on reporting by 1894 undertakings reporting on a solo basis under Solvency II. For the analysis of corporate bonds and equity, 1569 of these undertakings were found to hold assets relevant to this analysis.

96 Full details available here: https://www.iea.org/reports/world-energy-model/sustainable-development-scenario

Figure B.5.3.1. Change in value of re-priced equity and corporate bonds (incl. look-through where possible). Values given as share of initial holdings in assets for which a price-adjustment was applied. Non-unit linked investments. Main scenario. EEA excl. UK

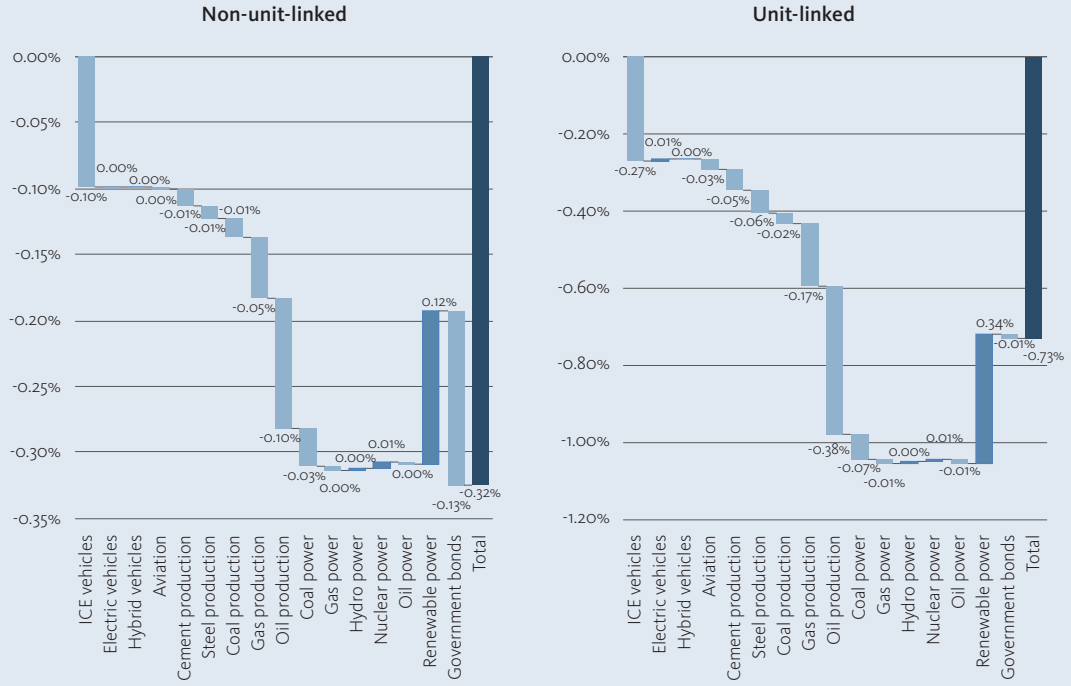


Source: Solo insurance undertakings reporting under Solvency II. 2019 Q4.

While the impacts on directly affected equity, and to a lesser extent corporate bond holdings, could potentially be large, the overall impact on the balance sheets of the insurance sector is also counter-balanced by the fact that the high-carbon investments considered in this report account for a small part of the total investments of European insurers. Solvency II is a risk based regime, and insurers therefore generally hold well diversified portfolios, and the overall size of the losses also reflects this. Overall, the results indicate the impact on the aggregate portfolio is likely to be more modest: B.5.3.2. show the change in the value of investments as a share of the assessed holdings in the relevant assets (i.e. not only those assets that were subject to price change). The overall impact for EEA insurers is less than 0.5% in the non-unit-linked portfolio, and about 0.7% in the unit-linked portfolio.

While 0.32% may seem small, it is important to bear in mind that it is scaled to all assessed investments. As mentioned in the report, the asset holdings of insurers are generally kept to cover liabilities, which in EEA is on average valued to more than 85% of the assets. This means that the impact of relatively small losses on the overall asset portfolio can be larger when scaled to the "free assets", namely the excess of assets over liabilities (eAOL). However, a detailed assessments of the impact on the liability side was outside of scope of the exercise.

Figure B.5.3.2. Change in value of re-priced equity, corporate bonds (incl. look-through where possible) and government bonds. Values given as share of share of the (assessed) full holdings. Main scenario. EEA excl. UK



Source: Solo insurance undertakings reporting under Solvency II. 2019 Q4.

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.[97]

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 2,837.
- **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.**

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

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 2020 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 Q4 2020, including also branches of third-country insurance undertakings (QRB). But as not all templates and/or companies report under QRS and QRB, EIOPA also uses Annual Reporting Solo (ARS), including also branches of third-country insurance undertakings (ARB) 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, where as 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.

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)[98] 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.

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

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 Q4 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 without such pension funds 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.

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 ARTICLE

IMPACT OF EU-WIDE INSURANCE STRESS TESTS ON EQUITY PRICES AND SYSTEMIC RISK[99]

Petr Jakubik[100] and Saida Teleu[101]

ABSTRACT

Since the global financial crisis in 2007, stress tests have become standard tools for regulators and supervisors to assess the risks and vulnerabilities of financial sectors. To this end, the Insurance and Occupational Pensions Authority (EIOPA) regularly performs EU-wide insurance stress tests. This paper analyses the impact of the conducted exercises in 2014, 2016 and 2018 on the equity prices of insurance companies. Using an event study framework, we find a statistically significant impact only for the publication of the 2018 exercise results. Our empirical analysis further suggests that the final version of technical specifications for the 2014 exercise, the initiation of public consultation, and the published stress test scenario of the 2018 exercise contributed to the decline in systemic risk. To our best knowledge, this is the first paper that investigates this topic for the European insurance sector. Our empirical results could help improve the communication and design of future stress test exercises.

1. INTRODUCTION

Over the past decade, system-wide stress tests have been fully established as a key tool for financial stability risk assessment. Regulatory authorities aim to promote transparency in financial sectors, improve market discipline and foster financial institutions' own risk management capacity. Furthermore, they intend to help policymakers set up microprudential and macroprudential measures to ensure the adequate resilience of financial sectors.

How stress tests are implemented has evolved since the financial crisis. Supervisors, policy makers and academicians continue to discuss the long-term strategy for their use with market participants. While system-wide bottom-up banking stress tests were extensively used to determine the level of capital needed after the financial crisis in 2007, that changed in later years to using stress test exercises as a supervisory tool. In the case of EU-wide bottom-up insurance stress tests conducted by the European Insurance and

99 This paper should not be reported as representing the views of the European Insurance and Occupational Pensions Authority (EIOPA) or the Central Bank of Malta. The views expressed are those of the authors and do not necessarily reflect those of the EIOPA or the Central Bank of Malta.

100 European Insurance and Occupational Pensions Authority (EIOPA)

101 Central Bank of Malta

Occupational Pensions Authority (EIOPA), it has never been considered a pass-or-fail or capital exercise. Instead, the exercises have been tailored to assess the resilience of the European insurance sector to specific adverse scenarios with potential negative implications for the stability of European financial markets and the real economy.

The first EU-wide insurance stress test was conducted in December 2009 by the Committee of European Insurance and Occupational Pensions Supervisors (CEIOPS) for large and important insurance groups in Europe as a response to the 2007 financial crisis.[102] The second EU-wide insurance stress was conducted by EIOPA and employed a market-based valuation framework. However, the first fully-fledged EU-wide insurance stress test exercise using the Solvency II framework was conducted only in 2014. Such exercises had been regularly performed every two years until 2018. Since then, EIOPA has moved to a three-year frequency in order to allow for sufficient follow-up with national supervisors on the identified vulnerabilities to utilise the full potential of the exercises.[103] In this respect, EIOPA has further worked on methodologies to be used according to objectives selected for the particular stress test exercise. Supervisory stress tests can have various objectives which drive the design, methodology and application of each stress test exercise. The most important distinction is between microprudential and macroprudential objectives (EIOPA, 2019). Based on constructive dialogue and feedback received from stakeholders in the preparation of the first methodological paper (EIOPA, 2019), EIOPA has followed the same approach and has engaged with stakeholders to enrich the stress test toolbox with additional elements that may be applied in future exercises (EIOPA, 2020). Apart from the main aim of EU-wide stress test exercises to assess the resilience of financial institutions to adverse market developments, these exercises should also contribute to the overall assessment of systemic risk in the EU financial system.

The objective of this paper is thus twofold. In the first part, we assess the potential impact of the key issued EIOPA announcements related to EU-wide stress tests on the equity prices of participating insurers via an event study. In this respect, we follow an event study methodology described e.g. by Brown and Warner (1985), Thompson (1995), and MacKinlay (1997). The second part of the paper assesses the possible changes in systemic risk caused by the stress test-related announcements as consultation, scenario, launch, and follow-up recommendations of the exercises. For this purpose, we decompose the insurers' beta into a market correlation component and a volatility component partially following the approach of Nijskens and Wagner (2011). This helps us develop a model that estimates the relation between insurers' returns and their betas through the coefficients capturing the change in insurers' betas after the several types of events. In addition to the previous studies, we use a novel approach utilising company specific betas.

Our paper contributes to an emerging research on stress testing and the effectiveness of EU-wide stress tests conducted by EIOPA at the EU level. In particular, it contributes to the ongoing discussion on optimal stress test disclosures and their implications (Ellahie, 2012; Petrella and Resti, 2013; Morgan et al., 2014, Ahnert et al., 2018, Sahin et al. 2020). Our paper aims to answer whether an EIOPA EU-wide stress test produces new valuable information for the market and whether such exercises have any impact, either positive or negative, on the stock prices of involved institutions.

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102 On 5 November 2003, the European Commission adopted the decision, to establish the Committee of European Insurance and Occupational Pensions Supervisors, which entered into force on 24 November 2003.

103 EIOPA is not a direct supervisor of the European insurance sector. Hence, all contacts with participating insurance companies are hold via national supervisors.

The paper is structured as follows. First, we review previous relevant studies. Second, we present the data and the methodology employed. Third, we provide an empirical results and their discussion. The key conclusions are detailed in the last section.

2. LITERATURE REVIEW

This paper contributes to the recent research stream on regulatory stress tests as well as the more established literature on financial stability and regulation of financial institutions.

There is a small but emerging literature on stress test disclosures and their implications, offering both theoretical and empirical angles. Theoretical studies mainly cover the optimal level of disclosure. Following Bernanke (2013), the disclosure of information related to stress tests promotes transparency by providing investors and market participants with consistent and comparable information on financial institutions' (particularly banks') financial conditions. Other authors recognize the benefits of disclosure, but also shed light on potential related issues (Schuermann, 2014, Goldstei, et. al, 2012, Gick, et.al, 2012). Carboni et al. (2017) highlight the so-called Hirsh-Leifer effect related to the disclosure of too much information, which consequently destroys risk-sharing opportunities and reduces liquidity in the interbank market. During a crisis, when the risk-sharing arrangements are compromised by public perception that financial institutions are opaque and under-capitalized, the disclosure, at least partial, of regulatory stress tests can produce a stabilizing effect. To reinforce this effect, it is critical that regulators provide new and valuable information to market participants by increasing transparency on their financial conditions. Similarly, based on a game-theoretical framework, Gick and Pausch (2012) claim that macro stress tests can improve welfare if the methodology and results of the stress test are communicated effectively. In the case of the banking sector, Spargoli (2012) argues in favour of disclosing banks' capital shortfalls under the assumption that regulators are able to ensure banks' recapitalizations. Some theoretical papers investigate the trade-off implied by the disclosure of stress test results. Goldstein and Sapra (2012), for example, find that disclosure of regulatory information and stress test results can have an inimical effect on the ex-ante incentives of financial institutions. In this context, Georgescu et al. (2017) argue that in the absence of information frictions, more information always improves market discipline. In reality, financial institutions are opaque and their reactions are endogenous to the regulatory environment. Furthermore, the results of Morris and Shin (2002) suggest that if the precision of the disclosed information is not sufficiently high, market participants may place unnecessary weight on the public signal, causing market overreaction and coordination failures.

