EIOPA REGULAR USE

EIOPA-FSI-16-016

Financial Stability Report

December 2016

Table of Contents

Foreword by the Chairman

This year is an important milestone for the European insurance sector. The new regulatory regime increases risk based awareness and provides us with the opportunity to assess all relevant risks. EIOPA is presenting its first Financial Stability Report employing Solvency II data which will gradually transform our capacity to analyse the financial stability of the sector. Progressively building up an information system based on this rich data source will allow further developing enhanced risk analyses and early warning indicators at individual, group and system-wide level, increasing supervisory capacity of National Authorities and EIOPA as a whole. This will reinforce the quality of both micro and macro-prudential supervision in Europe. A key factor for success is good data quality, which is a challenging area for the industry and supervisors alike. The implementation of Solvency II introduces a risk-based regulatory regime, but also new challenges in terms of the relevant expertise. In a single market, where cross border business plays an increasing role, it is fundamental to ensure that the supervisory system has no weak links.

This year, a new European insurance stress test was conducted to assess the resilience of the sectors to the current challenging environment. The exercise concentrates on two major risks: the prolonged low yield environment and the so-called "double hit scenario". In addition, EIOPA will launch its second Pensions stress test in 2017 analysing also the impact of adverse market conditions on sponsors' and assessing the possible negative consequences for financial stability and the real economy.

The important role of the insurance sector in the economy, increasing cross border activities and the current challenging macroeconomic environment bring to surface discussions for a European macro-prudential framework for insurance. Such discussions should take into account the specific nature of the insurance business as well as funding models and define insurance specific objectives and instruments. Solvency II is a micro-supervisory regime that already contains some macro-prudential elements. A full assessment of the effectiveness of those elements needs to be made in the coming years. The 2021 overall review should be used to integrate a macro-prudential framework for insurance in Solvency II. This approach would ensure the coherence between the micro and the macro elements to avoid the emergence of

conflicting incentives to insurers, and facilitate the implementation of the regimes by the respective authorities. EIOPA will work in this area in close cooperation with the European Systemic Risk Board (ESRB).

Finally, this report provides two thematic articles dealing with the impact of the monetary policy interventions on insurers and discussing possible approaches to long term interest rate update. I am confident that this work will further contribute to constructive discussions and cooperation among supervisors and academia to enhance risk assessment and efficient supervision.

Executive Summary

The European macroeconomic environment remains fragile, further challenged by a number of geopolitical risks. Although it is generally assumed that yields will remain low for some time, the debate on whether the present interest rate levels represent the "new normal" or whether they will gradually move back to their long-term averages is still non-conclusive. Nevertheless, a moderately prevailing view among economists and analysts points out that the so-called "low for long" scenario is more likely than a gradual increase of interest rates to the previous levels. The ECB recently announced the continuation of its monetary stimulus until March 2017. The inflation rate has been slowly reacting to further stimulus, but it is still far from the target.

The insurance sector remains challenged by cyclical and structural factors. Technological innovations such as the eminence of autonomous vehicles, a more precise and accessible genetic analysis and the advent of the sharing economy are examples of trends that might have large impacts on the insurance sector. Moreover, the transition to a low-carbon economy as a consequence of the climate change might affect the insurance sector as well. These are aspects that demand business models to adapt in the near future.

Currently, business model adaptations have been driven mainly by the prolonged period of low interest rates and weak growth, which pressures earnings prospectively. In particular, guaranteed-return life insurers and defined-benefit pension funds as well as insurers with high duration mismatches between assets and liabilities are affected, weakening their resilience and increasing the risk of failures. Therefore, there is now a clear shift from long-term guarantees to unit-linked investments, transferring interest rate risks to policyholders. Maturing assets will have to be reinvested in the current yield environment in order to match the cashflow profiles of all outstanding liabilities, exposing the insurer to reinvestment risk. Insurers need to protect themselves against the effects of low interest rates. The insurance sector exhibits significant exposures towards the banking sector, not only to the domestic, but also to the cross-border level. Regarding the sector's profitability, mainly thanks to benign loss developments in recent years, combined ratios for non-life companies (i.e. incurred losses and expenses as a proportion of premiums earned) are below 100 per cent for all business lines.

Insurance companies are required to hold eligible own funds at least equal to their respective Solvency Capital Requirement (SCR) at all times in order to avoid supervisory consequences with various levels of severity. An adequate level of capital

will ensure proper protection of the policyholders and beneficiaries. As of June 2016, almost all of the insurance groups reported sufficient SCR coverage. Many of the undertakings made use of both transitional measures and volatility adjustments. Long Term Guarantee (LTG) measures and transitional measures are part of the Solvency II framework. Both elements have - as intended when the new framework was developed - significant positive effects on the own funds. However, careful monitoring of the exact impact of these measures is needed.

The reinsurance demand is still subdued, whereas the reinsurance capacity continues to increase. Thus, overall, the general environment remains largely unchanged. The combination of the continuing capital-inflow into the reinsurance market, benign catastrophe activity and increasingly low investment returns due to the ongoing challenging economic environment increases the profitability pressure in the reinsurance business.

In the European occupational pension fund sector, total assets significantly increased in 2015. Investment allocation remained broadly unchanged and the average rate of return decreased but remained positive across the sample. The average cover ratios for defined benefit schemes decreased over 2015 compared to 2014 and remain a concern for a number of countries.

The EIOPA risk assessment further confirms the low interest rate environment as the main concern among national supervisors. In detail, the section elaborates on insurers' exposure towards the banking sector, distinguishing between domestic and cross-border exposures. The insurance sector exhibits significant exposures towards the banking sector, not only to the domestic, but also to the cross-border level.

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 key risks identified for insurance and occupational pension sectors. The second, third and fourth chapter elaborates on these risks covering all sectors (insurance, reinsurance and pension). The fifth chapter provides the final qualitative and quantitative assessment of the risks identified. This assessment is done in terms of the scope as well as the probability of their materialization using also qualitative questionnaires. Finally, one thematic article elaborates on the impact of the monetary policy interventions on the insurance industry and another on a possible approach to update the long term rate in time.

About EIOPA Financial Stability Reports

Under Article 8 of Regulation 1094/2010, EIOPA is, inter alia, mandated to monitor and assess market developments as well as to undertake economic analyses of markets. To fulfil its mandate under this regulation EIOPA performs market intelligence functions regarding its supervisory universe, develops a market surveillance framework to monitor, and reports on market trends and financial stability related issues. The findings of EIOPA's market development and economic analyses are published in the Financial Stability Report on a semi-annual basis.

(Re) insurance undertakings and occupational pension funds are important investors in the financial market and provide risk sharing services to private households and corporates. In the financial markets, they act as investors, mostly with a long-term focus. Their invested assets aim to cover liabilities towards policy holders or members of pension schemes to which long-term savings products are offered, for example in the form of life assurance or pension benefits. Aside from offering savings products, (re)insurance undertakings provide risk sharing facilities, covering biometric risks as well as risks of damage, costs, and liability.

Financial stability, in the field of insurance and pension funds, can be seen as the absence of major disruptions in the financial markets, which could negatively affect insurance undertakings or pension funds. Such disruptions could, for example, result in fire sales or malfunctioning markets for hedging instruments. In addition, market participants could be less resilient to external shocks, and this could also affect the proper supply of insurance products or long-term savings products at adequate, risk-sensitive prices.

However, the insurance and pension fund sectors can also influence the financial stability of markets in general. Procyclical pricing or reserving patterns, herding behaviour and potential contagion risk stemming from interlinkages with other financial sectors, are examples that could potentially make the financial system, as a whole, less capable of absorbing (financial) shocks. Finally, (re)insurance undertakings might engage in non-traditional/non-insurance business such as the provision of financial guarantees or alternative risk transfer, which also needs to be duly reflected in any financial stability analysis.

The Financial Stability Report draws on both quantitative and qualitative information from EIOPA's member authorities. Supervisory risk assessments as well as market data are further core building blocks of the analysis.

Second half-year report 2016

EIOPA has updated its report on financial stability in relation to the insurance, reinsurance and occupational pension fund sectors in the EU/EEA. The current report covers developments in financial markets, the macroeconomic environment, and the insurance, reinsurance and occupational pension fund sectors as of 21st November if not stated otherwise.

PART I

1. Key developments

The European macroeconomic environment remains fragile since the last review in June 2016. Financial markets largely recovered from the short-lived market turmoil followed by the UK referendum result, but lasting political uncertainties including further negotiations raise caution among business and investments. The main drivers of the modest economic activity have been mainly exports and domestic consumption. Consequently, unemployment rates are decreasing, but remain at high levels in many countries.

Several geopolitical risks still challenge the European economic and political environment: the aggravation of the refugee crisis, (upcoming) political elections in some European countries, tensions between Ukraine and Russia and heightened terrorist threats are just some examples which expose the region to vulnerabilities. In addition, although shadowed by the latest events, the sovereign debt problem of Greece and some other peripheral countries persists as a serious concern for the European economy.

External factors such as the consequences of a potential rise of the US policy rate, the sluggish economic performance of the emerging markets reinforces the global market volatilities with impacts on the European economy. In this context, although stabilised after a turbulent juncture of the stock markets in the beginning of the year, the Chinese economy is expected to slow down. So far, growth is still aligned with the Chinese government’s target, but economic activity is heavily supported by public spending in infrastructure and by an increasing credit supply. This might have problematic implications and raises the question on sustainability in an environment in which corporate debt is currently very high for international standards.

In addition, financial imbalances related to the current level of non-performing loans and uncertainties regarding off-balance sheet exposures as well as potential consequences of the US judicial regulatory response to a major financial institution in Europe might trigger risks in the banking sector. These risks could be transmitted to the insurance sector directly via balance sheets' exposures or indirectly via contagion due to the high level of interconnectedness among the sectors.

Risks resulting from low interest rates and search for yield remain unchanged. In fact the low interest environment has been identified as highest both in terms of probability of materialisation and in terms of impact (see Chapter 5). Risks stemming from a prolonged period of low interest rates are closely linked to general macro risks.

As some insurers act globally, emerging markets will increasingly be in the focus of analysis.

Within a medium to long-term perspective, relevant global transformation trends raise emerging risks as well as opportunities to the insurer sector. This configuration becomes more evident as technology advances at a fast pace. Examples of such development as the eminence of autonomous vehicles and a precise and more accessible genetic analysis might have large impacts in the insurance sector. The sharing economy in segments involving private and high-value assets such as cars and accommodations leads to new opportunities in the industry.

Regarding environmental issues and transformations, the transition to a low-carbon economy as a consequence of the climate change might affect the insurance sector in the short and in the medium-to- long run. Potential repricing of carbon-related assets and higher frequency of disasters are factors that should be considered (see Box 1).

Box 1 Climate change and potential implications for the insurance sector

The world is changing from the environmental point of view. Climate change is a reality that is becoming more and more accepted internationally, culminating in the recent Paris Agreement, which limits the global warming to less than 2°C.[1] This will require substantial changes in terms of energy sources and alternatives will have to be put in practice to efficiently reduce greenhouse gas emissions over the next years.

In the short run, the potential repricing of carbon-related assets could pose threats to portfolios that hold such assets. In addition, the higher frequency of natural disasters will affect costs due to its coverage, affecting the profitability of the sector. However, this risk is somehow limited for non-life insurance companies since they can adjust pricing typically within one year. In the medium to long-term, these related risks might be moved to households and the non-financial sector as some risks might become considered non-insurable. As a consequence, certain insurance services might not be provided to the society anymore, which might imply ultimately that the public sector might needs to step into certain fields to cover risks, with potential fiscal implications. Consequently, the current business model of the insurance companies might also be under pressure. The

[1] United Nations (12/12/2015): https://unfccc.int/resource/docs/2015/cop21/eng/l09r01.pdf

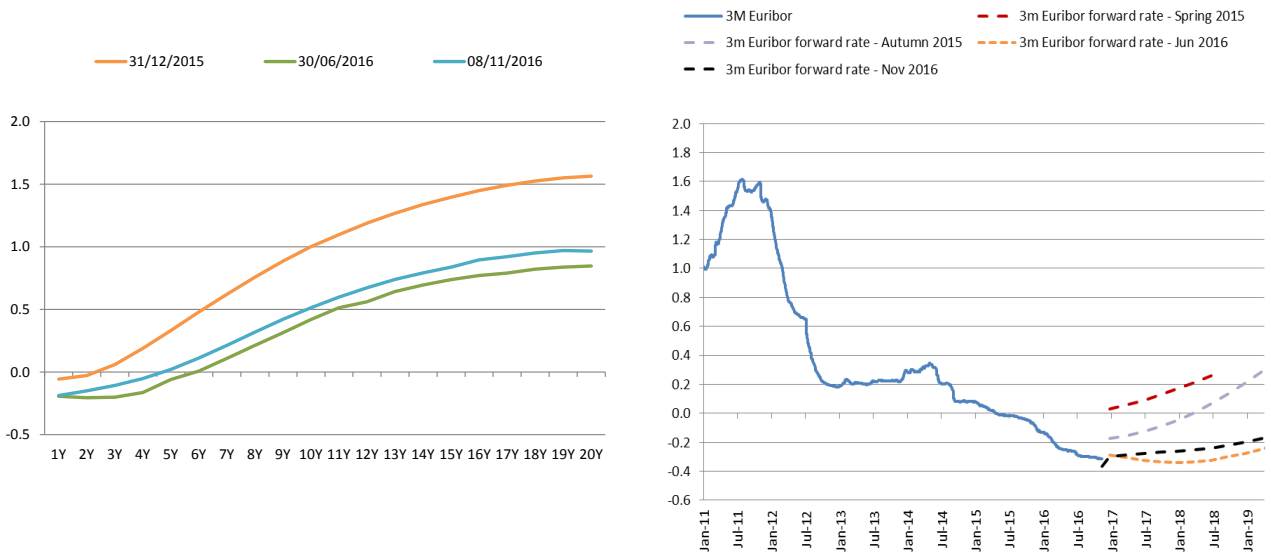
risk-management and catastrophe modelling becomes more challenging with rising number of unpredictable events. If innovative methodologies and solutions are not implemented correctly, the performance of the insurance companies might be affected as a result of a less precise risk-management.

1.1. Low yield environment

The current macro-economic and financial environment remains extremely challenging for insurance companies and pension funds. Although it is generally assumed that yields will remain low for some time, the debate on whether the present interest rate levels represent the "new normal" or whether they will gradually move back to the long-term average is still non-conclusive. Nevertheless, a moderately prevailing view among economists and analysts points out that the so-called "low for long" scenario is more likely than a gradual increase of interest rates to the previous levels. The ECB recently announced to continue its monetary stimulus until March 2017. It is clear that the market needs to use robust risk management practices to deal with the current situation. However, in the insurance sector, not all institutions are equally affected by the low interest rate environment due to diverging market conditions, different product or business lines, maturity of liabilities and varying levels of guaranteed interest rates. For already several years, EIOPA has been devoting a lot of attention to these risks, monitoring the implications of such an environment and recommending concrete actions from supervisors and the industry.