There is a limited but growing number of empirical papers assessing market reactions to stress tests or similar regulatory exercises. Some of these studies assess whether those exercises were able to increase transparency. The results of these empirical assessments have contributed greatly to the discussion of designing an optimal level of disclosures of stress tests. Financial institutions are generally considered to suffer from a degree of opaqueness, specifically the inaccessibility of financial data to outsiders (Carboni et al. 2017). Hence, the market reaction to the disclosure of stress test results is to some extent proof of the existence and the reduction of opaqueness. However, the scale and timing of stress test information provision are challenged by scholars and regulators as a trade-off between restoring confidence in financial institutions and risk of destabilising the financial system by signalling-out institutions failing the exercise (Golstein, et. al,

2015). Studies that assess the impact of the released information related to stress tests can be used to modify stress test design and to improve stress test-related communication.

The literature that compares US and EU stress tests raises important issues regarding governance, which is essential for the effectiveness of stress tests (Schuerman, 2013, Candelo et al., 2015). The analysis suggests that a well-established institutional framework, a credible backstop and efficient communication of the scope, methodology, scenario design, the granularity of disclosed information, and the planned follow-up may play greater role than the technical specifications of the stress test. The existing empirical evidence on stress tests conducted across the EU member states suggests that the mandatory disclosure of stress test-related information generally produces new information for investors. Breckenfelder et al. (2018) assess the reaction of equity and CDS markets to the publication of 2014 bank stress test results to measure the cross-border spill-overs from changes in banks' CDS and equity prices in stressed countries (Greece, Ireland, Portugal, Italy, and Spain) to the sovereign CDS in non-stressed countries (Austria, Belgium, France, Germany, and the Netherlands). The results of the paper offered evidence that non-stressed countries provide a second line of defence to financial institution in stressed countries within the studied period. Similarly, Acharya et al, (2014) debate the trade-off faced by the ECB between maintaining its reputation as an independent regulator and disclosing financial institutions' shortfalls shortfalls in the context of the absence of credible backstops.

There is an emerging literature that provides an empirically-oriented impact assessment of the effectiveness of the disclosure of European regulatory institutions, specifically, EU-wide stress test by the European banking Authority (EBA) (Georgescu, et al., 2017, Ahnert, et. al., 2018, Georgoutsos, et. al, 2020) and Comprehensive Assessment by the Single Supervisory Mechanism (SSM) (Sahin et al., 2016, Lazzari et al., 2017; Carboni et al., 2017). Our study takes a different perspective from the existing papers on the European cases, since we analyse the market reaction related to the EIOPA insurance wide stress tests covering not only the dates of results' disclosures, but also other intermediate steps of the exercises.

Moreover, the aforementioned literature concentrates on the financial sector or the banking industry, with minimal emphasis on the insurance sector. Traditionally, insurance sectors are not deemed to be of systemic relevance to destabilise the overall financial system. Insurers, in contrast to banks, are typically not subject to a "bank run" type of event and therefore do not face the potential of unexpected liquidity risk.[104] Nonetheless, the seminal theoretical work of Arrow (1963), Akerlof (1970), and Rothschild, et al. (1976) shed light on the potential for market failures arising from asymmetric information in private insurance markets. Research in this direction has advanced, beginning with theoretically motivated attempts to test if asymmetric information exists in insurance markets, and in what form (Chinkelstein, et. al, 2004, Cohen 2005, Finkelstein, et. al, 2006, Einav et.al 2010). More recently, Bierth et al (2015) assess the exposure and contribution of 253 insurance companies operating worldwide to systemic risk between 2000 and 2012. The authors suggest that the rise of interconnectedness within the financial sector increases insurers' systemic risk exposure, and highly leveraged insurance entities contribute more to systemic risk. Garcia, et al. (2021) analyse the optimal information structure in competitive insurance markets with adverse selection from a regulatory perspective. They suggest that the optimal rating system minimises ex-ante risk subject to

104 However, similar situation as bank run was experienced by several life-insurance companies steaming from mass lapse events. Hence, the need to monitor and assess liquidity risk is currently widely debate (EIOPA, 2020).

participation constraints, which proves the existence of a unique optimal system under which all individuals trade.

The main contribution of this paper is that, to the best of our knowledge, this is the first study providing empirical evidence of market reaction to the EIOPA EU-wide stress tests and their impact on systemic risk in the sector. By observing market reactions from the announcements of the EU-wide insurance stress tests, this is the first paper that investigates whether the insurance stress test increased transparency and confidence in the insurance sector. The results have important policy implications for regulators, since they shed some light on investors' perceptions on the use of this important supervisory tool applied to the European insurance sector.

3. DATA DESCRIPTION AND METHODOLOGY

We collect data for all listed insurance companies at the group level participating in the EIOPA EU-wide stress test in 2018 and 2014.[105] There are 42 (out of which 20 are listed) and 31 (out of which 19 are listed) insurance groups participating in the 2018 and 2014 exercise, respectively. Overall, 29 insurance groups are included in our sample for both the 2014 and the 2018 stress test.

Moreover, we collect data for all listed insurers at the solo level for both the 2014 and the 2016 exercise. However, only a few solo insurers are listed. Out of the 236 solos which participated in the 2016 EIOPA insurance stress test, only 6 are listed, and 24 solos are listed out of the 327 that participated in the 2014 EIOPA stress test. However, some of those listed solos participating in the 2014 exercise were traded with only a few transactions. In fact, their market value changes were very limited. Hence, we also select a subsample of those solo insurers whose equity prices were changed at least in 85% of trading days included in the sample. In this respect, we ensure sufficient liquidity of those titles in stock exchange markets, but reduce the sample to 7 solo insurers only. The results for solos thus have to be interpreted very carefully due to their limited representativeness.

We measure market reaction around all announcements related to the mentioned EIOPA insurance EU-wide stress tests. Table 1 reports the list of the considered events related to the stress tests. Further details on the reported announcement days can be found in the Appendix.

105 Apart from the 2014 and 2018 exercise, there has not been any further stress test exercise that would be conducted at group level. The exercise in 2016 was performed on insurance solo basis and the 2021 exercise was ongoing at the time of writing this study.

Table 1: EIOPA Stress Test events

2014		2016		2018	
		Invitation to the workshop with stakeholders	14-Mar-16		
Consultation	13-Mar-14	Scenario	17-Mar-16	Scenario	09-Apr-18
Scenario	08-Apr-14	Consultation	13-Apr-16	Consultation	16-Apr-18
Launch	30-Apr-14	Launch	24-May-16	Launch & technical specifications	14-May-18
Technical specifications	28-May-14	Technical specifications	01-Jun-16	Results	14-Dec-18
Results and Recommendations	01-Dec-14	Results and Recommendations	15-Dec-16	Recommendations	26-Apr-19

Daily stock market data are obtained from Reuters. We estimate abnormal returns (ARs) as the difference between actual stock returns and expected returns. Following a common procedure to estimate (e.g. De Long and De Young, 2007), we use the market model (MacKinlay, 1997) in which expected returns for an insurer ($R_{i,t}$) are obtained as a function of the market portfolio returns ($R_{m,t}$), represented by the European equity index (i.e. STOXX 600). Market model parameters are obtained with daily logarithmic returns of insurance stock prices over a year period preceding 10 days before the announcement date. ARs are then cumulated over a time period around the announcement date. Following Morgan et al. (2014) and other articles measuring market reaction to policy announcements (e.g. Flannery et al, 2017, Sahin et. al, 2020) we have considered the following event windows: (-1;+1), (-1;+2), (-1;+5), (-1;+8), (-2;+1), (-2;+2), (-2;+5), (-2;+8) to ensure the consistency of our findings. We test the hypothesis of a market reaction significantly different from zero using a standard event study methodology. A recent study by Korali and Pynnonnen (2010) proposes a new test statistic that adjust t-statistics in order to consider possible cross-sectional correlation among abnormal returns. Furthermore, as a robustness check, we also use the non-parametric rank test proposed by Corrado (1989) for a single day and further elaborated by Campell and Wasley (1993) for a multi-day event period.

Following Nijskens and Wagner (2011), we decompose the beta into a volatility component and a market correlation component to measure the possible changes in systemic risk related to stress test events using equation (1).

$$R_{i,t} = \alpha_i + \beta Rm_t + \sum_j \delta_j D^j + \sum_j \zeta_j D^j * Rm_t + \varepsilon_{i,t} \quad (1)$$

where α_i is the insurer's fixed effect, and D^j is a dummy variable with value of 1 after the event and up to 10 trading days of the following stress test event j that refers to all events listed in table 1. Furthermore, we introduce novelty into their methodology through the adjustment of the decomposed beta, following the methodology of Jakubik and Uguz (2021). In the first step, we estimate beta for each insurance company *i* in the sample. In the second step, we create a new variable as follows.

$$\widehat{Rm}_{i,t} = \hat{\beta}_i Rm_t \quad (2)$$

Then we substitute the original variable for market return in equation (1) by the newly created variable. Formally,

$$R_{i,t} = \alpha_i + \theta \widehat{Rm}_{i,t} + \sum_j \delta_j D^j + \sum_j \varphi_j D^j * Rm_t + \varepsilon_{i,t} \quad (3)$$

Systemic risk is represented by the interacted term between event date and market return. Negative coefficients of this term imply a reduction of systemic risk as a reaction to the specific stress test-related event, while positive coefficients suggest an increase in systemic risk.

4. EMPIRICAL RESULTS

Our study covers three EU-wide stress tests based on the market based Solvency II regime that were conducted so far, namely, the exercises performed in 2014, 2016 and 2018. The 2021 exercise is in process at the time of conducting this study, therefore it could not be included in this research. The empirical results obtained should be assessed in the context of the different attributes and aims of past exercises. The stress test in 2014 that was performed for insurance groups was the first exercise that employed the Solvency II framework at a time when its main attributes were already agreed on, despite the regulatory regime still not being in place. Hence, it could be seen as the first exercise providing a vulnerability assessment under the Solvency II valuation regime. In contrast, the 2016 exercise was the first stress test when the new Solvency II regulatory regime was in place. Unlike in 2014 and 2018, the 2016 exercise was conducted for insurers' solos, having two modules. The first was a standard module assessing the impact of an adverse market scenario on insurance solvency position. The second one assessed the impact of low yields on European solo insurers. Finally, the 2018 exercise was again conducted for insurers' groups. It was also the first time EIOPA asked groups for their consent to publish individual results, as EIOPA does not have the legal power to enforce it. However, only four groups agreed to publish their results. For the majority of stress test participants, therefore, only aggregate results were published, as in the previous two exercises investigated in our study.

Our analysis covers the launch of public consultation of the exercises, publication of stress test scenarios, launch of stress test exercises, publication of a revised version of technical specifications based on a question & answer process, publication of results and issuance of supervisory recommendations. Furthermore, for the 2016 exercise, we also test a public invitation to the workshop with stakeholders meant to initiate the process of public consultation. In some cases the two events took place on the same day, such as launching the exercise together with the final version of the technical specifications in 2018, and publishing the results together with supervisory recommendations in 2014 and 2016.

Results of the conducted event studies for the 2014 and 2018 exercises with event windows (-1, 2) and (-1, 8) are provided in table 2. Results for other different event windows' specifications bring no additional information to the market.

Overall, the results reveal no significant market reactions to the 2014 and 2018 stress tests that would be robust through different specifications and employed statistical tests. The significant negative impact of publishing the final version of technical specifications for the 2014 stress test only applied to some event windows when using the rank

test. On the contrary, a statistically significant positive impact could be observed for the publication of the 2018 stress test for (-1, 8) event windows that is robust across different test statistics. We further investigated the results at individual group level. A significant market reaction was obtained only for a few insurers. However, no significant market reaction could be seen for those insurers that agreed to publish their individual results.

For the 2016 exercise, the sample is very limited. However, it seems to be in line with the results for the 2014 and 2018 exercise, as the analysis does not point to any significant impact that would be robust across all tests. For the 2016 exercise, some statistically significant negative effect could be seen for the announcement of the stress test scenario for the (-1,2) and (-1, 5) event windows. The statistically negative effect for consultation could be seen only for one event window (-1, 1). Given that so few companies were used for this sample, we cannot draw any strong conclusion from this.

Table 2: Cumulative abnormal market returns (CAR) and their statistical significance

Stress Test	Events	CAR	t-test st.	Adjusted t-test st.	Rank test st.
Event window			(-1,2)		
2014	Consultation	0.7379%	0.7480	0.7303	0.1114
	Scenario	-0.4714%	-0.5040	-0.4920	-0.5173
	Launch	-0.7543%	-0.8298	-0.8097	-0.1706
	Technical Specifications	1.2231%	1.5622	1.5242	2.0895**
	Results and recommendations	-0.7506%	-0.9062	-0.8827	-0.0727
2018	Consultation	0.2848%	0.3035	0.2949	0.3321
	Scenario	0.5803%	0.6160	0.5985	0.6853
	Launch & technical specifications	-0.8248%	-0.8720	-0.8468	-0.9965
	Results	0.8379%	0.8248	0.8020	0.6818
	Recommendation	0.2969%	0.2836	0.2759	0.6791
Event window			(-1,8)		
2014	Consultation	0.8085%	0.4942	0.4826	0.3343
	Scenario	-1.0511%	-0.7108	-0.6938	-0.4876
	Launch	-2.3475%	-1.6332	-1.5936	-1.0167
	Technical Specifications	1.5926%	1.2456	1.2153	0.9201
	Results and recommendations	-0.0890%	-0.0648	-0.0631	0.2531
2018	Consultation	-0.0122%	-0.0082	-0.0080	0.5763
	Scenario	1.5644%	1.0504	1.0206	1.1932
	Launch & technical specifications	-1.9662%	-1.3859	-1.3458	-1.3064
	Results	2.5935%	1.7018*	1.6549*	1.6761*
	Recommendation	-0.4427%	-0.2674	-0.2601	0.0079

Note: *p<0.1; **p<0.05; ***p<0.01

Finally, we investigate whether the conducted stress tests based on insurance groups contributed to a decrease in systemic risk (2014 and 2018, Table 3 and 4). To this end, we estimate equation (1) with insurers' returns (column – "Normal"), standardised returns (column – "Standardised") and returns with adjusted beta (column – "Beta-adjusted") according to equation (3). The obtained results for insurers' groups suggest that some elements of the exercise could decrease systemic risk. In particular, publication of the final version of technical specifications for the Insurance Stress Test 2014 reduced systemic risk in in the insurance equity market.

Table 3: Systemic risk results for groups, EIOPA Stress Test 2014

2014	Normal	Standardized	Beta-adjusted
Stoxx	0.8913***	0.5783***	1.0211***
	(0.0206)	(0.0129)	(0.0225)
Consultation	0.1876	0.1175	0.1907
	(0.1453)	(0.0913)	(0.1585)
Scenario	0.0764	0.0616	0.0724
	(0.0844)	(0.0530)	(0.0921)
Launch	-0.2606	-0.2200**	-0.1301
	(0.1699)	(0.1068)	(0.1853)
Technical specifications	-0.0818**	-0.0562**	-0.0843**
	(0.0352)	(0.0221)	(0.0384)
Results and	0.0141	0.0136	-0.0061
Recommendations	(0.0486)	(0.0306)	(0.0531)
Constant	-0.0002	-0.0123	-0.0001
	(0.0002)	(0.0123)	(0.0002)
Observations	7,999	7,999	10,260
R2	0.2942	0.3074	0.3150
Adjusted R2	0.2932	0.3065	0.3140
F Statistics	302.6484***	322.2708***	333.8484***

Note: *p<0.1; **p<0.05; ***p<0.01

A similar positive effect is revealed for the initiation of consultation with stakeholders and the stress test scenario announcement of the 2018 exercise. On the contrary, the publication of the final version of technical specifications and recommendations in 2018 seems to increase systemic risk. However, the latter represents a market reaction to the follow-up supervisory actions at the national level rather than to the EU-wide stress test itself, as a recommendation is a legal tool of the EIOPA Regulation. It therefore might be the choice of tool driving the obtained results. It could also be related to the fact that apart from four insurers, the others did not grant their consent on publication of their individual results that might be expected by the market.[106] Unlike the EU banking stress tests, the European body does not have the legal power to enforce the disclosure of individual results. Furthermore, contrary to the 2014 exercise, our empirical results show that the launch of the stress test 2018 exercise, which was accompanied by publication of the final version of technical specifications, increased systemic risk — albeit to a lesser extent than other changes in systemic risk revealed. The significance of the coefficient further decreases when using the beta-adjusted model. All mentioned results are robust to different specifications: insurers' returns, standardised returns, and returns with adjusted beta. In addition, the launch of Insurance Stress Test 2014 seems to reduce systemic risk when using standardised insurers' returns. This reduction appears to be insignificant for insurers' returns and returns with adjusted beta, however.

Table 4: Systemic risk results for groups, EIOPA Stress Test 2018

2018	Normal	Standardized	Beta-adjusted
Stoxx	0.9377***	0.5816***	0.9828***
	(0.0192)	(0.0116)	(0.0195)
Consultation	-0.3298**	-0.2029**	-0.3551**
	(0.1616)	(0.0976)	(0.1635)
Scenario	-0.3935***	-0.2479***	-0.4146***
	(0.0932)	(0.0563)	(0.0944)
Launch & technical	0.0772**	0.0496**	0.0669*
specifications	(0.0337)	(0.0204)	(0.0342)
Results	0.0064	0.0026	0.0112
	(0.0387)	(0.0234)	(0.0393)
Recommendations	0.1124**	0.0686**	0.1241**
	(0.0519)	(0.0313)	(0.0526)
Constant	-0.0001	-0.0044	-0.0001
	(0.0001)	(0.0119)	(0.0001)
Observations	10,260	10,260	10,260
R2	0.3331	0.3437	0.3465
Adjusted R2	0.3324	0.3440	0.3458
F Statistics	465.3435***	489.9953***	493.8766***

Note: *p<0.1; **p<0.05; ***p<0.01

106 The consent was provided by Vienna Insurance Group, PFA Pension, Forsikringsselskabet Danica Skadeforsikringsab and MAPFRE S.A. However, only Vienna Insurance Group and MAPFRE S.A. are part of the employed data sample in this study.

The same analysis was also performed for solo insurers for both the 2014 and 2016 stress test. Due to the small number of listed companies participating in the exercise, however, we cannot draw a clear conclusion. In this case, only the empirical results for the 2014 exercise suggest some impact on systemic risk. In particular, consultation appears to reduce systemic risk for both the full and reduced sample when using insurers' returns and standardised insurers' returns. Nevertheless, these results are not very robust, as the coefficient for market return is insignificant in all cases. This is further confirmed by the estimates for the adjusted beta specification according to equation (3), as the coefficient for market returns turns significant, but the coefficient for systemic risk for consultation turns insignificant. This is driven by the fact that the sample is too small to make reliable estimates. Similarly, our empirical results for the 2016 exercise, do not point to any conclusion due to the extremely limited sample.

Table 5: Systemic risk results for solos, EIOPA Stress Test 2014 and 2016

	Full-sample 2014	Full-sample standard. 2014	Reduced sample 2014	Reduced sample standard. 2014	Reduced sample beta adjusted 2014	2016
Stoxx	-0.0085	0.0063	0.0271	0.0206	1.2038***	-0.0537
	(0.0275)	(0.0138)	(0.0259)	(0.0159)	(0.4626)	(0.1328)
Consultation	-0.4553***	-0.1943**	-0.3888**	-0.2126**	-1.5026	0.2006
	(0.1755)	(0.0881)	(0.1653)	(0.1017)	(2.8224)	(0.8068)
Scenario	-0.2995***	-0.1325**	-0.1633	-0.0948	0.7488	-0.2064
	(0.1143)	(0.0574)	(0.1077)	(0.0662)	(1.9340)	(1.1118)
Launch	0.4513*	0.2311*	0.2944	0.1931	1.5722	0.0362
	(0.2349)	(0.1179)	(0.2213)	(0.1361)	(3.9744)	(2.0059)
Technical specifications	0.0284	0.0068	0.0033	-0.0053	-1.0015	0.2432
	(0.0463)	(0.0232)	(0.0436)	(0.0268)	(0.7836)	(0.2506)
Results and recommend.	0.0052	-0.0023	-0.0115	-0.0038	0.1526	1.4382
	(0.0615)	(0.0309)	(0.0579)	(0.0356)	(1.0362)	(2.9505)
Constant	0.0008***	0.0550***	0.0009***	0.0654***	0.0009***	-0.0003
	(0.0002)	(0.0129)	(0.0002)	(0.0148)	(0.0002)	(0.0020)
Observations	10,056	10,056	7,542	7,542	7,542	2,358
R2	0.0029	0.0027	0.0036	0.0033	0.0038	0.0006
Adjusted R2	0.0018	0.0016	0.0021	0.0018	0.0024	-0.0041
F Statistic	2.6537***	2.4626***	2.4629***	2.2436**	2.6366***	0.1356

Note: *p<0.1; **p<0.05; ***p<0.01

CONCLUSION

EU-wide insurance stress tests have become a standard part of the supervisory risk assessment toolkit to identify key risks and vulnerabilities to follow up. This study contributes to the existing literature by investigating market reactions to the conducted EU-wide stress tests as well as the impact of exercises on systemic risk. To our best knowledge, this is the first paper dealing with this topic for the insurance sector.