Market data points to a prolonged low yield environment (Figure 1.1 and Figure 1.2). A further decrease in the 10-year swap rates and short-term forward rates indicates a market expectation of the current European monetary policy. A slight upward move of the yield curve can be observed in autumn but this move cannot be interpreted as a changing trend yet.

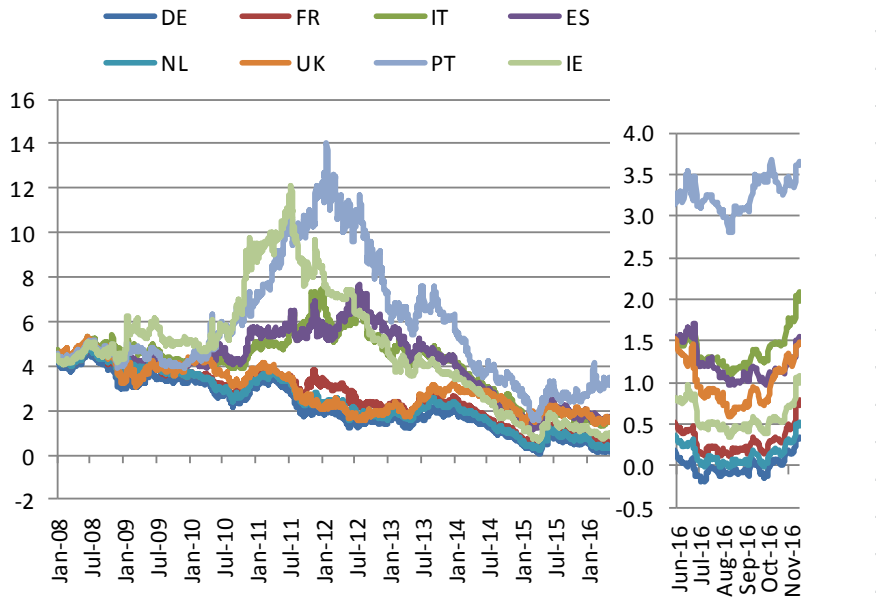
Figure 1.1. EUR swap curve (in per cent) *Figure 1.2: 3M EURIBOR (in per cent)*



Source: Bloomberg; Last observation for EUR swap curve: 08/11/2016 and for 3M Euribor: 12/10/2016

Government bond yields remain at very low levels (Figure 1.3). In fact, bond yields have fallen broadly this year. The current interest rate policy out of Europe along with large government bond purchases increased investors' struggle to get income in high-grade bonds, putting downward pressure on yields.

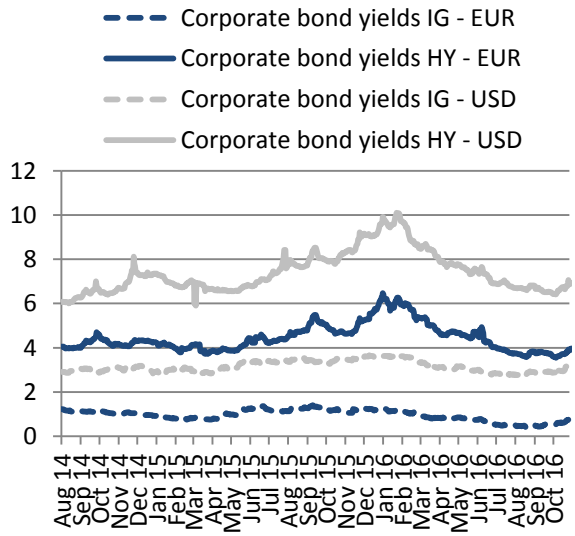
Figure 1.3: 10-year government bond yields (in per cent)



Source: Bloomberg; Last observation: 15/11/2016

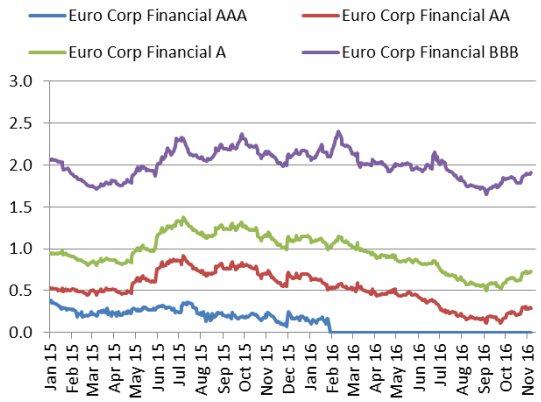
In both the eurozone and the US corporate credit yields remain very low allowing cheaper access to funds, even for lower rated entities (Figure 1.4 and Figure 1.5). Following the ECB bond purchase program, bonds fell to their lowest level ever. Also several European central banks cut interest rates into negative territory.

Figure 1.4: Corporate bond yields and EMU and US Indices (in per cent)



Source: Bloomberg;
Note: IG (Investment grade) and HY (High yield)
Last observation: 21/11/2016

Figure 1.5: European financial bond yields (in per cent)



Source: BofA Merrill Lynch Global Research, used with permission

Last observation: 09/11/2016

The inflation rate has been reacting slowly to further stimulus, but it is still far from the target (Figure 1.6). The inflation rate is the harmonised consumer price index. In the euro area, inflation was only slightly above zero towards the end of 2015 against minus 0.1 per cent one year ago.[2] This is a positive sign regarding the ECB's monetary stimulus, but overall inflation is still far below the target of 2.0 per cent. Oil prices continue to have a downward impact on inflation, although in a decelerating path (Figure 1.7). Services and food, alcohol and tobacco on the other hand have been the main upward contribution drivers towards inflation.

[2] http://ec.europa.eu/economy_finance/eu/forecasts/2016_winter_forecast_en.htm

Figure 1.6: Inflation rate (annual rate in per cent)

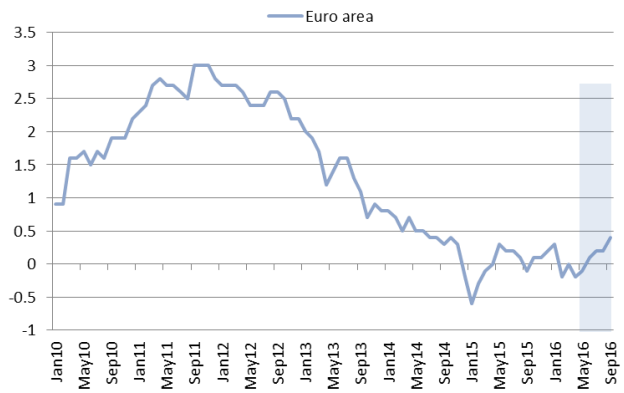
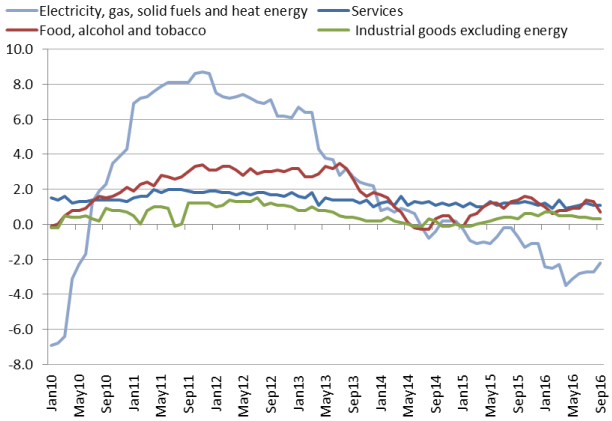


Figure 1.7: Main components of inflation (annual rate in per cent)



Source: ECB and Eurostat; Last observation: 07/09/2016

The economic growth remains weak and heterogeneous in Europe, mainly driven by private consumption and exports (Figure 1.8). Although overall a slightly positive economic growth can be observed in the EU, some countries still struggle to reach their pre-crisis levels. The creditworthiness of sovereigns as judged by the three largest rating agencies has deteriorated at a record pace in the first six months of the year. In fact, many sovereigns have been downgraded so far in 2016, including e.g. the UK following the outcome of the referendum on the EU membership.[3]

Unemployment remains high and persistent in the euro area (Figure 1.9). In a few countries, especially Spain, some signs of improvements can be seen.

[3] Financial Times, July 7, 2016 (by Elaine Moore): Sovereign downgrades hit new record; Fitch has cut credit ratings of 14 nations so far this year and says Brexit 'hard to overstate'

Figure 1.8: Real GDP (2007Q1=100)

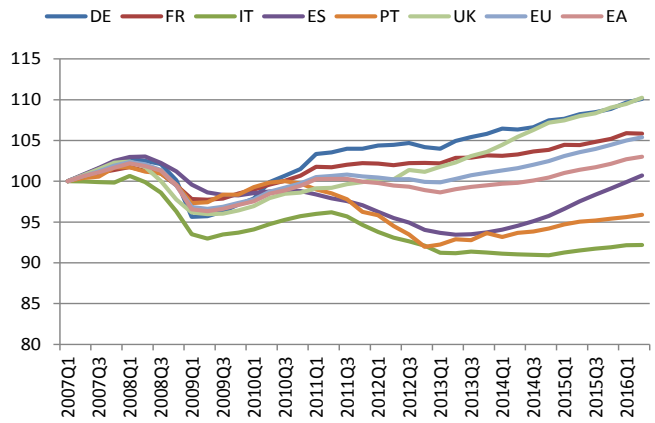
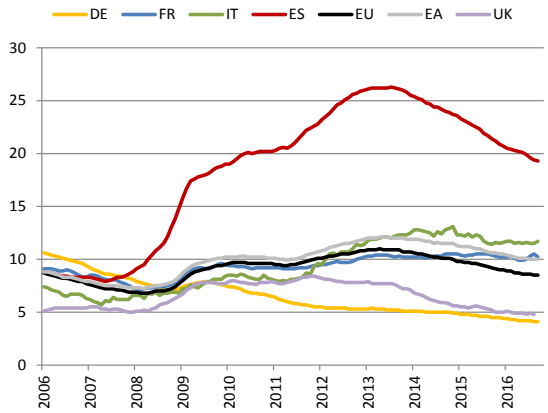


Figure 1.9: Unemployment rate

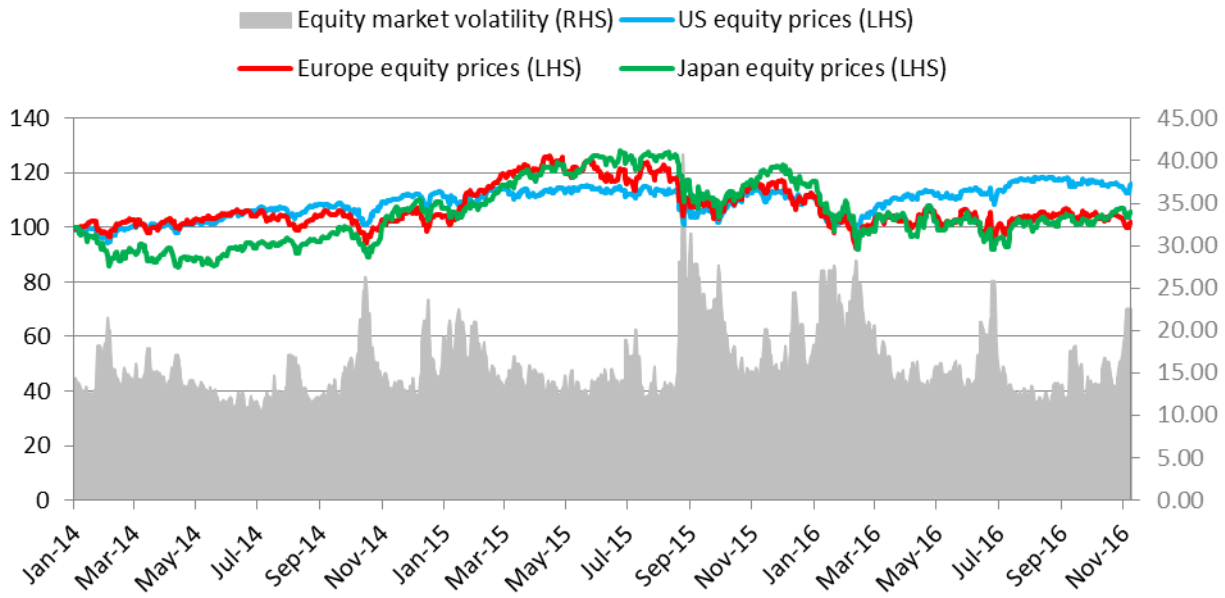


Sources: ECB and Eurostat; Last observation: 2016Q2 for the GDP figure and September 30/09/2016 for the unemployment figure.

1.2. Financial markets volatility

Risks of a strong reversal in equity premia highlighted in previous EIOPA financial stability reports have partially materialised from the beginning of this year (Figure 1.10). In early January 2016, concerns about weak economic activity around the globe, mostly in emerging markets, in conjunction with signals from falling commodity prices negatively affected the stock markets. A further deterioration in the global growth outlook is likely. Hence, the risk of market turmoil remains high.

Figure 1.10: Equity markets and volatility

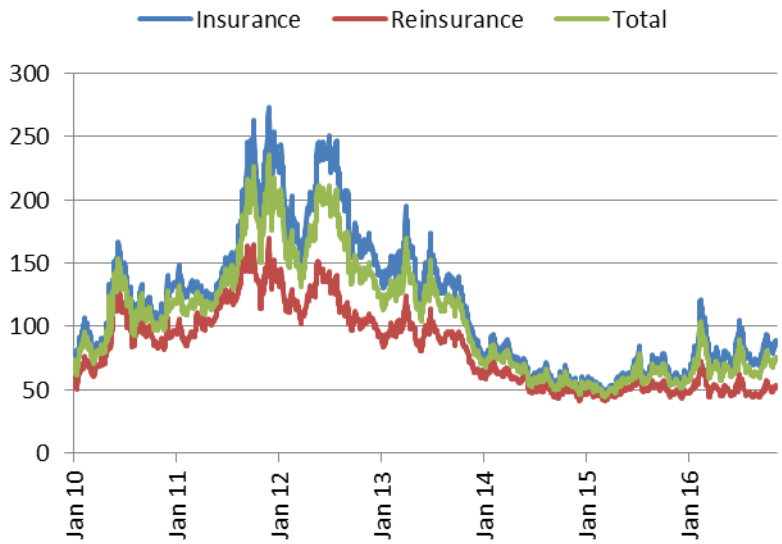


Source: Bloomberg, Last observation: 14/11/2016; Note: Volatility is measured by VIX. RHS is right hand side and

LHS is left hand side

Credit default swap (CDS) premia of insurers have been characterised by transitory spikes in volatility (Figure 1.11). After the big shocks in the periods of the Lehman Brothers collapse (in September 2008) and the euro area sovereign debt crisis (in the years 2010 to 2012) CDS stabilised to low levels. CDS for the insurance sector tend to mirror financial market developments. In particular, since the beginning of 2016, there have been transitory spikes in volatility, with particular marked episodes at the beginning of the year and around the UK referendum.