Our empirical results suggest that the EU-wide insurance stress tests conducted in 2014, 2016 and 2018 have a rather limited impact on the market. This is in line with the aim of regulators, namely to avoid negatively affecting financial markets. At the same time, our study points out some positive market reactions, but these are quite limited and not robust to different test statistics and event windows. Our analysis also reveals that EU-wide insurance stress tests have the potential to reduce systemic risk. In particular, publication of technical specifications for the 2014 insurance stress test helped reduce systemic risk. Similarly, public consultation also has the potential to reduce systemic risk. This seems to be the case for the 2018, exercise with closer interaction with stakeholders ensuring better feedback and being reflected in the design of the exercise. Our results suggest that this practice should be kept as a standard part of the exercise. Finally, the announcement of a stress test scenario could help reduce systemic risk, as suggested by our empirical results for the 2018 exercise.

This study shows the important role of communication and its potential to positively affect the sector. Further research would be needed to better understand under which conditions the publication of technical specifications could decrease systemic risk, as in 2014, and when it could increase risk, as in 2018. Likewise, a better understanding of the impact of the recommendations in the 2018 insurance stress test would need further investigation. However, the impact of recommendations is linked to the follow-up actions as a response to the identified vulnerabilities at the national level rather than the reaction to the stress tests themselves. One explanation of the market reaction to the recommendation related to the 2018 stress test could stem from the negative response of participating insurance companies to the EIOPA request to provide consent on the publication of individual results. Unlike the banking stress tests conducted at the EU level, EIOPA does not have the legal power to do so without such consent. Based on numerous research studies, enhanced transparency could contribute to the overall stability of financial sectors.

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ANNEX

Insurers participated in the 2014 and/or 2016 and or 2018 stress tests included in the sample

Group level	2014	2018
Münchener Rückversicherungs-Gesellschaft AG	X	X
NN Group N.V.		X
RSA Insurance Group plc	X	X
Aegon N.V.	X	X
Ageas	X	X
Allianz Group	X	X
Aviva plc	X	X
AXA	X	X
CNP Assurances	X	X
Generali	X	X
Grupo CATALANA OCCIDENTE		X
IF P&C Insurance		X
Legal & General Group Plc	X	X
Mapfre S.A.	X	X
Phoenix Group Holdings		X
Prudential plc	X	X
RSA (Royal Sun Alliance)	X	X
Sampo plc		X
SCOR	X	
Standard Life Aberdeen plc		X
Swiss Re	X	
Unipol	X	X
UNIQA Insurance Group	X	
Vienna Insurance Group AG Wiener Versicherung Gruppe	X	
Zurich Insurance Group	X	

Solo level	2014	2016
Aegon N.V.	X	
Ageas	X	X
Allianz SE	X	
Assicurazioni Generali Spa	X	
AXA	X	
CNP Assurances	X	X
Croatia osiguranje d.d.	X	X
European Reliance General Insurance S.A.	X	
Gjensidige Forsikring Konsern	X	
Grupa Powszechnego Zakładu Ubezpieczeń Spółka Akcyjna	X	X
Grupo Catalana Occidente, S.A.	X	
JADRANSKO osiguranje d.d.	X	
Legal & General	X	X
MAPFRE SA	X	
Minerva Insurance Company Public Ltd	X	
Munich Re Group	X	
PRIME INSURANCE	X	
Prudential PLC	X	
Sava Reinsurance Company	X	
Tryg A/S	X	
UnipolSai Assicurazioni S.p.A.	X	X
UNIQA Insurance Group AG	X	
Zavarovalnica Triglav, d.d., Ljubljana	X	
Zurich Insurance Group	X	

EIOPA press releases related to the EIOPA EU- wide stress test

	2014 Insurance Stress Test
March 13th, 2014	EIOPA invited insurance and actuarial associations (Insurance Europe, CRO Forum, AMICE, Actuarial Association of Europe, CFO Forum) for the consultation to provide comments on stress test reporting templates
April 8th, 2014	Letter from the ESRB Chair to the Chair of EIOPA on the two scenarios and the qualitative questionnaire - scenario announcement
April 30th, 2014	List of technical details in the calculations carried out for EIOPA Stress Test 2014 regarding the Volatility Adjustment, launch of the EU wide stress test
May 28th, 2014	The announcement of Stress Test 2014 specifications
December 1st, 2014	Press Conference on EIOPA Stress Test's Results
	2016 Insurance Stress Test
March 14th, 2016	Invitation to the consultation /workshop
March 17, 2016	Scenario for the European Insurance and Occupational Pensions Authority's EU-wide insurance stress test in 2016
April 13th, 2016	Consultation
May 24th, 2016	Launch of the EIOPA EU-wide insurance stress test 2016
June 1st, 2016	Insurance Stress Test 2016 technical specifications
December 15th, 2016	Publication of the results for the Insurance Stress Test 2016 for solos
	2018 Insurance Stress Test
April 9th, 2018	Adverse scenario for the European Insurance and Occupational Pensions Authority's EU-wide insurance stress test in 2018
April 16th, 2018	EIOPA workshop with industry
May 14th, 2018	Insurance Stress Test 2018 technical specifications
December 14th, 2018	Publication of the insurance stress test results of 2018 for the European insurance sector, including individual results
April 26th, 2019	EIOPA's Insurance Stress Test 2018 recommendations

CLIMATE CHANGE, CATASTROPHES AND THE MACROECONOMIC BENEFITS OF INSURANCE[107]

Linda Fache Rousová[108], Margherita Giuzio[108], Sujit Kapadia[108], Hradayesh Kumar[109], Luisa Mazzotta[109], Miles Parker[108], Dimitris Zafeiris[109, 110]

ABSTRACT

This article considers the protective role that insurance can play in mitigating the negative macroeconomic and welfare impact of catastrophes, and the interplay between climate change and insurance coverage. The article first develops a theoretical model of insurance, climate change, catastrophes and the macroeconomy as a basis for the analysis. Predictions from this model are then empirically tested to explore how insurance has mitigated the impact of catastrophes in the past. Finally, we use these empirical results to explore the potential future impact of catastrophes using a range of climate-change related scenarios.

1. INTRODUCTION

There is little natural about natural catastrophes. The underlying peril is certainly natural, such as extremes of temperature, precipitation or wind, although even here the impact of humankind on climate is making an increasing contribution. Yet the impact of a catastrophe is ultimately determined by how exposed people and economic activity are to the peril, their vulnerability and which actions are taken beforehand and afterwards to mitigate the impact. Long-term drought in the middle of the Sahara has markedly less economic impact than lack of rainfall would in Saxony or Sardinia: little economic activity takes place there, and the inhabitants have adapted to the conditions.

Natural catastrophes, in short, are substantially man-made. Assessing their impact can only be effectively undertaken by considering exposure and mitigating actions taken to bolster resilience. This article considers one facet of that assessment: the protective role

107 This paper should not be reported as representing the views of the European Insurance and Occupational Pensions Authority (EIOPA) or of the European Central Bank. The views expressed are those of the authors and do not necessarily reflect those of EIOPA or of the European Central Bank.

108 European Central Bank (ECB)

109 European Insurance and Occupational Pensions Authority (EIOPA)

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that insurance can play in mitigating the negative macroeconomic and welfare impact of catastrophes, and the interplay between climate change and insurance coverage.

Climate change is likely to bring about an increase in the frequency and magnitude of natural perils. Insurance can play an important role in helping to mitigate the impact of that greater risk, but at the same time insurance coverage may fall due to climate change. The future impact of catastrophes may consequently be greater than similar events in the past, and economic models which fail to account for this mechanism may underestimate the full magnitude of the costs of climate change.

We present here a new theoretical model that links insurance to macroeconomic performance in the short and long run, accounting for changes in the distribution of climatic conditions. The model provides three main conclusions: insurance can help mitigate the macroeconomic and welfare impact of catastrophes, climate change is likely to have an increasingly negative impact on welfare and that impact is likely to be magnified by a reduction in insurance coverage.

Those theoretical findings are supported by an empirical estimation of the macroeconomic impact of past natural catastrophes across developed and middle income countries, which demonstrates the beneficial role of insurance. A catastrophe causing 1% of GDP worth of damage is estimated to reduce GDP growth by around 0.2pp in the quarter of impact. However, if a high share of damages are covered by insurance, the initial fall in GDP may be averted. Projecting those estimates forward to the end of the present century using different global warming scenarios demonstrates that output losses from disasters could increase substantially, in particular should insurance coverage retreat from current levels. These findings further reinforce the necessity of meeting the Paris Agreement targets for limiting global warming.

To better understand how insurance can help mitigate the impact of catastrophes, it is useful to first consider how catastrophes affect the economy. When catastrophes strike, they damage capital, crops, livestock, lives and livelihoods. This destruction reduces both wealth and productive capacity. Dependent on the type of natural peril, there can be continued physical disruption – for example until floodwaters recede – as well as economic disruption through supply chains and damaged infrastructure that can far exceed the initial area of impact. Notable examples include the March 2011 earthquake and tsunami in Japan that affected automobile production nationwide (Matsuo, 2015), the 2018 drought in Germany where low river levels disrupted transport of oil and other commodities, and the current pandemic.

The initial phase of the disaster is usually followed by a period of rehabilitation as disruption wanes and eventually by reconstruction, which can take years to complete. In short, the overall economic impact of catastrophes extends beyond the initial direct damage (often described as "economic damage" in the insurance literature). The lost output in the months and years before full reconstruction, assuming it occurs, can far exceed the value of the initial direct damage.

Estimates of the welfare consequences of catastrophes have typically focused on GDP growth as a way of capturing both direct and indirect impacts (see, for example, Noy, 2009, Felbermayr & Gröshl, 2012, Fomby et al., 2013, Klomp & Valckx, 2014). But this is an imperfect measure, since it mostly captures changes to the flow of activity rather than changes to the stock of wealth. Moreover, reconstruction activity is recorded as positive in GDP numbers, while in reality it does not represent an increase in welfare relative to the counterfactual of no catastrophe since it diverts resources that could otherwise be used for productive investment, for improving the current housing stock, or

for consumption (see Hallegatte and Przylkuski, 2010, for a more detailed description of estimating the costs of catastrophes).

Therefore, the aggregate welfare cost depends not just on the severity of the initial damage, but also on how swiftly reconstruction can be completed. Yet there is evidence that this phase can be prolonged and may even be incomplete in the absence of sufficient resources. Poverty traps can occur, where poorer households lack sufficient funds to cope with the disruption caused by catastrophes and end up in a permanently weaker financial situation (e.g. Carter et al., 2007, Nazrul Islam and Winkel, 2017). Broadly speaking, the paradox is that reconstruction requires funds, just at a time when economic activity, profitability and wealth may be depressed. The literature points to a substantial role for external financial support for activity and reconstruction – be it from international aid or domestic fiscal transfers – in reducing the overall impact of catastrophes (McDermott et al., 2014).

This is also why insurance can play a protective role. Insurance payouts can help households and businesses better endure the post-catastrophe disruption and underpin the reconstruction phase. Von Peter at al. (2012) find that the recovery from catastrophes is faster and more complete when the share of damages covered by insurance is higher. Indeed, aggregate GDP losses appear related to the uninsured component of damages rather than to the total amount. And firm-level evidence also demonstrates the protective value of insurance (Poontirakul et al., 2017).