Figure 1.11: 5-year CDS - Insurance (in basis points)



Source: Bloomberg; Last observation: 08/11/2016

1.3. Risk transmission channels between the banking and the insurance sector

Strains in the European banking sector constitute a material source of risks for insurers. Challenges for the European banking sector in the current context of low growth and low yield environment intensified. The insurance sector is considered to be an important source of funding for banks.[4] In many European countries credit loan quality has deteriorated. For example, over the past decade Italian banks have accumulated large portfolios of bad loans as economic stagnation and weak recovery has affected dramatically private companies, particularly smaller businesses which are predominant in Italy. The proportion of non-performing loans as a percentage to total loans, although currently decreasing, reached 17 per cent in Italy, where the EU average is around 6 per cent.[5] Similarly, Portuguese banks are undercapitalised, loaded with bad debt and may face potential big losses. [6] The International Monetary Fund (IMF) has linked this issue with the problems facing Italian and Portuguese lenders as potential risks to global growth. Concerns about banks' ability to deliver sustainable profit in a low interest rate environment, uncertainties regarding off-balance sheet exposures and potential consequences of US judicial regulatory responses to a major financial institution in Europe might trigger risks in the banking sector.

There has been a strong downward correction on bank equity and debt instruments (Figure 1.12). The implementation of bail-in of creditors, as foreseen in the new banking regulation (Bank recovery and Resolution Directive) which prevents government intervention in rescuing defaulting banks implies that the distribution of losses takes place among bank equity holders, but also other creditors such as bond holders and depositors. The risks related to the banking sector could be transmitted to the insurance sector indirectly via contagion due to the high level of interconnectedness among the sectors or via direct exposures (as discussed in Chapter 5).

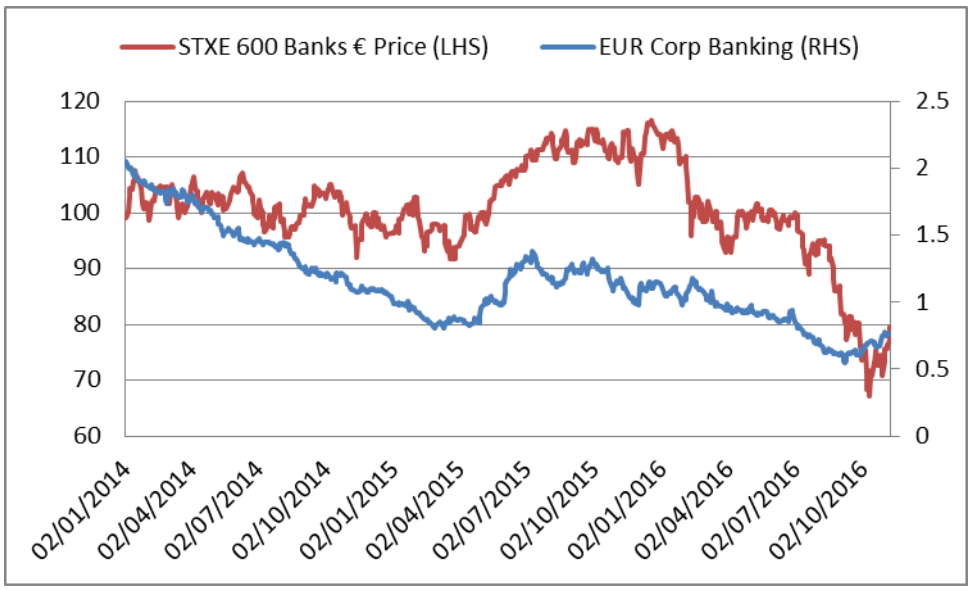
---

[4] IMF (October 2015) Global Financial Stability Report

[5] Financial Stability Report n. 02- 2016 – Bank of Italy - https://www.bancaditalia.it/pubblicazioni/rapporto-stabilita/2016-2/index.html

[6] Financial Times 28/01/2016: How Italy's bad loans built up - Logjam of non-performing loans built up over past decade but the "big five" banks hold the bulk

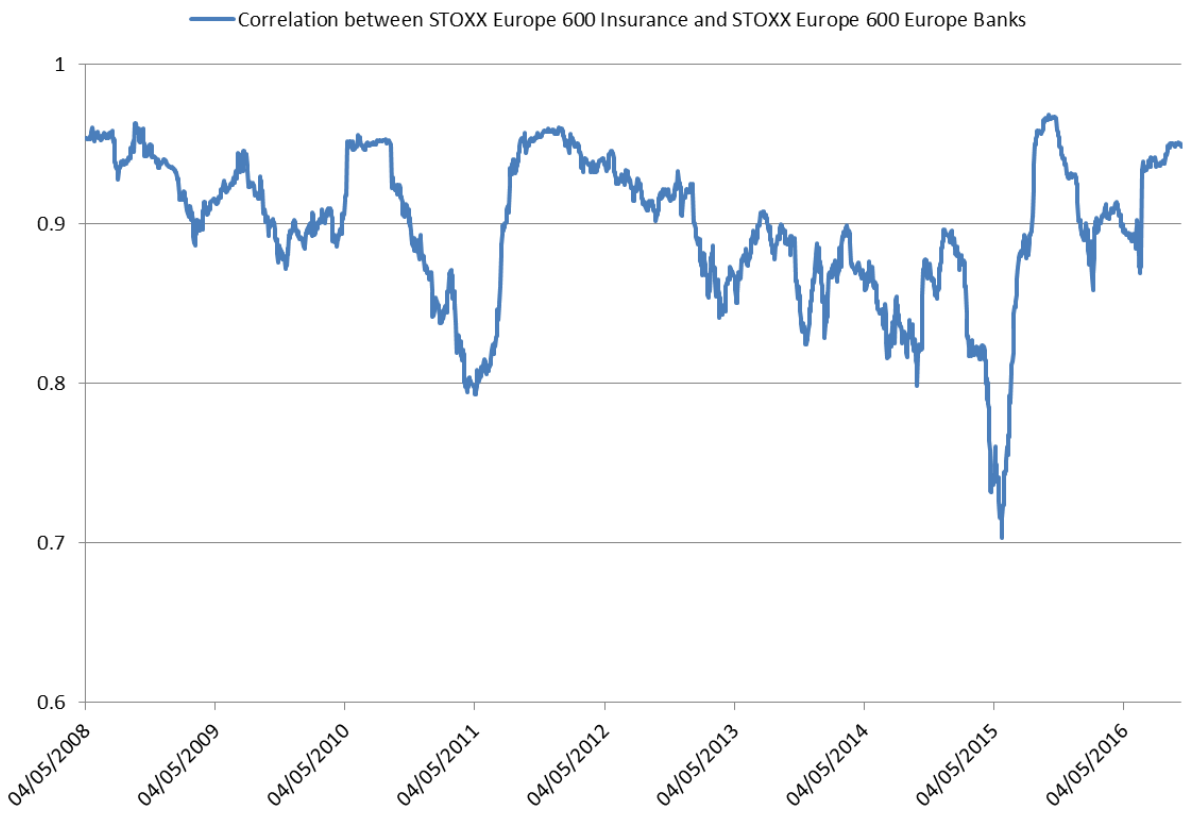
Figure 1.12: Bank yields and equity prices in Europe (index)



Source: Bloomberg for Stoxx 600 and BofA Merrill Lynch Global Research, used with permission for EUR Corp Banking yield index; Note: RHS is right hand side and LHS is left hand side ; Last observation: 14/11/2016

The correlation between STOXX 600 Insurance Index and the STOXX Bank Index is high (Figure 1.13). The risks related to the banking sector could be transmitted to the insurance sector directly or indirectly via contagion, spreading systemic risks. The indirect channel is difficult to fully assess. However, the correlation index indicates high co-movements between the sectors.

Figure 1.13: Correlation between Insurance and Banking



Source: Bloomberg; Correlation calculated for the period between 04/05/2008 to 12/10/2016

The transmission channel via direct exposures, mainly through the holdings of bonds, equity and other securities, is investigated in more detail in chapter 5 of this report. In a first instance, a potential default of bank bonds directly held by (re)insurers will affect balance sheets negatively by decreasing asset values and capitalisation. This might further impact other financial assets with negative consequences for (re)insurers. In a second stage, insurers may address potential losses by fire sells of bank bonds or other affected assets, which in turn would intensify the shock even further.

1.4. Global transformations: risks and opportunities

The world is changing in a very rapid pace and the insurance sector needs to be prepared to adapt to the new challenges and demands. Insurance often plays an essential role in some strategic and fundamental trends, and consequently new tendencies have to be correctly identified and addressed as its effect might remain in the medium to long term. Technology is one of the main transformative factors, with a great power of reshaping the economy and social interactions.

The advent of the sharing economy creates promising opportunities for insurers (Box 2). Digital transformation carries disruptive risks and brings new players into the market, although it is also a chance for the insurance sector to modernise and better interact with customers.

Box 2. The advent of the sharing economy and the insurance sector

The sharing economy consists in a rent-based peer-to-peer economic model enabled by online transactions. In practical terms, consumers can rent goods such as cars and accommodations supplied mainly by other private individuals utilising the internet as the main channel. Most of these transactions occur through matches of renters and owners in websites or apps. The advent of the technology not only reduces transactions costs as it also offers innovative alternatives that were impossible in the past. A clear example is the possibility of detecting the precise location of the nearest rentable bike or car using a smartphone. The quality check of the products and providers gradually becomes faster and gains accuracy as the rating classification usually justified by detailed opinions is often part of the business. This transparency factor is fundamental to stimulate competition and improve consumer choices. As a consequence, a larger fraction of the population can now have access to products and services for a fair price when specific needs appear. As technology becomes more accessible and the population gains more trust on online payment systems, new opportunities emerge and suddenly private individuals can provide cheaper services and products that were before restricted to certain niches, typically with high entry costs, such as hotels or taxis. Individuals might simply offer their idle assets to be rented, increasing the allocation efficiency, having also a potential positive impact in the environment; or even purchase goods exclusively with the purpose of making business. At a smaller scale, some companies also use the same principle to better allocate their idle resources.

In the European Union, the gross revenue from sharing economy platforms and providers was estimated to be approximately EUR 28 bn in 2015[7] (European Parliament), with the biggest contributions attributed to ridesharing companies. The fast ascension of this new business model brings regulatory uncertainties and gaps. National and local authorities across the EU are currently responding to the sharing economy with non-harmonized regulatory actions. In order to address such uncertainties, the European Commission has launched a communication[8] providing legal guidance and policy orientation to public authorities and market operators.

The insurance sector plays an essential role in the context of the sharing economy as private resources are being traded for commercial purposes. As challenges and opportunities emerge, a clear legal status would also benefit the insurance industry. Liability claims tend to shift to much larger volumes as it now moves from individuals to commercial purposes. Traditional insurance policies do no fully cover the needs of the sharing economy as they are designed based on the owner's risk profile and do not consider guests and renters. Therefore, new products and partnerships with insurers and brokers are the main strategies to adapt to the new underlying risks.

Through partnerships, more mature companies include in the service limited coverage to all of their users, but this option is often not accessible for start-ups due to the costs involved. Other insurers offer additional policies when personal policies do not cover certain events. In this context, new solutions might also come from what enabled the emergence of this sector: technology. Auto insurance coverage in form of endorsements is facilitated when incorporating connected devices. This is especially applicable for ridesharing drivers, which is the largest market share of the sharing economy in Europe. For instance, although in a very primary level, there are attempts to provide coverage for ridesharing drivers while they are not yet matched to passengers, which is possible to activate through apps. Possibilities are still to be exploited as the sharing economy grows and further consolidates.

[7] http://www.europarl.europa.eu/RegData/etudes/STUD/2016/558777/EPRS_STU(2016)558777_EN.pdf.

[8] http://ec.europa.eu/DocsRoom/documents/16881/attachments/2/translations

As digitalisation becomes more prominent, cyber risks increasingly emerge and challenge companies, but also offer opportunities for insurers to create new products.[9] The eminence of e.g. autonomous vehicles will also largely impact conventional insurance business models. Due to the prospect of reduced scope of accidents, premiums might be reduced in the long run and depending on regulation outcomes, car insurance might even become non-compulsory in some countries. However, during the transition period when manual and autonomous vehicles will be coexisting, price discrepancies might appear between those driving manually and automatically, with a higher charge from those with less sophisticated machines. Underwriting criteria will be re-adapted and reweighted between the driver's profile and the model of the car. Moreover, a clear regulation will have to be set up in order to address the obligations to the correspondent responsible in case of accidents as it might imply the participation of several parties: the supplier, the manufacturer and the driver itself.

Technological changes are also transforming the health segment and raising new issues. One outcome of new data sources and analytical tools is precision medicine (PM), which is defined as the customization of healthcare according to the genetic and epigenetic characteristics of individuals, which includes analysis of lifestyle and environment. New data sources and storages can address individuals into subgroups with characteristics in common, such as response to treatments and susceptibility to particular illness.

For insurers, personalised and advanced diagnostics may improve treatment effectiveness and potentially decrease costs in the long run through prevention. Contrary, this might also increase prices for certain groups of individuals as characteristics that were impossible before can be captured now. If adverse selection is reduced dramatically, this could in turn also restrict or even rule out a group of people of being insured. This is due to high probabilities of developing serious diseases that require expensive treatment. The predictability of the genomic data will therefore challenge the boundaries of the privacy protection ethics and lead to potential lapse risks.

[9] For a more detailed analysis, please refer to the Spring FSR 2016.

2. The European insurance sector

The market-based Solvency II (SII) regime came into force in January 2016 and required insurance companies to align with new rules and standards.[10]

In recent years, insurers had been taking actions to improve their solvency position, by e.g. accumulating specific reserves on their balance sheet as well as changing their product mix towards less capital-intensive products. The SII strengthens insurers' risk management and introduces further harmonisation at the European level, thereby promoting a level playing field for all insurance companies in Europe.

The implementation of Solvency II was a major step forward to reinforce policyholder protection, especially in a period where insurance companies had to cope with challenges triggered by a difficult economic and financial environment, with persistent low interest rates questioning their solvency position and the sustainability of their promises and business models.

With SII, starting in January 2016 insurance undertakings are subject to a risk-based supervisory regime. SII rules stipulate the minimum amounts of financial resources that insurers and reinsurers must have in order to cover the risks to which they are exposed. Equally importantly, the rules also lay down the principles that should guide insurers' overall risk management so that they can better anticipate any adverse events and better handle such situations.

SII introduced economic risk-based solvency requirements across all EU Member States. These new solvency requirements are more risk-sensitive and more sophisticated than in the past, thus enabling a better coverage of the real risks run by any particular insurer. The new requirements move away from a crude "one-model-fits-all" way of estimating capital requirements to more entity-specific requirements. Solvency requirements will be more comprehensive than in the past and also take into account the asset-side risks.

Insurance companies need to disclose information in the "Quantitative Reporting Templates" (QRTs) to EIOPA and national supervisors for supervisory purposes. EIOPA makes use of this data for the first time in this financial stability report (FSR).

[10] Solo data is used for country and business line analysis in this report. The data description section on page 66 gives more information on data used in this FSR.

EIOPA is currently in the process of building a comprehensive information system based on the data collected under the new harmonized QRTs. This creates a unique opportunity to improve the functioning of the internal market, in particular by ensuring a high, effective and consistent level of supervision, preventing supervisory arbitrage, guaranteeing a level playing field and ensuring a similar level of protection to all policyholders. On the other hand, the risk based approach represents an enormous opportunity to improve risk management over time, embeds a risk culture in the organisations and develop sustainable business models putting customers at the centre of the insurance company's strategy.

Solvency II is a prudential regime based on risks and uses specific models to evaluate assets, liabilities and capital requirements for insurance companies. It should be kept in mind though that Solvency II results differ when compared with results of the previous Solvency I regime. Hence, a full understanding of Solvency II needs to be developed over time.

2.1. Overview

This chapter provides an overview of the insurance undertakings subject to SII regulation and discusses some key aspects of the insurance market.[11]

The size of insurance undertakings can be measured by total assets, TP (technical provisions) and GWPs (gross written premiums). Table 2.1 shows that for the largest undertakings in Europe (subject to Financial Stability reporting), total assets are more than EUR 92bn (EUR 50bn) in Q2 of 2016. Also, for the average (median) company, more than EUR 75bn (EUR 40bn) of insurers' liabilities are TPs, i.e. contractual obligations to policyholders. Finally, the average (median) company, writes more than EUR 3bn (EUR 1.3bn) GWP in Q1. The table also shows the cross-sectional distribution of the discussed variables. The aggregate amounts (total of the sample) of total assets, TPs and GWP are shown in the last column of Table 2.1.

Table 2.1: Summary statistics in EUR mn

Percentile	average	min	10th	25th	median	75th	90th	max	total
Total assets	92,485	40	16,373	23,852	50,803	98,590	200,639	691,882	7,768,705
TP	75,243	25	12,014	18,466	40,981	81,066	163,942	560,032	6,320,445
GWP	3,214	3	355	879	1,386	2,964	7,273	36,061	269,982

Source: EIOPA (sample based on 84 insurance groups in EEA)

Reporting reference date 30/06/2016 for Total assets and TP and 30/03/2016 for GWP

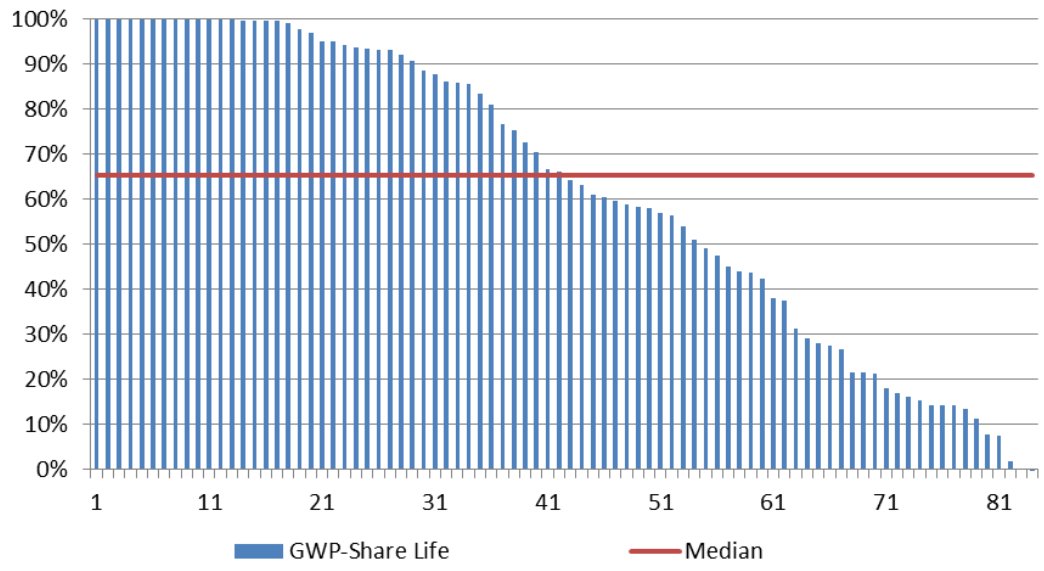
Insurance companies do different types of activities such as life and non-life business and may insure directly or reinsure.[12]

[11] The 84 insurance groups represent approximately 77 per cent of total assets of insurers subject to Solvency II.

[12] A further breakdown is by lines of business. The Implementing Technical standards define twelve lines of business for non-life companies in the reporting templates: 1) medical expense insurance 2) income protection insurance 3) workers' compensation insurance 4) motor vehicle liability insurance 5) other motor insurance 6) marine, aviation and transport 7) fire and other damage to property insurance 8) general liability insurance 9) credit and suretyship insurance 10) legal expenses insurance 11) assistance and 12) miscellaneous financial loss. For life insurance companies, there are six lines of business 1) health insurance 2) insurance with profit participation 3) index-linked and unit-linked insurance 4) other life insurance 5) annuities stemming from non-life insurance contracts and relating to health insurance obligations and 6) annuities stemming from non-life insurance contracts and relating to insurance obligations other than health insurance obligations.

The share of life business for each individual undertaking is shown in the sample (Figure 2.1). Most insurance groups offer both life and non-life products. The business mix is slightly unbalanced towards life insurance business (with the median having a share of life business of 65 per cent).

Figure 2.1: Gross Written Premiums (GWP) - Share life business in per cent



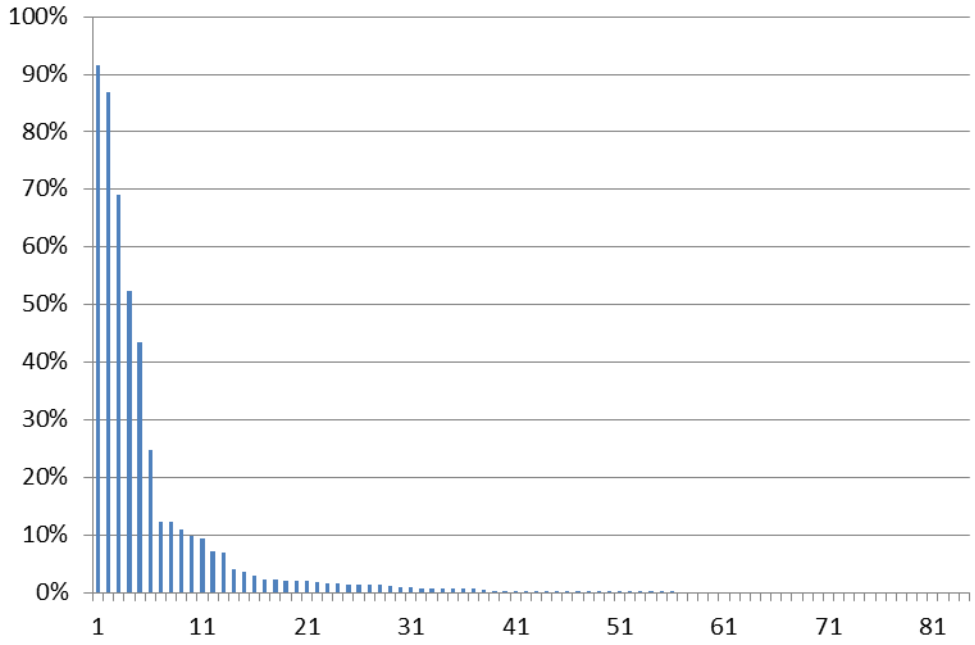
Source: EIOPA (sample based on 84 insurance groups in EEA)

Reporting reference date: 31/03/2016

Reinsurance is the process of multiple insurers sharing an insurance policy to reduce the risk for each insurer. The company transferring the risk is called the "ceding company"; the company receiving the risk is called the "assuming company" or "reinsurer."

The share of reinsurance business (in terms of gross written premium) for each individual undertaking is shown in the sample (Figure 2.2). Only six insurance groups have more than 20 per cent of the reinsurance companies' share.

Figure 2.2: Gross Written Premiums (GWP) - Share reinsurance business in per cent



Source: EIOPA (sample based on 84 insurance groups in EEA)

Reporting reference date: 31/03/2016

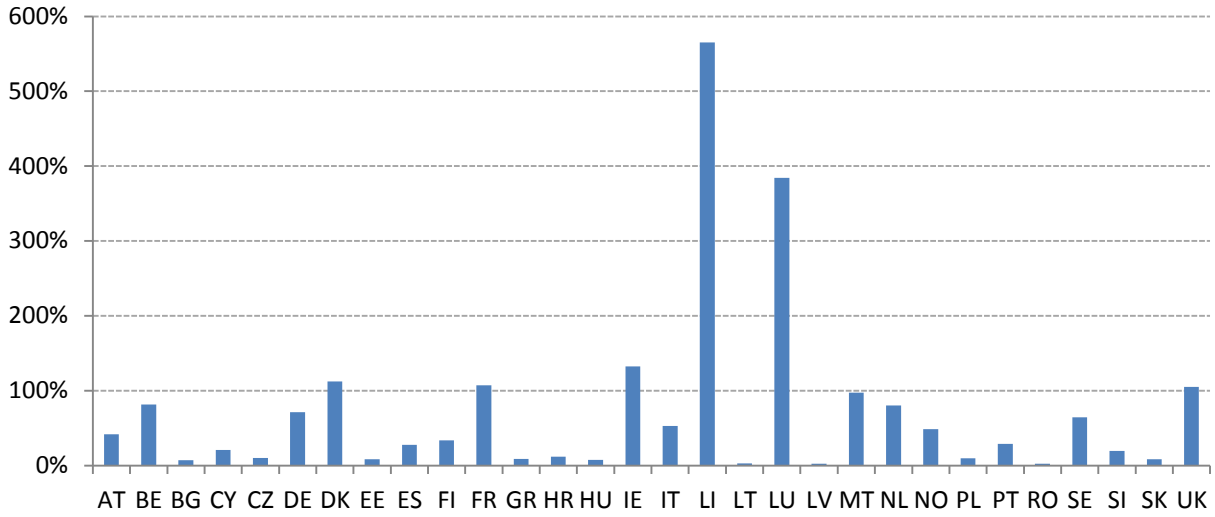
Based on the geographical location of the subsidiaries each group can be classified into the categories domestic, European and global.[13] From the groups that report to Solvency II, about 11 per cent are domestic, 22 per cent European and 67 per cent global.

The size of the insurance sector varies substantially across countries (Figure 2.3). Liechtenstein and Luxembourg rank highest when total assets are used; Bulgaria, Latvia, Lithuania and Romania rank lowest.[14] The potential for growth is hence more likely in countries with a low rate of total assets as a share of GDP in per cent.

[13] The classification is based on total assets, where all activities and not only the insurance activities are considered. Note: if more than 90 per cent of subsidiaries' total assets are within the country, the group is domestic. If more than 90 per cent of the subsidiaries total assets are out the EEA, the group is global. The remaining companies are EEA groups.

[14] Listing of countries is in alphabetical order throughout the report.

Figure 2.3: Total Assets (TA) - Share of GDP in per cent



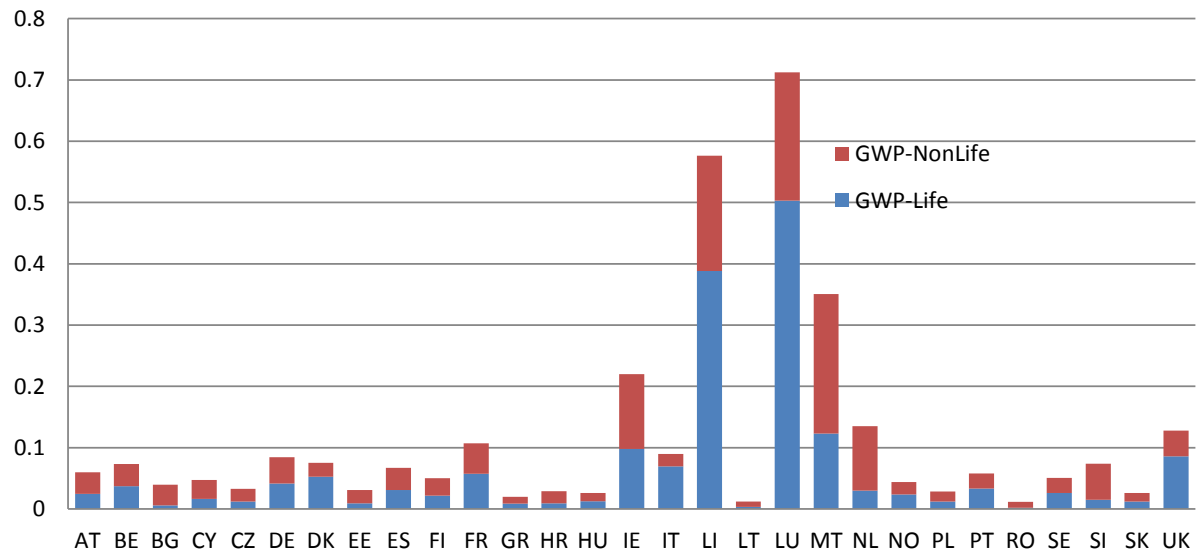
Source: EIOPA (sample based on 2600 solo undertakings in EEA)

Reporting reference date: 30/06/2016

The size of the insurance market and the business mix (i.e. life vs. non-life) varies substantially across countries as well (Figure 2.4). Also Liechtenstein and Luxembourg rank highest; Greece, Lithuania, Romania and Poland lowest.

The sale of life insurance products is particularly pronounced in countries with high household wealth and income. These markets often benefit from international customers. The price an insurance company can charge for a product or line of business is influenced heavily by supply and demand for the type of coverage on offer. Changes in tax rules, in legislation or in consumer preferences can herald a considerable shift away from traditional life insurance. Life insurance policies can be "pure insurance" products, savings products or a combination of both. The lines between products become increasingly blurred and some insurers might be better positioned than others to respond, by offering a product range which encompasses the broader financial services market. In fact, recently increased taxation on premiums or reduced tax incentives for long-term life and savings products contributing to declining premium growth were observed in some countries.

Figure 2.4: Gross Written Premiums (GWP) - Share of GDP in per cent



Source: EIOPA (sample based on 2600 solo undertakings in EEA). Annualised GWP

Reporting reference date: 30/06/2016

Life insurance contracts in some countries entail a market risk for the insurance company in case they offer policyholders a guaranteed rate of return. In order to meet these guarantees, the life insurance companies must choose in their asset and liability management an asset mix that is the most appropriate for both the structure and the characteristics of the associated liabilities, while establishing a balance between the risks on the investment portfolio and the expected rates of return.

The low interest rate environment fosters the evolution of business models towards unit-linked investments, shifting investment risks to policyholders. This changes the business model and increases competition between asset managers and insurers. In addition, the life insurance market may be on the verge of growth. Demographic changes coupled with low interest rates might lead to an increase in European households' long-term savings. If current trends continue, then the growth of unit-linked products may be even stronger.