While insurance has proven effective in some past episodes, coverage for catastrophes is patchy and there is currently a substantial protection gap. According to EIOPA estimates,[111] only 56% of damage caused by meteorological events (e.g. hurricanes and storm surges) in Europe is currently insured. For hydrological events (e.g. landslides and floods), the coverage falls to 28% and for climatological events (e.g. extreme temperatures, droughts and wildfires) just 7%. In a few countries, financial instruments other than private insurance are in place to mitigate the impact of disasters. For example, the Insurance Compensation Consortium in Spain is a public institution that covers losses arising from extraordinary risks, such as natural catastrophes and terroristic attacks, by charging an extra-premium on any private insurance contract. This mechanism provides insurance if damages are not covered by private policies. In France, a compensation scheme (CRR) in the form of a public-private partnership provides state-guaranteed unlimited reinsurance coverage against natural disasters and uninsurable risks.

Reducing the insurance protection gap could provide substantial welfare benefits and help reduce the social and economic impact of catastrophes. Closing the gap becomes even more important in the context of the expected increase in catastrophes brought about by climate change in the coming decades, an increase that will be particularly acute if the Paris Agreement targets are not met (IPCC, 2018). As reported by the International Association of Insurance Supervisors (IAIS) and Sustainable Insurance Forum (SIF), rising natural catastrophes are already resulting in increased claims, affecting the premiums and availability of non-life insurance, e.g. in property, transport and liability insurance.[112]

These developments also highlight how material climate change may widen the insurance protection gap. By affecting the frequency and correlation of events, climate change poses risks for insurance reserves and capitalisation and, ultimately, for insur-

111 Based on EIOPA pilot dashboard, MunichRe and SwissRe historical data (1980-2018 & 1970-2019). NatCat-Service data from MunichRe were taken from MunichRe's website in April 2020. Source links: https://www.munichre.com/en/solutions/for-industry-clients/natcatservice.html and https://www.sigma-explorer.com/

112 See "Draft Application Paper on the Supervision of Climate-related Risks in the Insurance Sector", (October 2020).

ance supply. Under severe scenarios, it is possible that the insurance market for certain climate-related events becomes unviable if the willingness or ability of households and businesses to pay for insurance is lower than the premium for which insurers are willing to (or able to) accept the risk transfer. For example, recent devastating wildfires in California and Australia have resulted in widespread reports of difficulties with insurance renewal. A survey of Australian businesses last year found that more than half reported difficulties in obtaining insurance over the previous year, citing high growth in premiums, coverage being too limited, or not being available at all (Reed at al., 2020). And a study of major New Zealand cities found that even a small rise in sea levels could substantially increase flood risk and that at least partial insurance retreat was likely within the coming decade (Storey et al., 2020).

The following sections present in turn a theoretical model of insurance, climate and the macroeconomy, empirical evidence of how insurance has in the past mitigated the impact of catastrophes, and an illustration of the potential future impact of catastrophes using different of global warming scenarios.

2. A THEORETICAL MODEL OF THE MACROECONOMIC IMPACT OF CLIMATE CHANGE AND INSURANCE

The environmental economics literature provides extensive evidence that climate change affects the level of output and the economy's ability to grow in the long-term. In this section, we model the role of insurance in mitigating the macroeconomic costs of climate change by distinguishing the long-term effect of gradual but persistent changes in climate variables, such as temperature and precipitation (chronic physical risks), from the short-term effect of more frequent and severe extreme weather events, such as floods, storms, droughts and wildfires (acute physical risks).

We show that insurance is beneficial to the economy, as it mitigates losses when disasters occur and reduces the recovery period by facilitating investment. But changes in climate variables as well as more frequent and severe natural catastrophes may reduce the supply of insurance and increase its costs. In particular, the model shows that the macroeconomic and welfare costs of climate change are likely to be greater than they would otherwise be because of this potentially growing insurance protection gap. We start with a baseline growth model that incorporates disaster risk in the presence of insurance but abstracts from climate change (section 2.1). Then we turn to the impact of climate change via a gradual increase in temperatures and more frequent natural hazards that affect the insurance market (section 2.2).

2.1 MODELLING OUTPUT IN THE FACE OF NATURAL DISASTERS

Consider an economy in which aggregate production is described by the following production function, where L and K are labour and capital inputs, and Λ is labour productivity:

(1) $$Y_t = F(\Lambda_t L_t, K_t)$$

We start by focusing on modelling the impact of natural disasters on output growth through capital, in the presence of insurance. The model assumes diminishing returns on capital, such that $dY / dK > 0$,and $d2Y / dK < 0$. When disasters occur, total capital is

reduced. We map changes in capital to three variables: the total amount of capital in the absence of disasters *K*, the amount of damaged capital upon a disaster K_d and the insurance payout K_i as shown in Equation (2). In the absence of disasters, output is given by the long-term production function in Equation (1). Output growth is constrained following a disaster because both the available capital stock decreases, and because resources are reallocated away from the optimum (see also Hallegatte and Vogt-Schilb, 2019):

$$Y_t = \left(1 - \left(\frac{K_d - K_i}{K}\right)\right) F(\Lambda L, K) \quad (2)$$

We assume that assets that were not directly damaged by the disaster continue producing with an unchanged productivity, although in reality their productivity could be reduced due to indirect effects.

The impact of natural disasters and insurance on capital and economic growth

We assume that disasters occur as discrete downward jumps to the capital stock and can be modelled as Poisson arrivals with a mean arrival rate π. Here we assume this probability to be fixed, at least in the short-term, but in section 2.2 we will allow π to vary as a function of climate change. K_d denotes the amount of damaged capital, $K_d = (1 - Z)K$, where *Z* is the undamaged share of capital. For simplicity, we assume that the loss given event is independent of risk adaptation, i.e. households and firms cannot reduce the damage.[113] $K_i = WK_d$ is the insurance payout in the event of a disaster and is equal to the total amount of insured capital that is damaged, where *W* indicates the share of damaged capital covered by the insurance. The insurance payout K_i cannot be larger than the damaged capital K_d, therefore $W \leq 1$. Abstracting from labour, output can be written as:

$$Y = F(K, K_d, K_i) = K - K_d + K_i = K - (1 - W)(1 - Z)K \quad (3)$$

where $(1 - W)(1 - Z)K$ is the uninsured damage. This expression defines the insurance protection gap. The protection gap increases as either *Z* falls for a given level of W (e.g. a bigger disaster that affects a larger share of capital), or as *W* decreases for a given level of Z (a smaller share of capital is insured). If there is no disaster, i.e. $K_d = 0$ and $Z = 1$, changes in output depend only on changes in capital. In the presence of full insurance, i.e. $K_i = K_d$ and $W = 1$, changes in output also depend on capital only, independently from damages. In the complete absence of insurance activity, i.e. $W = 0$, changes in output depend on changes in capital and the severity of damages, $Y = ZK$, for a given level of disaster probability π.

In each period, aggregate output can be spent on consumption *C*, investment *I* and insurance premiums *P*. These insurance premiums determine the degree of insurance coverage which, as modelled in Equation (3), reduces damages upon a catastrophe event by shortening the recovery period. We do not distinguish here between public and private investments and we abstract from other mitigation spending that may reduce the damage from disasters, e.g. seawalls or land-use zoning (Hong et al., 2020). The uninsured damages at time *t* depend on pre-disaster insurance spending. Investments are adjusted by a cost function $\Phi(I,K)$ that captures effects of depreciation and costs of installing capital (Pindyck and Wang, 2013). In the presence of adjustment costs, the capital is not perfectly liquid and cannot be used for consumption without incurring some costs, i.e. consumption and investment are not perfectly substitutable.

$$Y = C + (I + \Phi) + P \quad (4)$$

113 Alternatively, the loss could be modelled as a function of adaptation as in Fried (2020), $K_d = (1-Z)KF(a)$, where a denotes the adaptation capacity.

(5) $$\Phi(I,K) = \phi(i)K$$

where *i* is the investment-capital ratio, *i = I/K*,and *φ(i)*is increasing and concave. After a disaster, damaged assets are replaced or repaired by reducing consumption and regular investment. Following Hallegatte et al. (2007), we define two types of investments: investment towards reconstruction of the damaged capital, I_R, that increases the residual capital remaining after disasters, and investment into new capital, I_N, that would regularly increase the production capacity *K* (i.e. independent of disasters). The marginal return on reconstruction is higher than the marginal return on new capital, consistent with empirical evidence: e.g. following disasters, the construction of new buildings and infrastructure would be postponed to rebuild the damaged ones. Therefore, when capital is destroyed in a catastrophe, investment is first devoted to replacing the destroyed capital.

The time it takes to rebuild destroyed capital depends not only on the extent of the losses, but also on the cost and availability of financial tools for households and firms (Hallegatte et al., 2007). In practice, the pace of reconstruction, I_R, can be limited by a lack of savings or borrowing capacity, for example, or by limited production capacity in certain sectors, such as construction. This leads to consumption losses since *C* would be reduced in favor of *I* and reconstruction periods would be much longer than what the initial amount of damage would suggest. Insurance can relax these financial constraints by quickly repaying insured damages and reducing consumption losses. At the same time, I_R is bounded by the amount of total investment that can be mobilized. We assume that all investment is devoted to reconstruction because of the higher return of I_R with respect to I_N, and that output losses are reduced to zero exponentially with a characteristic time of reconstruction *R*. This implies that the economy returns to its pre-disaster state, although in practice some activities could be permanently destroyed. Output losses after t_0 are then given by:

(6) $$\Delta Y = \mu \Delta K e^{-\frac{t-t_0}{R}}$$

where *μ* is the average productivity of capital *F(L, K)/K*. The duration of the reconstruction phase therefore determines the macroeconomic cost of natural disasters. If damages can be repaired immediately, output losses will be zero, but consumption will be reduced to reconstruct (i.e. ΔC = ΔK). By contrast, if there is no reconstruction, output losses will be permanent (R = ∞) and will be absorbed by consumption (i.e. ΔC = ΔY= μΔK). Assuming that the productivity of destroyed capital is equal to the average pre-disaster productivity of capital, the model therefore implies that the net present value of consumption losses is larger than direct losses when reconstruction takes some time, as μΔK > ΔK.In other words, consumption and welfare losses are magnified when reconstruction is delayed or slowed down.