The trend towards more unit-linked business is visible in the recent quarter (Table 2.5). This notwithstanding, these products are more complex to both manage and sell but the return is linked to the performance of global financial markets which

have slightly recovered in the first half of 2016. The insurance sector gradually lowers or even removes overall guarantees on returns in some countries. Consequently, risks related to longer-term returns on assets become largely allocated to policyholders.

Table 2.5: GWP-Life business: Unit-linked share

	Q1 (31/03/2016)	Q2 (30/06/2016)
Percentile	Percentage	Percentage
10th	0.03	1.04
25th	1.63	4.53
median	14.46	16.58
75th	32.11	34.98
90th	70.53	62.10
average	22.34	24.92

Source: EIOPA, Reporting reference date: 30/06/2016

For life insurance companies the lapse rates have been growing to some extent for the median company (Table 2.6). Several insurance undertakings have introduced some penalties during stressed periods. The evolution of lapses will be monitored carefully by EIOPA in the current low yield environment.

Table 2.6: Lapse rate

	Q1 (31/03/2016)	Q2 (30/06/2016)
Percentile	Percentage	Percentage
10th	0.00%	0.00%
25th	0.23%	0.41%
median	0.85%	1.20%
75th	1.79%	2.31%
90th	5.76%	5.37%

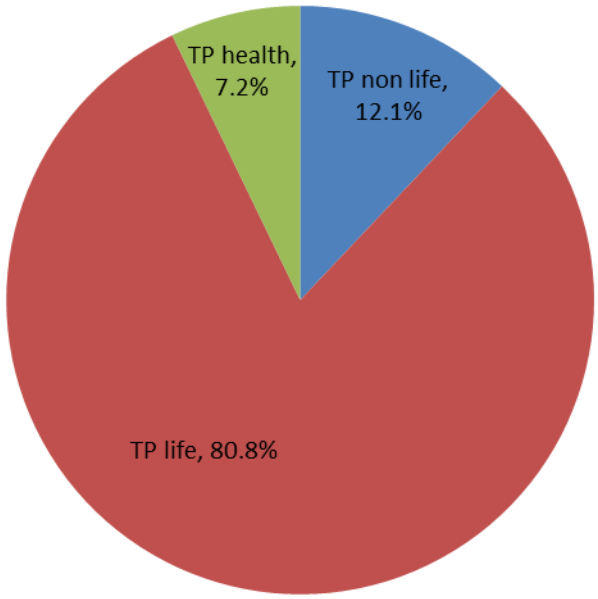
Source: EIOPA, Reporting reference date: 30/06/2016

Other liquidity monitoring tools include reporting requirements, supervisory on site and off site inspections. Insurance companies monitor their current liquidity situation and funding condition which in turn is monitored by the insurance

regulator in each country. In addition, Global Systemically Important Insurers (G-SIIs) have to develop Liquidity Risk Management Plans (LRMPs). Insurers using the Matching Adjustment (MA) or the Volatility Adjustment (VA) also have to develop a liquidity plan. In this context it should be mentioned that so far no significant liquidity pressure have been observed. Hence, the liquidity risk for insurance companies currently remains limited.

In terms of technical provisions, life insurance is by far the largest item per business line (Figure 2.7). The Solvency II Directive requires that insurance and reinsurance undertakings have processes and procedures in place that ensure the appropriateness, completeness and accuracy of the data used in the calculation of their TP.

Figure 2.7: Technical Provisions (TP) - by business line in per cent



Source: EIOPA (sample based on 2600 solo undertakings in EEA)

Reporting reference date: 30/06/2016

2.2. Profitability

Insurance companies face challenges arising from a prolonged period of low interest rates. This applies especially to undertakings with a material exposure to life insurance contracts with guarantees.

Long-term interest rates as for example 10-year government bond yields remain historically low. The rising share of negative or low yielding debt securities and long periods of such low interest rates could potentially harm the insurance sector and render it more difficult to produce sufficient income to cover the current interest rate guarantees (i.e. the risk gradually materializes over time). Eventually insurance undertakings could struggle to generate adequate returns to meet their long-term liabilities.

Maturing assets will have to be re-invested in order to match the cashflow profiles of all outstanding liabilities, exposing the insurer to reinvestment risk. If the low interest rate environment were to persist for a long time, this reinvestment risk could materialise in the coming years, especially if the large unrealised capital gains on bond portfolios are used for payouts in the short-run. Also, if there is a lack of long-term (maturity over 10 years) fixed-income instruments, this can pose a risk from an asset-liability matching point of view for life insurance undertakings. Duration mismatches could be compounded by negative investment spreads, if yields on long-term bonds fall below investment returns that have been promised to policyholders. Such challenges have prompted concerns that by squeezing returns, negative rates could incentivise insurance companies to take on inappropriately risky assets.

In order to protect themselves against the effects of low interest rates on the profitability, insurers need to boost returns. Insurance companies have various tools to address the risks of persistently low interest rates. They can increase the duration of their assets in order to ensure a better duration match between assets and liabilities or they can alter the terms of new policies by lowering guarantees, thereby lowering liabilities. In some countries, insurance groups currently sell their life insurance subsidiaries or simply stop writing new business. The current low interest rate environment and increased life expectancy simply poses challenges for life insurance companies and pension funds that could worsen in the medium to long run. The impact of low interest rates is heavily dependent on the business model. It is expected to be the highest for small and medium sized life insurers with large

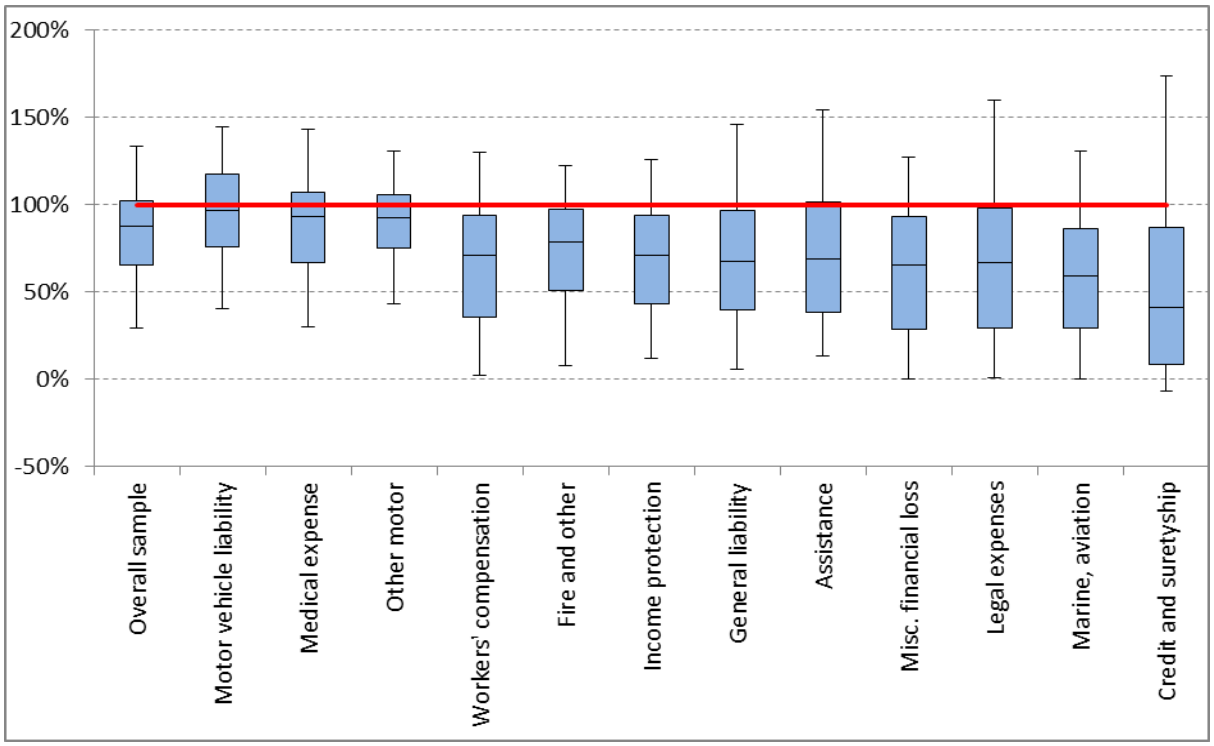
government bond portfolios and high guarantees to policyholders, especially where contracts embed a long time to maturity.

In order to boost returns, insurance companies could also shift their asset allocation towards more illiquid assets and higher-yielding (but lower-quality) investments. New business increasingly aims at reducing risk, as seen in the growth of unit-linked insurance or in the shift to more short-term life protection business or biometrical products. The maximum interest rates on insurance contracts are currently lowered in many countries in order to better reflect the current market conditions. In this environment insurance companies could be encouraged to excessive risk-taking, which could contribute over time to the formation of asset price bubbles. However, increases in house and equity prices have thus far remained moderate.

Article 132 of Solvency II introduces the "prudent person principle" which determines how undertakings should invest their assets. The absence of regulatory limits on investments does not mean that undertakings can take investment decisions without any regard to prudence and to the interests of policyholders.

The net *Combined Ratio remains low for the median company across business lines* (Figure 2.8). However, the motor insurance segment faces industry-wide pressures. In the short term, intense competition and higher expected claims are likely to continue to constrain profitability, but in the long term the motor sector may benefit from the usage of telematics data to help pricing the risk of a driver more accurately. On the other hand, the sector may face several challenges such as the introduction of driverless cars which will reshape the sector completely. Hence, the profitability of this segment may be scrutinised in the future.

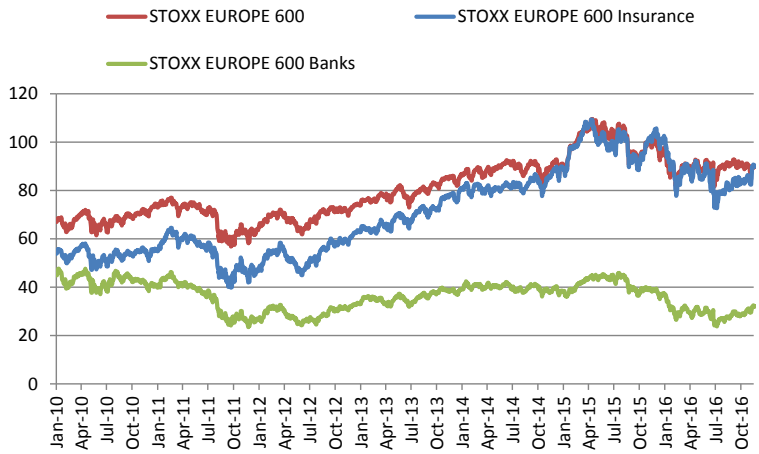
Figure 2.8: Net CR across business lines (in per cent; median, interquartile range and 10th and 90th percentile)



Source: EIOPA (sample based on 1601 solo non-life undertakings in EEA); Reporting reference data: 30/06/2016

In the current low yield environment maintaining profitability is getting more and more difficult as reflected by market returns (Figure 2.9). The downward trend, however, seems to have come to a halt in the last months, both for banks and insurance companies alike.

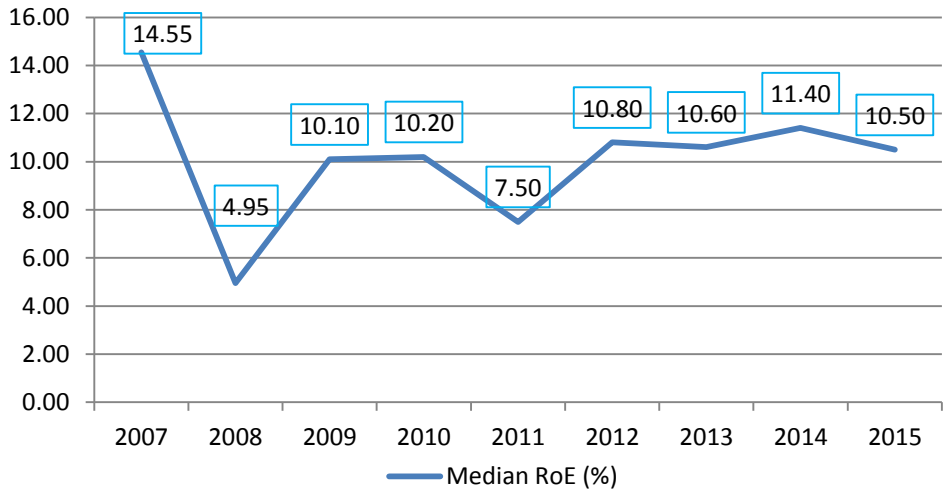
Figure 2.9: Market Returns (Index: 2007=100)



Source: Bloomberg; Last observation: 15/11/2016

Return on equity (ROE) dropped for the median from 11.4 per cent in 2014 to 10.5 per cent in 2015 (Figure 2.10). The long-term sustainability of the profitability needs to be monitored as the current low yield environment will eventually have a negative effect in the medium-to-long term for all business lines. Mainly affected will be life insurers with a large portion of endowment contracts with guarantees and non-life insurers with long-tail business lines.

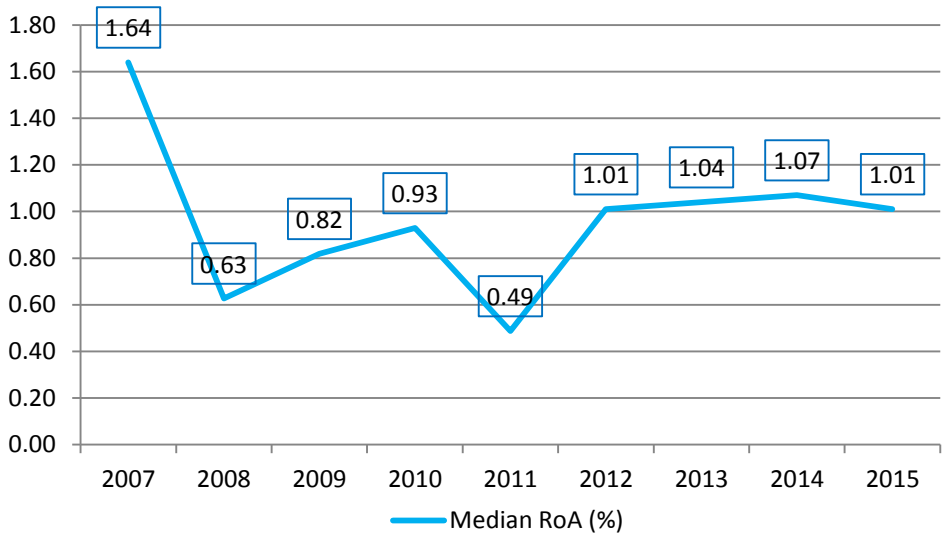
Figure 2.10: Return on Equity (in per cent)



Source: S&P Capital IQ, 148 insurance undertakings from 23 EEA countries

ROA did also drop slightly in 2015 (Figure 2.11). The median ROA dropped from 1.07 per cent in 2014 to 1.01 per cent in 2015.

Figure 2.11: Return on Assets (in per cent)



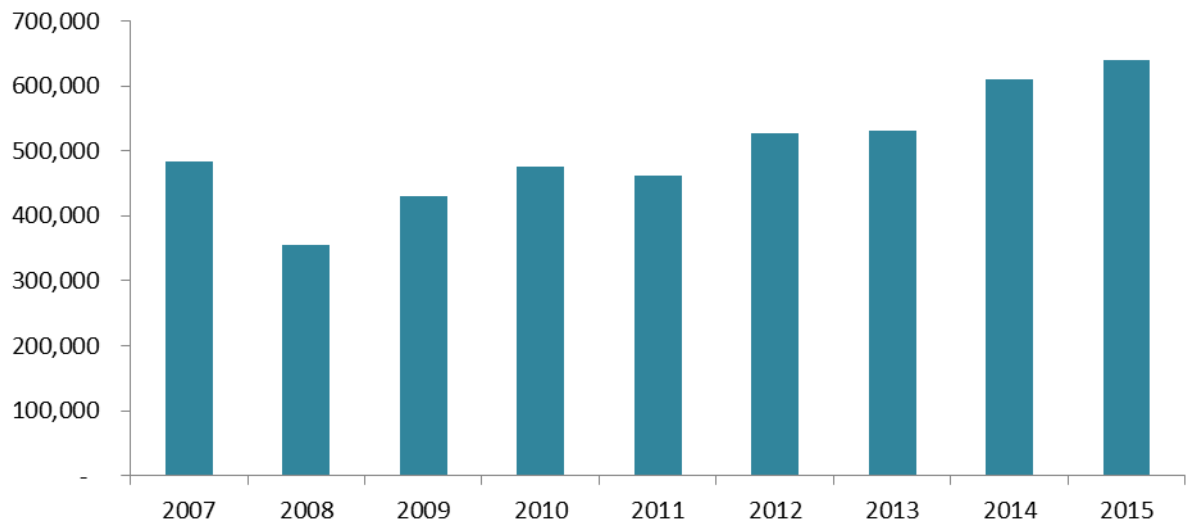
Source: S&P Capital IQ, 148 insurance undertakings from 23 EEA countries

2.3. Solvency

The Solvency II framework implies a completely different approach to assessing the solvency of insurance undertakings as compared to the Solvency I regime that was applicable up to the beginning of 2016. Following the introduction of Solvency II, several insurance companies have been taking measures to improve their capital positions and optimize their asset and liability profile. In Europe, solvency concerns can arise for European life insurers due to guaranteed policy pay-outs exceeding investment yields, and long asset liability duration mismatches. In order to properly consider an insurance undertaking's solvency position, it is necessary to evaluate its assets and liabilities.

Before Solvency II came into force, insurance companies built up their capital positions (Figure 2.12). In the two years prior to the introduction of Solvency II, insurance undertakings built up capital.

Figure 2.12: Total Equity(in EUR mn)



Source: S&P Capital IQ, 148 insurance undertakings from 23 EEA countries

Insurance companies are required to hold eligible own funds at least equal to their respective Solvency Capital Requirement (SCR) at all times in order to avoid supervisory consequences with various levels of severity. A common reference is to measure the amount of assets over liabilities. Insurance companies must have own funds available to cover any unexpected losses that might incur. Own funds therefore ensure that policyholders' claims against the insurers are covered

even under adverse circumstances. The solvency of an insurance company is deemed sufficient if the level of own funds meets at least the required solvency margin (own funds requirements).

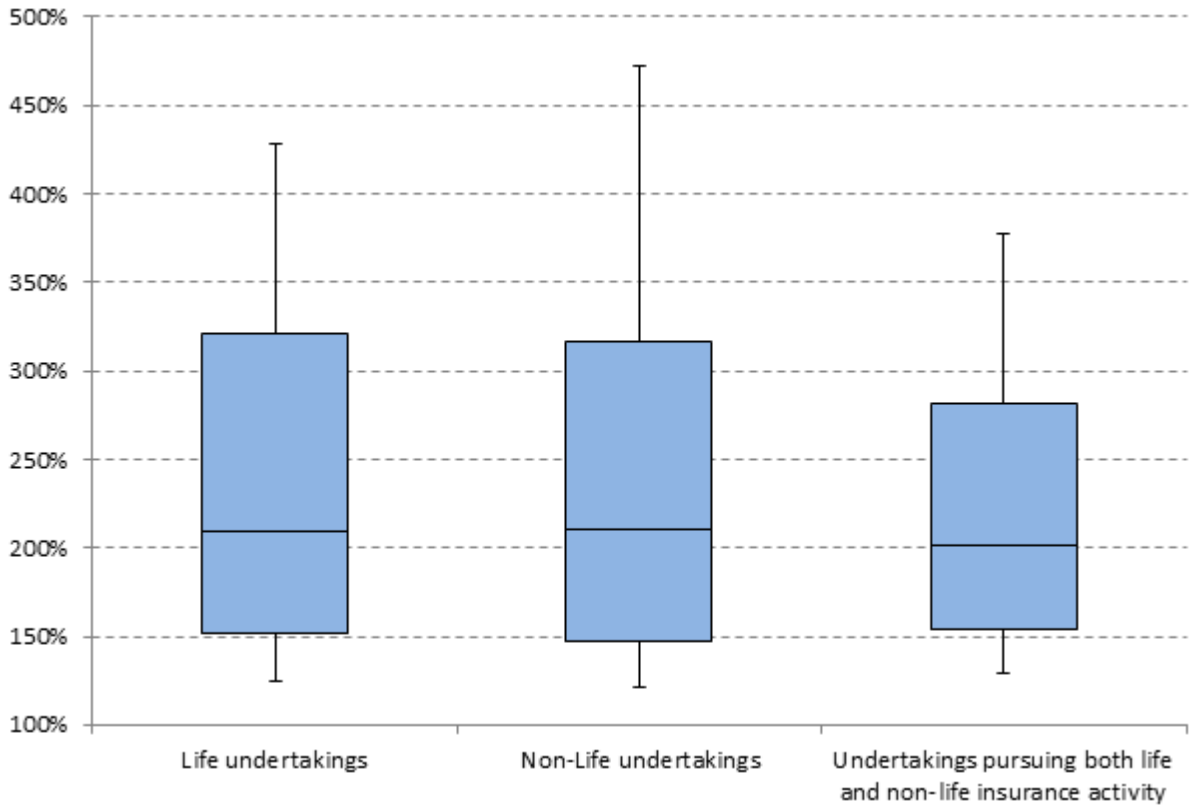
An adequate level of capital will ensure proper protection of the policyholders and beneficiaries. Insurance companies should calculate the SCR at least once a year according to the standard formula or by applying a (full or partial) internal model. The SCR calculated on the basis of the standard formula is the sum of the Basic Solvency Capital Requirement, the capital requirement for operational risk and the adjustments for the capacity to absorb unexpected losses of technical provisions and deferred taxes

Under the Solvency II regime, total assets and liabilities have to be calculated at market or market-consistent values, with a company's own funds being defined as the difference between the assets and liabilities at market value. Therefore, the estimated value of the technical provisions will be high, when market interest rates are low. Insurance companies' liabilities are mainly technical liabilities (for which market values as such are not available). The value of these reserves is arrived at by calculating the present value of the incoming and outgoing cashflows on the basis of the discount rate. This discount rate is a risk-free rate on the basis of market swap rates with maturities of up to 20 years, currently extrapolated to the ultimate forward rate of 4.2 per cent for maturities beyond 20 years.[15]

As of June 2016, all of the insurance groups reported sufficient SCR coverage (Figure 2.13). The SCR coverage ratio for the median non-life insurance company is 210 per cent and is approximately equal for life companies (209 per cent) and for undertakings pursuing both life and non-life business (201 per cent). While the sector overall seems well positioned for Solvency II capital requirements, the analysis of the solvency margins also revealed that some insurance companies, typically smaller ones, in some European countries were not adequately capitalised.

[15] See chapter 2.4 in this report for more information on regulatory developments

Figure 2.13: SCR coverage ratio (in per cent; median, interquartile range and 10th and 90th percentile)

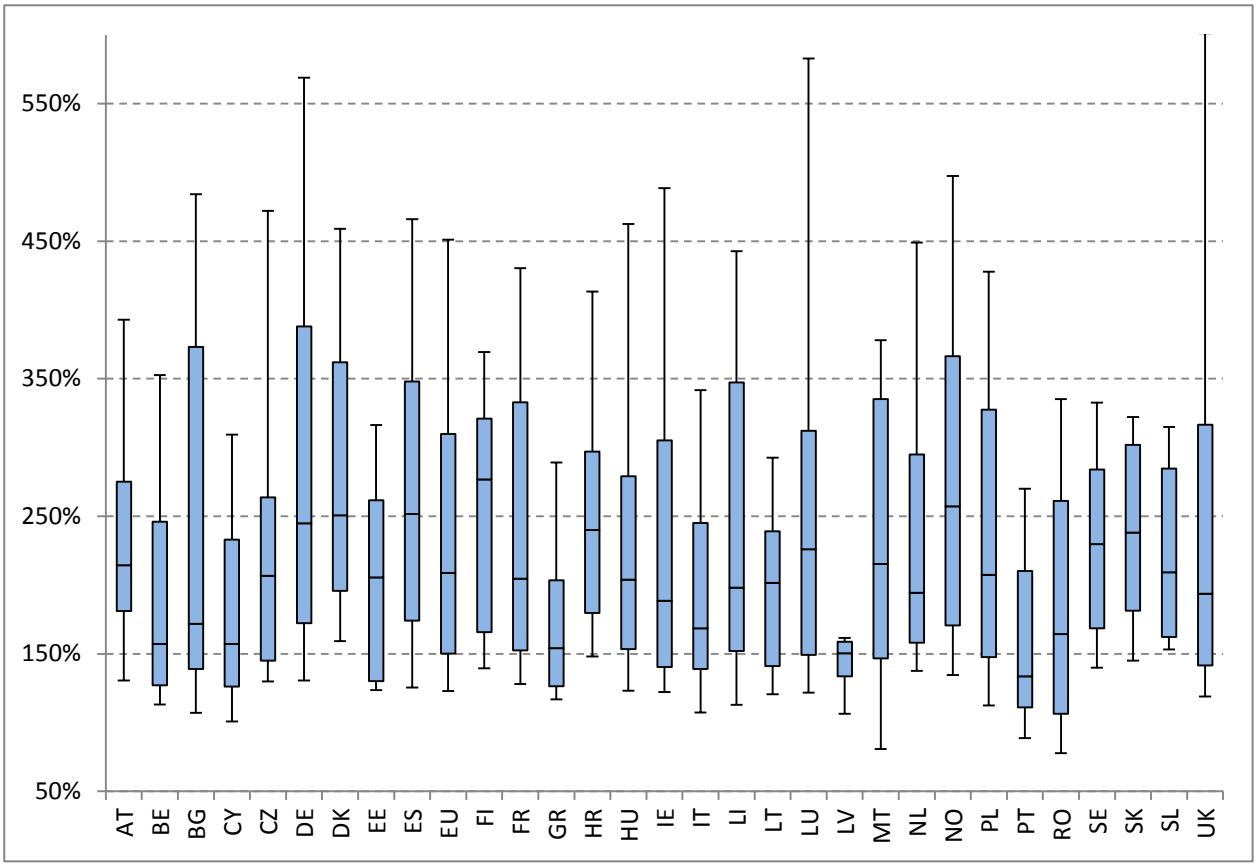


Source: EIOPA (sample based on 2600 solo insurance undertakings in EEA)

Reporting reference data: 30/06/2016

As of June 2016, the SCR coverage ratio by country was sufficient for the EEA average (Figure 2.14). However, the 10th per centile of Malta, Poland and Romania is loss making at county level.

Figure 2.14: SCR coverage ratio by country (in per cent; median, interquartile range and 10th and 90th percentile)



Source: EIOPA (sample based on 2600 solo insurance undertakings in EEA)

Reporting reference data: 30/06/2016

In order to smooth the transition towards the new regulatory framework, Solvency II has put in place transitional measures.

Most undertakings made use of both transitional measures and volatility adjustments in their ratio calculations. This means that some insurance companies, with the consent of the supervisory authority, may apply transitional measures that extend the period of adaptation to the Solvency II requirements for as long as 16 years. Also, volatility stemming from interest rate changes is an impediment to comparing individual SCR ratios. Detailed knowledge about the assumptions underlying the ratios is a prerequisite to gauging the financial strength based on Solvency II results. Insurers put transitionals in place for derisking balance sheets and increasing capital.

Several LTG and transitional measures have been introduced in Solvency II in order to allow a smooth transition. This could lead to a gradual increase of solvency needs (as the effect of the transitional measures is gradually lowered over time).

On the other hand, the use of the transitional measures or volatility adjustments reduces the comparability of Solvency II results. A deterioration in equity markets could result in a number of potential issues impacting capital. These could arise in the form of credit defaults and equity impairments. Widening credit spreads are not a problem per se, but, if seen to a major extent, these issues could hit capital materially as they increase the denominator of the Solvency II ratio (i.e. capital requirements) and decrease the numerator (i.e. available capital). In such a scenario, Solvency II ratios could decline faster than the rates suggested in reported sensitivities, as the latter tend to only reflect spread movements. There is some uncertainty about how companies would cope with a stress situation.

2.4. Regulatory developments

After the entry into force of Solvency II on 1st January 2016, insurance and reinsurance undertakings have started to report to their National Competent Authorities (NCAs) according to the new regime. The templates for the submission of information to the supervisory authorities according to Solvency II have been amended by Commission on 20th October 2016 in order to make the necessary adaptations following the amendments of the Solvency II Delegated Regulation adopted in April 2016; in particular the templates have been amended in order to ensure that supervisors collect all the relevant information concerning qualifying infrastructure investments made by insurance and reinsurance undertakings as well as investments in European Long-Term Investment Funds (ELTIFs) and equities traded on multilateral trading facilities (MTFs).

On 9th September 2016 Commission has adopted the implementing technical standards (ITS) with regard to the procedures for the application of the transitional measure for the equity risk sub-module in Article 308b (13) of the Solvency II Directive. Since the transitional measure applies to equities purchased on or before 1 January 2016, the IT'S refer to the procedure to be followed by insurance and reinsurance undertakings for the appropriate identification and documentation of those equities.

Furthermore, on 11th October 2016 Commission has adopted the ITS with regard to the allocation of credit assessments of external credit assessment institutions to an objective scale of credit quality steps. For the purposes of the calculation of the solvency capital requirement, credit assessments of external credit assessment institutions (ECAIs) are allocated to an objective scale of seven credit quality steps, from zero to six.

In April 2016, EIOPA published a Consultation Paper on the methodology for deriving the Ultimate Forward Rate (UFR) and its implementation. EIOPA will provide an update of the UFR at the end of December 2016.

Furthermore, EIOPA published changes to the relevant financial instruments used to derive the Risk Free Rate (RFR). EIOPA will implement these changes for the calculation of the RFR at the end of December 2016.