We can also translate the model to determine what it implies for the economy's growth rate by augmenting a standard specification of capital stock evolution in the presence of disasters (Barro, 2006; Pindyck and Wang, 2013; Hong et al., 2020) to incorporate the effects of insurance. The capital stock is subject to stochastic fluctuations and jumps, and evolves as follows:

(7) $$dK_t = \Phi(I_{t-1}, K_{t-1})dt + \sigma K_{t-1} dB_t - (1-W)(1-Z)K_{t-1} d\mathcal{J}_t$$

The first term is investment, adjusted for depreciation and costs of installing capital, as defined in equation (5) (Pindyck and Wang, 2013). The second term captures continuous shocks to capital that are standard in macroeconomic models, where B_t is a standard Brownian motion and the parameter *σ* is the diffusion volatility of the capital stock growth. *t-1* denotes the pre-jump time. The third term represents the effect of disasters. J_t is a jump process reflecting the probability of a natural catastrophe with a fixed but

unknown arrival rate, π. When the jump arrives, it destroys K_d, which is a fraction $(1 - Z)$ of capital K. The novelty of our model is that in the presence of insurance, this fraction is reduced by (1-W) times, as also shown in equation (3). If the catastrophe does not arrive, the third term is zero. The higher the arrival rate π, for example due to climate change, the more likely that the capital stock will be hit by a disaster. Substituting the expression for depreciation and installation costs (5) into (7) and taking the first derivative of capital stock K_t, we can see that:

$$dK_t/K_t = \phi(i^*)dt + \sigma dB_t - (1 - W)(1 - Z)d\mathcal{J}_t \tag{8}$$

where i^* is the optimal investment-capital ratio, constant in equilibrium. The expected growth rate, denoted by $\bar{g}$, is then

$$\bar{g} = \phi(i^*)dt - \pi E(1 - W)(1 - Z) \tag{9}$$

where the second term is the expected percentage decline of the capital stock due to catastrophes. While insurance may crowd out investment, it enhances long-run growth by reducing the expected loss due to catastrophes, $E(1 - W)(1 - Z)$.

Insurance premiums p_{t-1} mitigate the effect of disasters by insuring a share W of damages, so that the remaining share of capital after disaster conditional on the event arrival at time t, i.e. $(1 - W)(1 - Z) = Z + W(1 - Z)$, depends on pre-disaster insurance spending P_{t-1}:

$$W_t(1 - Z_t) = p_{t-1} \tag{10}$$

where $W_t(1 - Z_t)$ is the share of insured damages and p_{t-1} is the pre-disaster unit cost of insurance. If insurance spending P_t increases, then the benefit increases as well, but less than proportionally, i.e. insurance has decreasing returns to scale. In the next section, we therefore consider the determinants of insurance cost.

The cost of insurance

For a given probability of an adverse event, π, insurance is beneficial in expectation, with the benefits deriving from the reduction of (uninsured) damage after disasters. The price of insurance claims is modelled as follows:

$$p(W, Z) = \alpha\pi(1 - Z)W \tag{11}$$

where α reflects the insurance risk premium and depends on the risk aversion of insurance capital providers, $\pi(1 - Z)$ is the expected damage of a disaster and $\pi(1 - Z)W$ is the amount of damage insured. If the policyholder insures the whole capital at risk, $p(W,Z) = p(Z)$. Should the shock arrive, the policyholder would receive a lump-sum payoff of one unit of consumption. If the disaster probability (arrival rate) π increases, the insurance premium would increase too, as insurers will pay more claims. At the same time, for a given Z, the insured share W would decrease. This allows us to model the insurance cost endogenously. Lane and Mahul (2008) show empirically that the price of a catastrophe bond can be modelled as a multiple of expected loss, as in equation (11).

The risk charge reflects the cumulative feature of disaster risks that affect many policyholders at the same time. The higher is α and the bigger the loss, the higher the insurance premium, as the ability of insurers to diversify their portfolio and pool risks together decreases. Carayannopoulos et al (2020) and Dieckmann (2010) suggest that risk aversion among insurance capital providers can increase the value the insurance risk premium

α, for example after major natural disasters. For simplicity, we abstract here from the distinction between insurance and reinsurance providers.

We assume that if the probability of a catastrophe, π, increases, the demand for insurance K_i will also increase as the benefit of insurance will be larger other things being equal. But insurance supply is limited to a quantity, M, $K_i \leq M$, which depends on insurers' risk aversion. If the buyer of insurance knows the capital at risk and is strictly risk averse, then he will completely insure against the event, i.e. $W = 1$. In this model, we assume that the buyer cannot influence the probability or severity of a natural event. Otherwise, the insurer will offer only partial insurance, $W < 1$, so that the buyer has incentives to reduce risk/losses. If the policyholder could influence the probability or severity of disasters in our model, then the level of insurance would depend on such adaptation capacity, because a consumer with high adaptation capacity suffers lower damage and therefore chooses to insure less, i.e. lower W.

The insurance protection gap can widen for several reasons that relate both to insurance supply and demand. Insurers' risk aversion typically increases after large natural disasters. Also, a lack of awareness or willingness to buy insurance cover even when it is affordable and accessible, is not uncommon in many developed countries.[114] But the protection gap may also widen from the rising price or the unavailability of certain types of insurance coverage, especially due to risk factors related to climate change. If the frequency or severity of disasters rises globally, this may increase the insurance risk premium and reduce its risk pooling benefit. In this situation, buyers are aware and willing to buy insurance cover but are unable to do so due to unaffordability or insufficient availability.

2.2 INCORPORATING THE IMPACT OF GRADUAL CHANGES IN CLIMATE VARIABLES ON CAPITAL

Thus far, we have abstracted from the impact of climate change in the model. Climate change can affect output both via a gradual change in climate-related variables and more frequent natural hazards. In the next step, we consider only the direct effects of gradual global warming on capital, that affect neither the probability nor the severity of an adverse natural event and that cannot therefore be mitigated by insurance. In the final section, we introduce the impact of more frequent disasters on insurance activity, i.e. on the insurance protection gap, and therefore on output.

We start by modelling the impact of gradual changes in climate-related variables, such as temperature, T, and precipitation, on capital by exploiting the approach of Kahn et al. (2019). In particular, we consider the deviations from the historical norms of climate variables. In contrast to Kahn et al. (2019), we focus here on the impact of global warming (i.e. changes in T) on output growth, via gradual losses of physical capital related, for example, to land desertification or sea level rise, and we abstract from the impact on labour productivity. Gradual warming could also reduce the productivity and availability of natural resources as well as negatively affect certain aspects of the capital stock. For example, some machinery and equipment may not be able to operate as effectively above certain temperatures, or higher temperatures may accelerate the rate of depreciation of the capital stock. We abstract here from the development of new technologies that could mitigate these effects over time.

The historical norms are regarded as capital neutral, in the sense that if climate variables remain close to their historical norms, they are not expected to have any gradual long-

114 Aon Benfield's "Reinsurance Market Outlook," published in July 2019, said, "*Even in developed countries with the most mature insurance markets in place, there are several perils and sub-perils of events that remain highly uninsured.*"

term effects on capital. In this step, we also assume that K_d and K_i are not affected by gradual changes in climate-related variables.

Specifically, we consider the following specification for changes in capital due to temperature:

(12) $$K(x_t) = K_t \omega_0 \exp(-\omega x_t)$$

where $x_t = (T - T^*_{t-1})$, ω_0 is a positive constant and the exponential function is a multiplicative shifter of capital, with ω being the sensitivity of physical capital to climate change, and also assumed to be positive, so that climate change adversely affects the capital stock. The historical norms (i.e. T^*) are assumed to be fixed to reflect current temperature patterns. By substituting equation (12) into (3), we obtain the following:

(13) $$Y_t = F(K_t, K_{dt}, K_{it}, x_t) = K_t \omega_0 \exp(-\omega x_t)\,[1 - (1 - W)(1 - Z)]$$

Equation (13) shows that if there is no deviation of temperatures from historical norms (so that $x_t = 0$), output would be the same as in equation (3). But if changes in temperature directly affect capital, without changing the probability of a disaster, then the output in equation (13) is smaller than in equation (3) substituting $exp(-\omega x_t) < 1$. In short, regardless of the provision of insurance, output and welfare are likely to be lower in the presence of climate change.

The impact of changes in climate variables on capital through disaster insurance

Global warming is also likely to affect output by making adverse natural events more frequent or more severe. This affects output *directly* by increasing losses from disasters, and *indirectly* via the widening protection gap. The direct effect can occur even if the protection gap doesn't widen. In this section, we focus on the indirect effect of an increase in disaster probability, π, on insurance coverage. As an alternative, we could also consider the effect of an increase in severity, Z. As shown in equation (11), insurance premiums would increase as a consequence of increased disaster risk and insurance coverage would decline, a process called insurance retreat in the literature. Alternatively, insurers could introduce terms in insurance policies that transfer part of the risk to the policy holder (partial retreat) (Storey et al., 2020).

We modify equation (11) to account for changes in insurance premiums due to climate variables:

(14) $$P(W, Z, x) = \alpha\pi(1 - Z)W \exp(\psi x_t)$$

where ψ is the sensitivity of disaster probability to climate change. If there is no deviation of climate variables from historical norms (x = 0), insurance on physical capital will depend on the insurance risk premium and expected damages as in equation (11), and the output model collapses to equation (3). If climate change increases insurance costs, a positive ψ would be associated with higher premiums and therefore lower insurance coverage, i.e. a higher protection gap.

(15) $$Y_t = F(K_t, K_{dt}, K_{it}, x_t) = K_t \omega_0 \exp(-\omega x_t)\,[1 - \big(1 - W exp(-\psi x_t)\big)(1 - Z)]$$

Given the inverse relationship between insurance cost and coverage, the sensitivity of the disaster probability enters the expression with a negative sign. As above, the historical norms are regarded as insurance neutral, in the sense that if climate variables remain close to their historical norms, they are not expected to have any effects on the

probability of the adverse natural event and therefore on insurance. If insurance coverage is negatively affected by climate change, the output in equation (13) is larger than in equation (14) because $exp(-\psi x_t) < 1$ if $\psi > 0$. If there is no insurance, equations (13) and (15) are equivalent.

Overall, the theoretical model presented here provides several important conclusions. First, disasters are costly and influence output through their increasing frequency. Insurance can help mitigate the impact of disasters by relaxing financial constraints and accelerating the rebuild, thereby reducing the overall welfare loss. Second, the gradual increase in temperatures above historic norms can result in lower productivity and lower output overall, for which insurance can offer little protection. Finally, an increase in the probability of natural hazards can result in a widening of the insurance protection gap, which exacerbates the detrimental effect of increasing climate-related catastrophes on capital, output, growth and welfare.

3. EMPIRICAL EVIDENCE OF THE IMPACT OF THE PROTECTION GAP

In this section, we empirically test some of the predictions from the theoretical model, specifically the growth equation (9). Abstracting from the stochastic properties of that equation, it implies that the growth rate of an economy is adversely affected by damage from natural disasters, but insurance can play a role in mitigating their impact. More formally, for a given period *t*, Equation (9) can be rewritten as:

$$g_t = \phi_t - \mathrm{E}\,(1 - W_t)(1 - Z_t) = \phi_t - \mathrm{E}\,(1 - Z_t) + \mathrm{E}\,W_t(1 - Z_t) \tag{14}$$

where Φ_t is a growth rate in period *t* without any disaster damage (i.e. when $Z_t = 1$), $(1 - Z_t)$is the share of capital damaged by a disaster (or a set of disasters) occurring in period t, W_t is the share of the damaged capital covered by insurance and E is a non-linear function. Using Taylor's theorem, we obtain the linear approximation of this function from the first order Taylor polynomial and approximate the growth rate of a country *c* in period *t* as follows:

$$g_{ct} = \phi_{c,t} + \beta_1 * \left(1 - Z_{c,t}\right) + \beta_2 * W_{c,t} * \left(1 - Z_{c,t}\right) \tag{15}$$

Furthermore, decomposing $\Phi_{c,t}$ into a country fixed effect α_c, a time fixed effect ϑ_t and a random error term $\varepsilon_{c,t}$, we derive the following empirical specification:

$$g_{ct} = \beta_1 * \left(1 - Z_{c,t}\right) + \beta_2 * W_{c,t} * \left(1 - Z_{c,t}\right) + \alpha_c + \theta_t + \varepsilon_{c,t}, \tag{16}$$

In line with our model, we expect $\beta_1 < 0$ and $\beta_2 > 0$.

To account for the non-linearities in the theoretical model, we also derive a complementary empirical specification from equation (16) by transforming the continuous variables $(1 - Z_{c,t})$ and $W_{c,t}$ into dummy variables to distinguish between large-scale natural disasters with low and high shares of insured losses. The coefficient for large-scale natural disasters with a low share of insured losses is then expected to be negative (as in the case of β_1) and the coefficient for large-scale natural disasters with a high share of insured losses is expected to be higher than this (derived from $\beta_1 + \beta_2$).

DATA

For the dependent variable, we use quarterly data on real GDP growth rates from the OECD, which are available for a sample of 45 countries, including 8 non-OECD countries. This naturally skews the sample towards more developed economies. The sample does also include some emerging market economies (including Brazil, India, Russia, South Africa and Turkey), but no country classified as low income by the World Bank is present. By focusing on GDP growth rates, our empirical analysis follows the theoretical model and the approach of most other studies in this field (e.g., Noy, 2009, Felbermayr & Gröshl, 2012, Fomby et al., 2013, Klomp & Valckx, 2014). Yet GDP growth is only an imperfect proxy for capturing the overall welfare consequences of catastrophes, since it captures changes to the *flow* of activity rather than changes to the *stock* of wealth.

To proxy the share of capital damaged by natural disasters and the share of damaged capital covered by insurance, we use EMDAT, an international disasters database collected by Centre for Research on the Epidemiology of Disasters.[115] The EMDAT database contains information about individual disaster events across the globe since 1980. Owing to a somewhat lower coverage in early years, we only use data since 1996 and focus on four types of natural disasters: climatological (411 events), geophysical (521 events), hydrological (2,275 events) and meteorological (1,995 events).[116]

115 Available under www.emdat.be.

116 These are the disaster types most studied in the literature. Excluded types include technological disasters, which are typically factory and transport accidents and therefore generally small and localised, biological disasters, which in general have smaller initial impact on capital (although as the current pandemic shows there can be substantial indirect impacts) and extra-terrestrial (a meteor strike in Russia).

The most common events are floods (38% of all events) and storms (31%). A typical drought (climatological disaster) results in the largest damages (median around $860mn), followed by an extreme temperature event (median ~ $300mn), a storm (median ~$170mn) and a wildfire (median ~ $140mn). While earthquakes display a relatively limited median damage (around $90mn), the distribution is highly skewed to the right by events with exceptionally large damages, resulting in the largest mean among all types of events (around $2600 mn).[117] Although geophysical disasters such as earthquakes are independent of climate change, we include them in our analysis to increase the sample size, especially in relation to very large disasters.

While the database includes over 5,000 disaster events across the globe for the period of our analysis, information on financial damages is only available for about 2,300 disasters. Within those, a split between insured and uninsured losses is available only for around 650 events (see Table 1), with both the mean and median share of insured losses being around 40%. But those disasters with the split are in general much larger, which are likely to be more relevant in terms of macroeconomic impact. In particular, the average financial damage for disasters where insured losses are available is $3.2 billion, almost ten times higher than the average damage of disasters where the split between insured and uninsured damages is unavailable.

However, to increase the number of events for our empirical analysis, we impute insured and uninsured losses for most events where data on total damages are available. The values are imputed based on a country-specific regression models, where the dependent variable is the share of insured losses in total damages and the explanatory variables include the log of total damage and dummies for eight different types of disaster (drought, earthquake, extreme temperature, flood, landslide, mass movement, storms, volcanic activity, wildfire) to the extent applicable for a given country. For some countries, the model cannot be estimated owing to a low number of observations, resulting in around 250 events with

117 All values are in this paragraph are in constant 2010 USD.

damage data but no imputed values for insured/uninsured losses. In the empirical exercises below, we present results based on both the smaller sample where insured and uninsured losses are split in the data and the wider sample which exploits the imputed split.

Table 1: Results of data imputation for insured and uninsured losses (values in constant 2010 $)

	Damages	Insured	Uninsured	# events
Original dataset				
Information on (un)insured losses	$2.1 trillion	$0.7 trillion	$1.4 trillion	657
Information on total damage only	$0.6 trillion	-	-	1,654
No information on damage	-	-	-	2,891
Total				5,202
Dataset with imputed values				
Information on (un)insured losses	$2.7 trillion	$0.9 trillion	$1.8 trillion	2,066
Information on total damage only	<$0.1 trillion			245

Sources: EMDAT and authors' calculations.

We proxy the share of capital damaged by disasters in country c and quarter t by the share of financial damages from (all) disasters in that quarter and country relative to country GDP lagged by one year. We obtain the GDP level data from the World Development Indicators (WDI) and use constant 2010 USD for the calculation. The mean (median) disaster cost is 0.25% (0.029%) of GDP in the full EMDAT sample, which declines to 0.16% (0.027%) of GDP for our sample of countries where quarterly GDP data are available. The lower mean impact reflects the fact that quarterly GDP data are mainly available for developed countries, where natural disasters have typically had a smaller impact relative to GDP in the past. In this smaller sample, the disaster damage exceeds 1% of GDP for only 18 observations. The share of the damaged capital covered by insurance ($1 - Z_{c,t}$) is then proxied as the share of insured financial losses in total disaster damages. The share of insured losses is somewhat higher in the sample with quarterly GDP data (median at 47%) as compared to the world-wide EMDAT sample (median at 40%).

EMPIRICAL RESULTS

Using a panel regression with standard errors clustered by country, we estimate equation (16) and report the results in Table 2. We start by focusing in column (1) on the sample for which insured and uninsured losses are split in the underlying dataset. The sign of the coefficients is as expected, with greater damages from disasters being associated with a lower growth rate but with this effect being mitigated by a higher share of insured losses. The statistical significance of both coefficients improves when we use the larger sample with imputed data in column (2), while the size of the coefficients remains almost unchanged.

These estimated coefficients suggest that if a large disaster of 1% of GDP hits a country, the quarterly GDP growth rate declines by 0.25 percentage points in case of no insurance coverage (e.g. from the median of 0.7% in our sample to 0.45%; see the left panel of Figure 1). However, if 25% of the losses are insured, the GDP growth rate is estimated to only decline by around 0.15 percentage points. The effect is even smaller, around 0.06 percentage points, if half of the losses are insured. For unusually high shares of insured losses – e.g. a 75% insured share corresponding to the 90th percentile of the distribu-

tion – our empirical model even suggests an almost immediate (within quarter) rebound in GDP growth.

Table 2: Regression results – panel estimates

Dependent variable	quarterly GDP growth rate (in %)			
	(1)	(2)	(3)	(4)
Sample	Original	Imputed	Original	Imputed
Damage as a share of GDP (%)	-0.25*	-0.24**	-0.26*	-0.25*
	(0.07)	(0.05)	(0.07)	(0.06)
--> lag 1			0.28***	0.0040**
			(0.00)	(0.04)
Damage as a share of GDP (%) * Share of insured losses (%)	0.0037*	0.0037**	0.0042**	0.19**
	(0.05)	(0.03)	(0.05)	(0.05)
--> lag 1			-0.0043***	-0.0025
			(0.00)	(0.13)
Country fixed effects	Y	Y	Y	Y
Time fixed effects	Y	Y	Y	Y
Observations	2,938	3,431	2,214	2,827
R-squared	0.203	0.188	0.224	0.206
Number of countries	45	45	45	45

Notes: Panel regression using standard errors clustered by country. *, **, *** denote significance at 10, 5 and 1% confidence level. P-values are reported in parentheses.

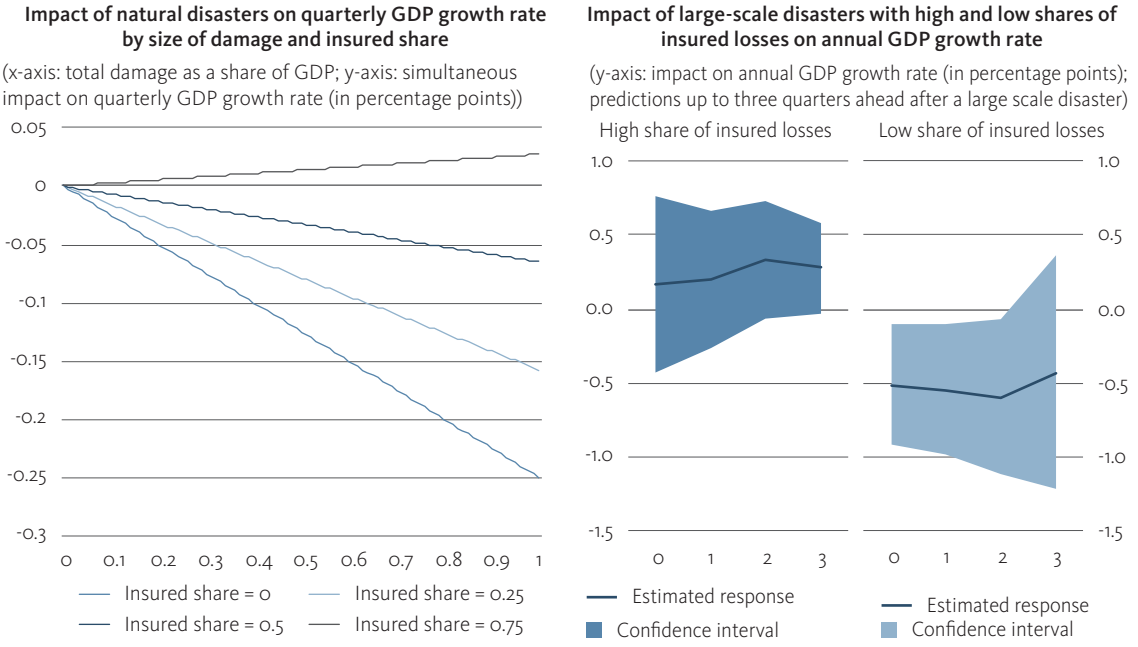
To further investigate such potential rebound effects, we test the effect of lagged disaster damage and insurance coverage on the quarterly GDP growth rate in columns (3) to (4). The results suggest that, on average, there is a rebound in GDP growth one quarter after a disaster happens (coefficients of further lags are estimated as insignificant). However, while reconstruction activity is recorded as positive in GDP growth numbers, in reality it does not represent a gain to welfare since it takes away available output that could otherwise be used for improving the current capital stock, or for consumption (see Hallegatte and Przylkuski, 2010, for a more detailed description of estimating the costs of catastrophes).

To account for the non-linearities in the theoretical model, we estimate an alternative empirical specification using two dummy variables to capture large-scale natural disasters with high and low shares of insured losses respectively. In view of the relatively high volatility of quarterly GDP data, we use as the dependent variable the annual GDP growth rate in each quarter (calculated as the year-on-year difference in the log of GDP) and include several lags of the two dummy variables. The results presented in the right panel of Figure 1 confirm the adverse effect on the GDP growth rate from large-scale natural disasters when insurance coverage is low. This adverse effect is then estimated to drag on the annual GDP growth rate for up to three quarters after the disaster.[118] For large-scale disasters with a high share of insured losses, the GDP growth rate is – in line with the theory – estimated to be higher and does not deviate significantly from its long-

118 This is consistent with the rebound in the quarterly GDP growth rate estimated in Table 2.

term trend. This suggests that insurance supports GDP growth after disasters, likely as insurance payouts can support reconstruction.