As part of the process of post-evaluation of the new insurance supervisory regime, EIOPA has received on 18th July 2016 a call for technical Advice from the Commission for the review of the Solvency Capital Requirement (SCR) standard formula. This call has two priorities: simplifications and proportionate application of the SCR requirements as well as the removal of technical inconsistencies, i.e. recalibration of certain risks and other technical issues. The Commission have requested the technical advice of EIOPA in preparation of the review of the Solvency II Delegated Regulation which is expected to be carried out in 2018.

Following the adoption of the Insurance Distribution Directive (IDD) in January 2016, EIOPA published on 13th April 2016 the Preparatory Guidelines on Product Oversight and Governance arrangements (POG). Insurers (manufacturers of insurance products) and distributors need to follow these arrangements, including requirements such as the appropriate identification of the group of consumers for whom each product is designed (the "target market"). Also products are aligned with the relevant interests and objectives of the target market in this context as is the usage of appropriate distribution channels. The preparatory Guidelines provide early guidance and support NCAs and market participants with the implementation of POG requirements in preparation for formal requirements provided for in the Directive and to be further specified in the delegated acts.

In this regard, EIOPA received from the Commission on 24th February 2016 a request for technical advice on possible delegated acts concerning the IDD. These delegated acts are expected to be approved in 2017 including provisions regarding POG as well as conflicts of interest, inducements, assessment of suitability and appropriateness and reporting.

3. The global reinsurance sector

Overcapacity, declining demand and non-abating alternative capital are expected to continue reducing underwriting margins at a time when the investment returns remain low. This coupled with so-far limited natural catastrophe events, has resulted in a continued softening of reinsurance rates at the 2016 renewals. Market experts expect these trends to continue over the short-to-medium term, in the absence of significant deteriorations in underwriting loss ratios

3.1. Market growth

The reinsurance demand is still subdued, whereas the reinsurance capacity continues to increase. As a long-term trend insurers tend to raise the retention as insurers have increased their risk management. Furthermore, the competitive markets as well as low investment returns force the insurers to be increasingly price sensitive, whereas the insurers' capital basis rose along with the reinsurers' due to the relative benign catastrophe activity in 2016 so far.

Thus, overall, the general environment remains largely unchanged. The rates continued to soften in 2016, even though the price declines have reduced. Along with rate reductions also the terms and conditions for reinsurance placements improved further, e.g. expanded hours clause, broadened terrorism coverage, improved reinstatement provisions.

Up to now the hurricane season was once again very benign (Table 3.1). In the first half year of 2016 the global insurance industry catastrophe losses were considerably higher than the corresponding figures for the previous year. The insured losses rose by roughly 42 per cent to USD 27bn (previous year: USD 19bn). The overall economic losses increased by nearly 19 per cent to USD 70bn (USD 59bn). Nevertheless the overall economic losses were still less than the 10-year average of USD 92bn, whereas the insured losses were strictly equivalent to the long-term average.

Table 3.1: The five largest natural catastrophes in the first half of 2016, ranked by insured losses (in USD bn)

Date	Event	Region	Overall losses	Insured losses
14.04.-16.04.2016	Earthquakes	Japan	25.0	5.9
May/June 2016	Severe storms	Europe	5.2	2.8
10.04.-15.04.2016	Severe storms	USA	3.5	2.7
May 2016	Wildfires	Canada	3.6	2.7
23.03.2016	Severe storm	USA	2.0	1.5

Source: Munich Re, NatCatSERVICE

The costliest natural disaster event for the insurance industry during the first half of the year was caused by two earthquakes on the southern Japanese island of Kyushu close to the city of Kumamoto in April. 69 people lost their lives, tens of thousands had to be temporarily housed in emergency shelters. Countless buildings were destroyed and many production facilities were damaged. The overall economic loss from the two earthquakes came to USD 25bn, of which only 5.9 was insured due to the low insurance density for earthquake risks.

In Europe severe weather in May and June caused the second costly event, both in terms of economic losses and insured losses. Most hit were France, the Netherlands and southern Germany. The overall loss from the storms in Europe totalled USD 5.2bn, of which 2.8bn USD was insured.

The most severe natural catastrophe in terms of fatalities was a devastating earthquake near the Pacific coast of Ecuador. Nearly 700 people were killed. As is many emerging countries, a relatively small share of the overall loss was insured, i.e. a total of USD 400mn out of USD 2.5bn.

Further major catastrophes occurred in the third quarter of 2016.[16] On 24th August a severe magnitude-6.2 earthquake struck central Italy. 296 people lost their lives, an additional 388 people were injured. The quake caused catastrophic damage, whole

[16] See AON Benfield: July, August 2016 Global Catastrophe Recap.

towns were flattened. More than 4.000 people were left homeless as buildings collapsed. Up to now the hurricane season was once again very benign this year.

3.2. Profitability

The competitive pressure in the reinsurance sector will increase further. The combination of the continuing capital-inflow into the reinsurance market, benign catastrophe activity and increasingly low investment returns due to the ongoing challenging economic environment increases the profitability pressure in the reinsurance business. Moreover, the ability to release reserves from previous years appears to have been diminished, whereas the long-term business is getting less profitable or even unprofitable as the high interest rates calculated in previous rates are difficult to earn. Against this background getting risk-adequate prices at the upcoming renewals is crucial for the reinsurance companies.

A further deterioration in reinsurers´ return on equity is expected, even assuming a normalised catastrophe load.[17] Given the amount of cash on the sidelines waiting to be put to work, even after a hurricane Katrina the overall capacity is to be expected to remain where it is. The reinsurance industry has sufficient capital to avoid insolvency from events that may occur once in 100 or 250 years (the so-called "probable maximum loss" or PML).[18]

3.3. Solvency

The reinsurance market still suffers from an oversupply of capacity owing to the absence of large losses and the continuing capital-inflow into the reinsurance market, both traditional and alternative. The rate of price declines reduced in 2016 further, but the reinsurance prices have not yet found their floor. The softening of pricing will continue into 2017 with rate declines in the low single-digits.[19]

The global reinsurer capital totalled USD 585bn at June 2016, an increase of 4 per cent since the end of 2015 (USD 565bn).[20] Thereof traditional capital rose by 3 per cent to USD 510bn, driven mainly by unrealised gains on bond portfolios associated with declines in interest rates during the period. Overall reinsurer capital has increased by more than 70 per cent since 2008.

---

[17] http://www.artemis.bm/blog/2016/09/14/reinsurers-only-profitable-due-to-low-catastrophe-experience-sp/

[18] http://www.artemis.bm/blog/2016/09/15/reinsurance-rate-softening-to-continue-ils-to-grow-influence-sp-execs/

[19] http://www.artemis.bm/blog/2016/09/15/reinsurance-rate-softening-to-continue-ils-to-grow-influence-sp-execs/

[20] AON Benfield: Reinsurance Market Outlook September 2016, page 2.

3.4. Alternative capital vehicles

Alternative capital rose by 5 per cent to USD 75bn over the first half year 2016.[21] Still, the absolute volumes are modest for now and this might mitigate the risks stemming from building-up of tail risk. The bulk of alternative capital was collateralized reinsurance transactions and outstanding insurance-linked securities (ILS). The total outstanding ILS amounted to USD 25.1bn (2015: USD 26.0bn) by the end of September.

Against the background of the ongoing finance and debt crisis the diversifying nature of catastrophe-exposed business attracts investors who are searching for higher yield and diversification. Low corporate and sovereign debt yields are likely to continue to produce more capacity for catastrophe and other reinsured risks. Some 40 per cent of global sovereign bond yields are now negative.[22] While the non-traditional capital is mainly going into the non-proportional catastrophe business, the new alternative capital seems to spill over into other reinsurance lines.

[21] AON Benfield: Reinsurance Market Outlook September 2016, page 4

[22] AON Benfield: Reinsurance Market Outlook September 2016, page 3

4. The European pension fund sector[23]

During 2015 the European occupational pension fund sector continued to face a challenging macroeconomic environment with low interest rates exerting pressures on IORP liabilities. Total assets increased in 2015 and investment allocation across the sector remained broadly unchanged compared to the previous year. This development reflects the fact that pension schemes hold assets with a long-term view and are less prone to shifts in investment strategy due to short-term market changes. The return on assets fell compared to 2014 but remained positive.

During 2015, continued low interest rates and the mixed performance of equity markets put additional pressure on traditional DB schemes, resulting on average in a shortfall in 2015 compared to a surplus in 2014. DB schemes experiencing deficits need to have a recovery plan in place to restore their financial position.

Many national frameworks are not sensitive to low interest rate risk, as liabilities are valued using fixed interest rates or expected returns on assets.

4.1. Market growth

Total assets owned by occupational pension funds increased by 13.5 per cent for the EEA and 2.5 per cent for the euro area in 2015 (Table 4.1 and Figure 4.1). This increase was partly caused by the drop in interest rates during 2015 which increased the market value of bond portfolios. Two countries, the UK and the Netherlands, account for 83 per cent of the European occupational pensions sector.

Table 4.1: Total assets per country as a share of total assets reported for 2015

UK	NL	DE	IT	IE	ES	NO	BE	IS	AT	SE	PT	DK
49.82%	32.75%	5.90%	3.13%	2.94%	0.98%	0.87%	0.69%	0.58%	0.55%	0.51%	0.46%	0.18%
LI	RO	FI	SI	LU	SK	GR	PL	LV	HR	BG	MT	HU
0.17%	0.16%	0.11%	0.06%	0.05%	0.04%	0.03%	0.01%	0.009%	0.003%	0.0001%	0.00004%	0.00002%

Source: EIOPA

Note: Figure for UK contains DB and HY schemes only

[23] All data employed in this section refers to IORPs (Institutions for Occupational Retirement Provision pension funds).

The penetration rate, i.e. the size of the occupational pension fund sector with respect to GDP, increased in 2015 compared to the previous year in the majority of countries. This ratio gives an indication of the relative wealth accumulated by the sector (Figure 4.2). In 2015 the penetration rate increased in the EEA by 2 per cent compared to 2014.

The huge heterogeneity across countries is driven by the different relative share of private and public pension provisions. In addition to this, the legislative systems tend to vary a lot according to the Member State.

Figure 4.1: Total Assets

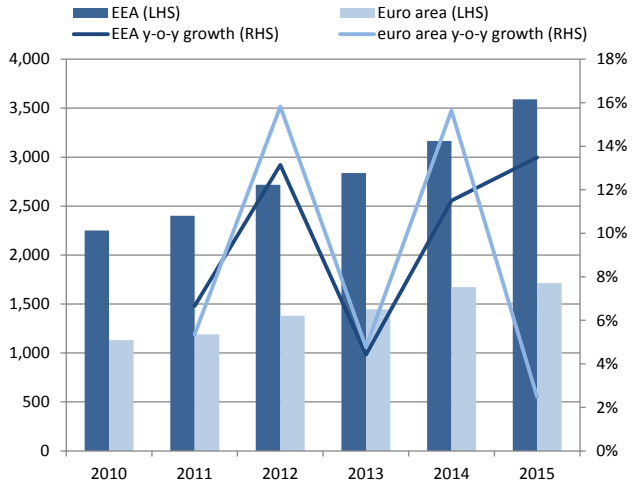
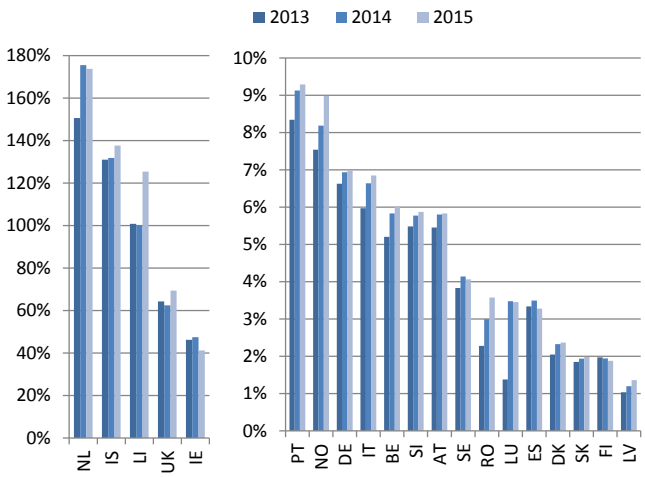


Figure 4.2: Penetration rates (total assets as per cent of GDP)



Source: EIOPA

Note: Penetration rates for GR, HR, PL, MT,BG and HU are lower than 1 per cent. LHS stands for left hand side and RHS for right hand side

4.2. Performance and Funding

In aggregate terms, the investment allocation of pension funds for most of the countries remained almost unchanged in recent years (Figure 4.3 and Figure 4.4). Debt and equity account for the highest share in the portfolio investment allocation of pension funds. The total exposure to sovereign, financial and other bonds added up to 47 per cent in 2015 and the total exposure to equity to 28 per cent. Pension funds have a long-term horizon regarding investments so equities generally have a much higher investment share than in the insurance sector.

This investment mix for IORPs is relatively stable in the past three years. This is partly due to strict legal or contractual obligations which are justified by prudential reasons as well as due to the fact that changes in the investment portfolios of pension funds take place very slowly. However, when compared with 9 years ago more substantial

changes in the fund's portfolios can be observed. For instance, when looking at data for 16 countries for the period 2007-2015[24] (available from online statistical annex[25]), there is a clear decline in equities from 46 per cent to 28 per cent and an increase in bonds from 32 per cent to 47 per cent. A possible explanation is the de-risking of investment portfolios in the UK.

Based on recent information reported to EIOPA two trends can be identified:

(1) The small increase of investment allocation to equity especially among DC schemes. Given the big size of the UK and the NL these trends cannot be observed in the aggregates.

(2) Given the low returns of bonds, signs of "search for yield" to more "risky" and "higher yielding" investments were highlighted by some members.

Both trends require caution and EIOPA will continue close monitoring.