Figure 1: The impact of natural disasters on quarterly GDP growth rate by size of damage and insured share



Notes: Left panel: Based on estimates in column (1) of Table 2. Right panel: The charts show the impact of large-scale natural disasters (with total damage larger than 0.1% of GDP) when the share of insured losses is high (above 35%) and low (below 35%). The estimates are obtained using a panel regression model with standard errors clustered by country and the sample with imputed data. For the quarter including the date(s) of the disaster (t=0) and the three subsequent quarters, the y-axis measures the percentage point impact of the disaster on the year-on-year annual growth rate at the end of that quarter.

4. THE POTENTIAL IMPACT OF DIFFERENT CLIMATE CHANGE AND PROTECTION GAP SCENARIOS ON THE MACROECONOMY IN A EUROPEAN CONTEXT

In this section, we link the findings of the theoretical model and empirical results to the possible evolution of key climate-change related perils under different warming scenarios.

The analysis starts by taking various Representative Concentration Pathways (RCP) developed by the Intergovernmental Panel on Climate Change to give different global warming scenarios. Assuming that no adaptation or mitigation measures will be introduced to limit the impact of climate change, the potential future financial damages due to natural disasters in a European context are then mapped on to GDP, under different protection gaps and warming scenarios, using the empirical results from the previous section.

The RCP pathways underpin the analysis carried out in the PESETA IV report, which calculates for Europe, including the UK, estimated annual damages and GDP losses arising from climate-related catastrophes, based on granular regional and sectoral models and

assuming no adaptation or mitigation measures. Table 3 presents the expected annual damages for key perils[119], while Table 4 shows the expected annual damages as share of GDP without damage reduction measures.

Table 3: Expected annual damages from climate-related catastrophes without adaptation and mitigation measures (in million €)

EU and UK (2015 values)	Baseline (1981-2010)	2050		2100		
		1.5°C	2°C	1.5°C	2°C	3°C
Windstorm	4,594	6,829	6,913	11,260	11,393	11,422
Droughts	9,048	12,354	15,475	24,723	31,457	45,380
River flood	7,809	15,609	21,268	24,072	33,081	47,824
Costal flood	1,400	10,900	14,100	*10,900*	110,600	239,400
Total	22,851	45,692	57,756	70,955	186,531	344,026

Source: JRC PESETA IV report. Note: The 1.5 degree figure for costal flood was not included in the source and is estimated for the purposes of this article. The Peseta IV report focuses on the 1.5°C and 2°C warming levels in 2050 as 3°C warming by mid-century is not considered a realistic scenario.

We combine the PESETA IV damage estimates with data from EIOPA's ongoing work on the insurance protection gap dashboard[120] to generate six scenarios. We take two potential warming paths – RCP4.5 (labelled here as moderate) and RCP8.5 (labelled here as severe) and their associated expected annual damages from Table 3. For each of these paths we consider three potential degrees of insurance coverage: current, which corresponds to the share of losses that are covered today (insured share of 30%), zero insurance coverage and full coverage.

We aggregate, across all the considered perils and European countries, the PESETA IV estimates on expected annual damages as share of the projected GDP based on the future socioeconomic conditions set out in the Commission's ECFIN 2015 Ageing report[121]. The expected future damages as share of the projected GDP are summarised in Table 4. Expected annual damages are estimated to increase from the baseline of 0.17% of GDP to 0.21% in 2050 under the moderate scenario and 0.29% in the severe scenario. By 2100 these losses are projected to increase to 0.41% and 0.76% respectively. In other words, expected annual GDP losses from natural perils are projected to increase by between 2.5 and 4.5 times by the end of the current century. Looking at the expected annual damages by mid- and end-century under the same warming scenario, the EAD as share of GDP may seem lower in 2100 than in 2050, but this can be explained by the fact that these figures are linked to different RCP pathways. For example, under the "moderate" warming scenario the mean global temperature is expected to increase by approximately 1.5°C by 2050, however under the same pathway the temperature would increase by almost 2°C by 2100. In other words, the expected results under the 2050 (1.5°C) should be compared with the foreseen results in 2100 in a 2°C warming scenario.

119 These estimates include the annual GDP loss in the EU, including the UK, arising from climate-related catastrophes, based on granular regional and sectoral models. The perils were selected on the basis on data availability and comparability with the modelling framework. The full results of PESETA IV can be found at https://ec.europa.eu/jrc/en/peseta-iv.

120 For further information please see: https://www.eiopa.europa.eu/content/pilot-dashboard-insurance-protection-gap-natural-catastrophes_en

121 The 2015 COM Ageing Report: Economic and budgetary projections for the 28 EU Member States (2013-2060): https://ec.europa.eu/economy_finance/publications/european_economy/2015/pdf/ee3_en.pdf

Table 4: Expected future annual damages from climate-related catastrophes as a share of GDP without adaptation and mitigation measures

EU and UK (2015 values)	Baseline (1981-2010)	2050		2100		
		1.5°C Moderate	2°C Severe	1.5°C	2°C Moderate	3°C Severe
Total (windstorm, drougths, river and coastal flood)	0.17%	0.21%	0.29%	0.19%	0.41%	0.76%

Source: JRC PESETA IV Report and authors' calculations.

Finally, we exploit the empirical estimates presented in Section 3 (Table 2, column 2) to give an indicative comparison of the evolution of GDP under the six scenarios (Figures 2a and 2b). Naturally, the uncertainty around estimates 30-80 years into the future is substantial due to material uncertainties in the climate and economic projections. In particular, these results assume that no action would be taken to counteract the increasing risk related to climate change through mitigation or adaptation measures. In this context, the results show that under both the RCP4.5 and RCP8.5 paths, differences in insurance coverage could have economically material effects on GDP. The difference between the GDP level assuming full and no insurance is around 2% under RCP4.5 and around 3% under RCP8.5 in 2050. By the end of this century, the difference widens to around 8% and 14% respectively.

Figure 2.a.

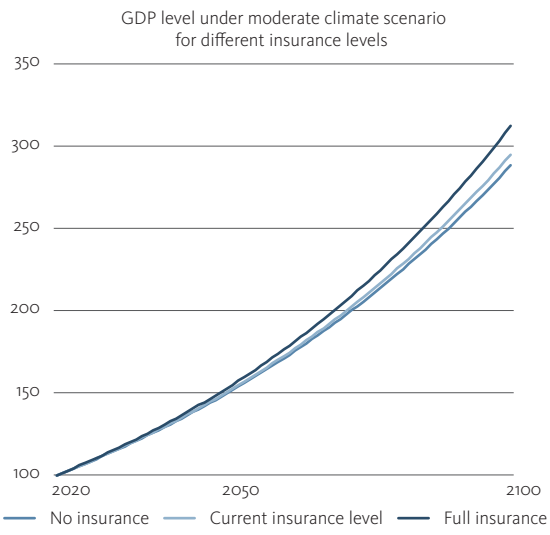
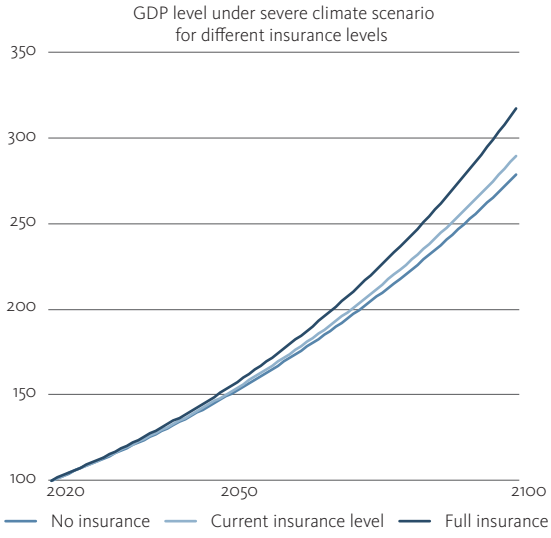


Figure 2.b.



Source: PESETA and authors' calculation.
Notes: The moderate (left panel) and severe (right panel) scenarios correspond to an increase in temperature by 2 and 3 degrees by 2100, respectively, and reflect two Representative Concentration Pathways (RCP) developed by the Intergovernmental Panel on Climate Change (IPCC). The GDP level is indexed to 100 in 2020. The annual GDP growth rate without damages from climate-related catastrophes is assumed to equal 1.4% (similarly as in The 2021 Ageing Report). The estimated annual damages from climate-related catastrophes in Europe are based on PESETA IV report, which estimates these damages for different RCP pathways using granular regional and sectoral models. No adaptation or mitigation measures are considered. The estimated impact of these damages on the GDP growth rate with different shares of insured losses is based on estimates in column (1) of Table 2.

5. CONCLUSION

Climate change, even under moderate scenarios, is likely to bring about a marked increase in natural perils both in Europe and globally. The theoretical and empirical results presented in this feature demonstrate that the aggregate welfare impact of that increase is not pre-determined. Setting aside the actions that can be taken to transition to a carbon neutral economy and thereby limit the extent of warming, insurance has a key role to play in mitigating the impact of future catastrophes. By accelerating reconstruction and limiting the period of lower output, insurance can help reduce the overall welfare loss.

Yet the insurance protection gap in Europe is already substantial, and there are several reasons to suspect it may widen as a result of climate change. More frequent and more severe disasters may act to reduce the supply of private insurance, whilst simultaneously making insurance more valuable from a welfare perspective. Policies aimed at enhancing both adaptation and mitigation of climate-related events are needed to increase the resilience of the economy to climate change. Addressing the structural causes of the protection gap now and in the future has the potential to provide substantial welfare benefits.

While this article provides new insights into the interplay between climate change, insurance, the protection gap and economic output, it also highlights the need for further research. In particular, the role of governments and the potential complementary role of the private sector are key issues with practical relevance, and possible policy implications which should be further explored. While substantial fiscal resources put towards reconstruction can help, this needs to be balanced against the possible effects of creating potentially large contingent liabilities on the balance sheet of fiscal authorities. Finally, while this article focuses on the reconstruction effect that shows up in measured GDP, further work would be necessary to fully understand the effects on welfare.

The potential policy implications of this work also warrant further exploration.[122] The cross-border nature and possible systemic implications of climate change related risks could, for instance, warrant a concerted response at the European level. Knowledge-sharing at European level could enhance risk management and modelling capabilities for natural catastrophes and foster more efficient capital allocation. Risk pooling at regional or European level could potentially improve insurability and affordability. Finally, the penetration of climate risk related insurance could be improved by pairing them with other common or mandatory insurance products.

122 See e.g. https://www.ecb.europa.eu/pub/pdf/other/ecb.eurosystemreplyeuropeancommissionpublicconsultations_20200608~cf01a984aa.en.pdf and https://register.eiopa.europa.eu/Publications/EIOPA-19-485_EIOPA%20Staff_Discussion_Paper_Protection_Gap.pdf for reference

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