Figure 4.3: Investment Allocation for 2013 to 2015 (in per cent)

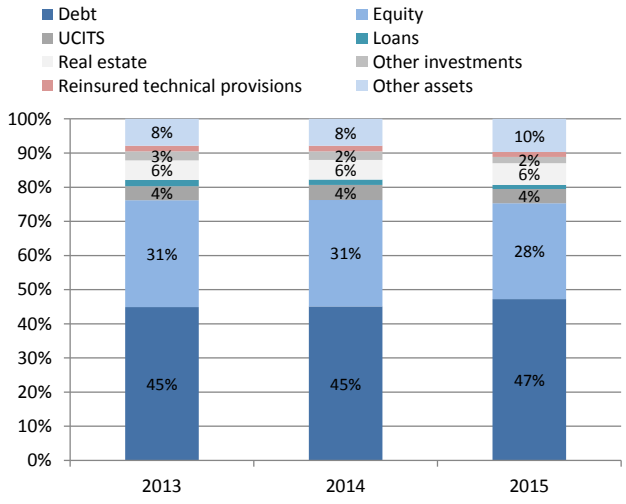
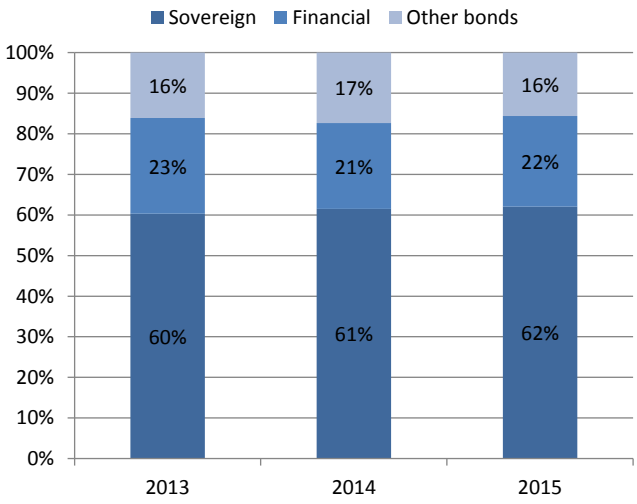


Figure 4.4: Bond investments breakdown for 2013 to 2015 (in per cent)



Source: EIOPA

Note: UCITS stands for Undertakings for Collective Investment in Transferable Securities. For all variable definitions please refer to the statistical annex published at:

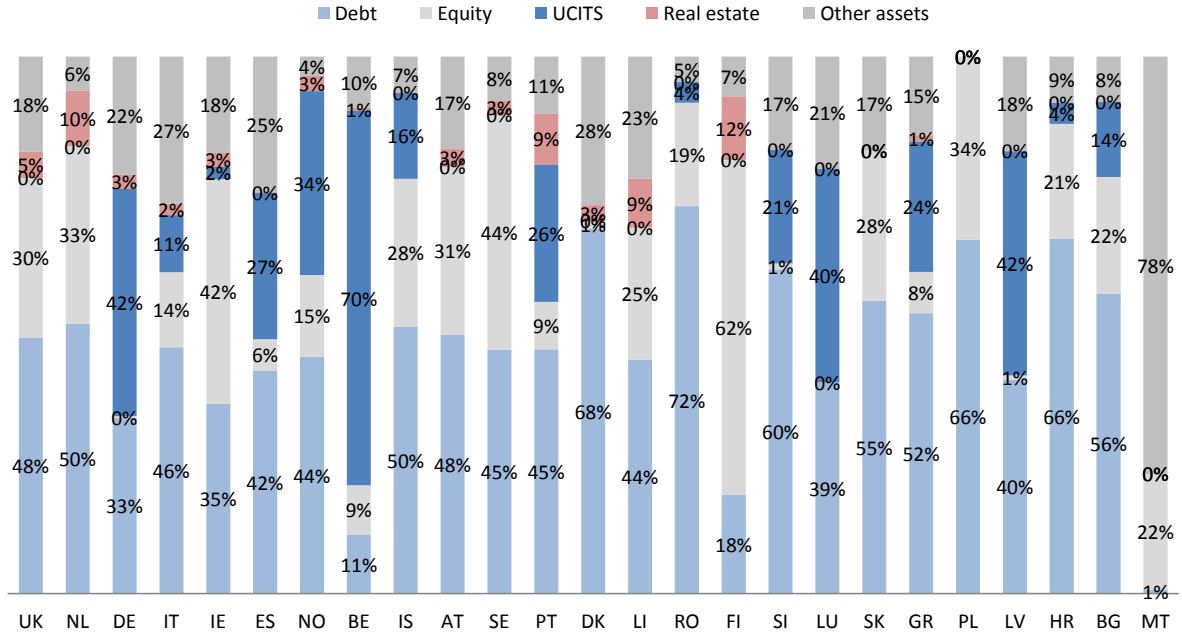
https://eiopa.europa.eu/financial-stability-crisis-prevention/financial-stability/statistics

[24] AT, BE, DE, DK, ES, FI, IT, LU, LV, NL, NO, PL, PT, SE, SI and the UK - Total assets of these countries add up to 97% of total assets in EEA.

[25] https://eiopa.europa.eu/financial-stability-crisis-prevention/financial-stability/statistics

Investment allocation for 2015 across countries is very heterogeneous (Figure 4.5). Direct investments in bonds and equity may vary across the countries of the sample. However, countries with particularly low direct investments to debt and equity usually invest in these categories through UCITS.

Figure 4.5: Investment Allocation per country (in per cent) for 2015



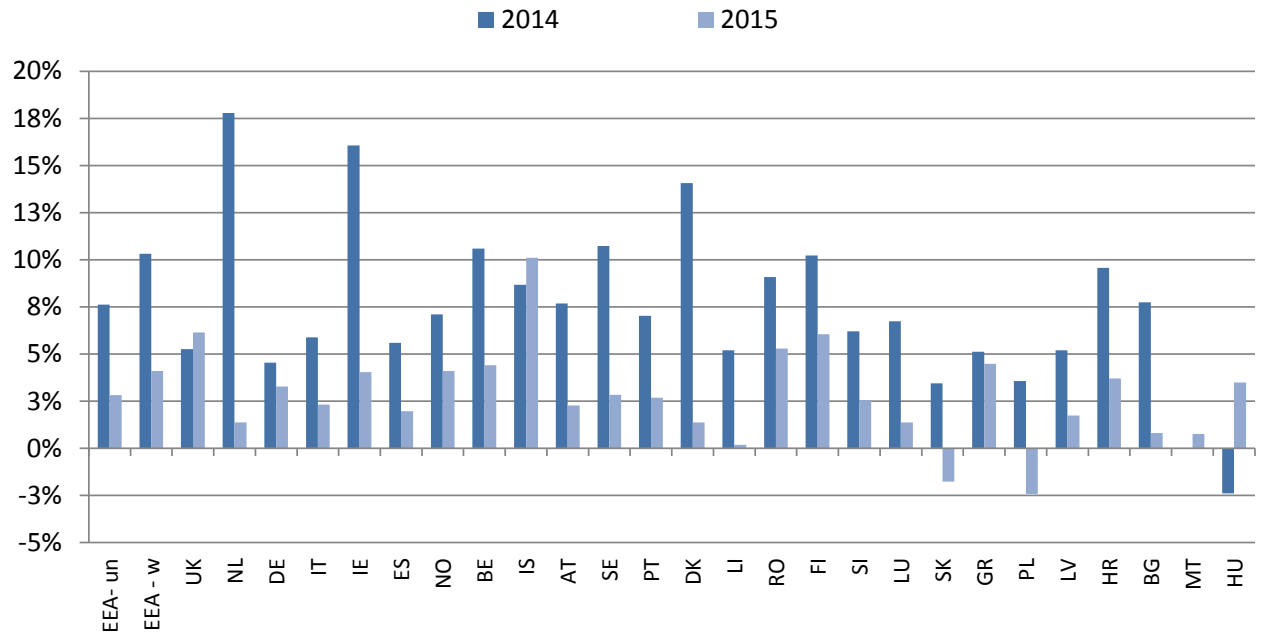
Source: EIOPA

Note: "Other" includes: Derivatives, loans, reinsured technical provisions, other investments and other assets.

Note: the UK figure used for the calculations of these figures relates to DB and HY schemes only. In the investment allocation chart, loans and reinsured technical provisions make approximately 3 per cent of total assets for the three years depicted in the chart. For SE, FI and SI the debt breakdown was not available.

The average rate of return decreased in 2015 but remained positive in most of the countries. The average ROA (Figure 4.6) in 2015 (un-weighted 2.8 per cent, weighted 4.1 per cent) was lower compared to 2014 (un-weighted 7.6 per cent, weighted 10.3 per cent). This can be attributed to the modest performance of the equity and fixed income markets during 2015. The investment returns in 2015 could not keep pace with the increase in IORP liabilities.

Figure 4.6: Rate of return on assets (ROA) in per cent



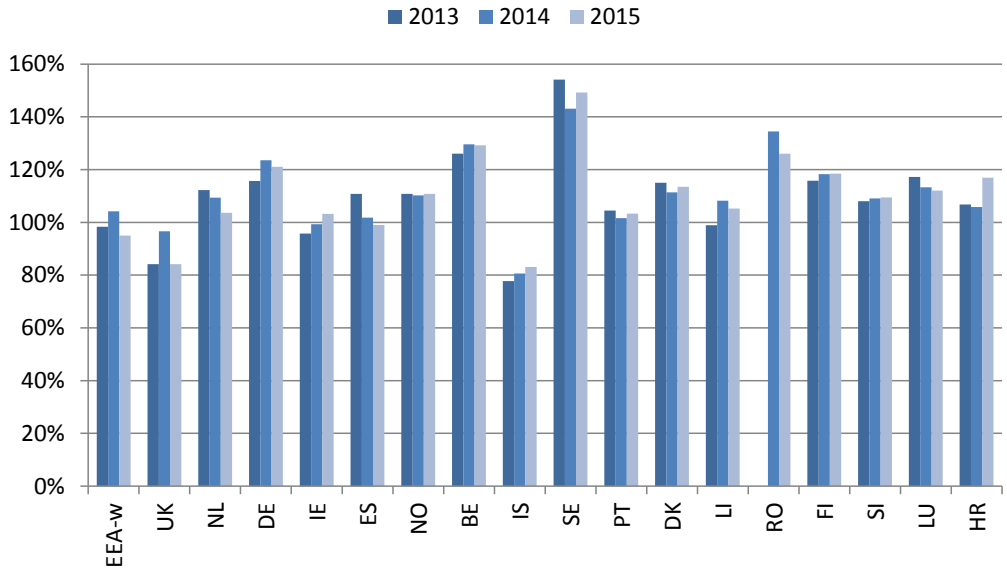
Source: EIOPA

Note: Both the weighted and un-weighted averages for ROA were calculated on the basis of the countries that are depicted in the chart. The weighting was based on total assets.

Cover ratios for DB schemes have decreased and remain a big concern for a number of countries.[26] Overall, the average weighted cover ratio significantly decreased in 2015 from 104 per cent to 95 per cent (Figure 4.7). Due to differences in national regulatory frameworks, IORPs across Europe are not subject to the same funding requirements. However, cover ratios close to or below 100 per cent remain a concern for the sector if low interest rates persist. In some countries there is full sponsor support and guarantees exist to support schemes in the event of shortfalls. However, an extreme adverse scenario may strain the ability of the sponsors to deal with the potential cost increases. In other countries a (partial) suspension of benefit increases as well as benefit reductions are ways to tackle low funding ratios.

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

Figure 4.7: Cover ratio (in per cent)



Source: EIOPA

Notes:

(1) Cover ratios refer to DB schemes. Countries with pure DC schemes present are not included in the chart and in the average calculations.

(2) Both the weighted and un-weighted averages for the cover ratio were calculated on the basis of the 17 countries depicted in the chart. The weighting was based on total assets.

(3) Due to different calculation methods and legislation, the reported cover ratios are not comparable across jurisdictions.

The overall active membership increased in 2015 by 7 per cent while the number of IORPs kept on decreasing in Europe by another 3 per cent compared to 2014 (Figure 4.8 and Figure 4.9). Many countries reported a declining number of occupational pension funds. A trend of consolidation can be identified in the sector. This process increases the average number of members in various individual schemes. The overall increase in active membership can be attributed to a large extent to the (gradual) introduction of auto-enrolment in the UK. Since October 2012 larger employers are required to automatically enrol workers in a workplace pension. This requirement will apply to all employers by 2018.

Figure 4.8: Number of Institutions

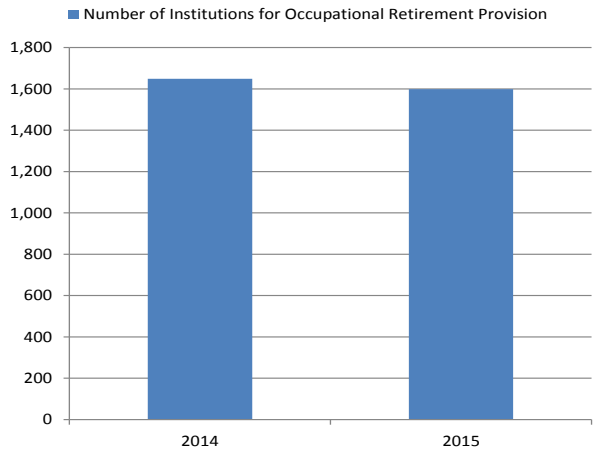
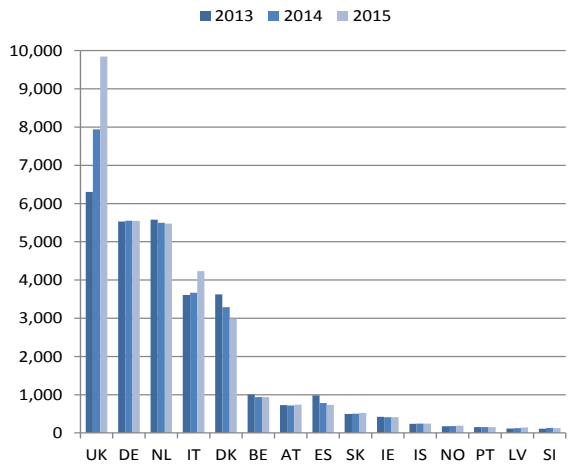


Figure 4.9: Active members (in thousands)



Source: EIOPA

Note: In the number of institutions chart UK, LI, RO, GR, BG and MT are excluded from the calculation. In the active members chart, MT, GR, PL, LI, HR, FI, LU, RO and BG have below 100.000 members.

5. Risk assessment

5.1. Qualitative risk assessment

A qualitative risk assessment is an important part of the overall financial stability framework. EIOPA conducts regular bottom-up surveys among national supervisors to rank the key risks to financial stability for the insurance, as well as for the occupational pension sector. Based on the responses of the Autumn Survey among national supervisors, the key risks and challenges classified as the most imminent in terms of their probability and potential impact remain broadly unchanged.

The most challenging risk factor remains the low interest rate environment (see Figure 5.1 and 5.2). The overall risk assessment relating to low interest rates increased in the insurance sector and in particular in the pension sector with its very long-term obligations. This reflects the negative impact of low interest rates on funding/solvency positions as well as the resulting search for higher yielding assets to enhance investment returns.

Figure 5.1: Risk assessment for the insurance sector

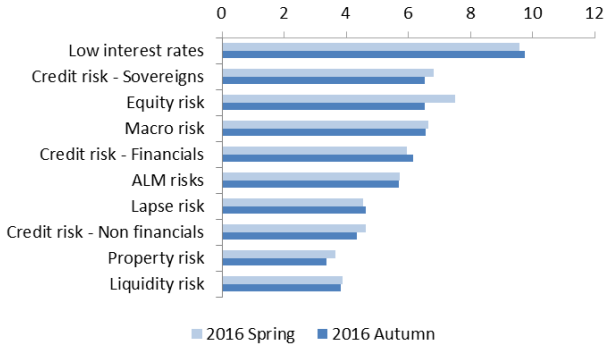
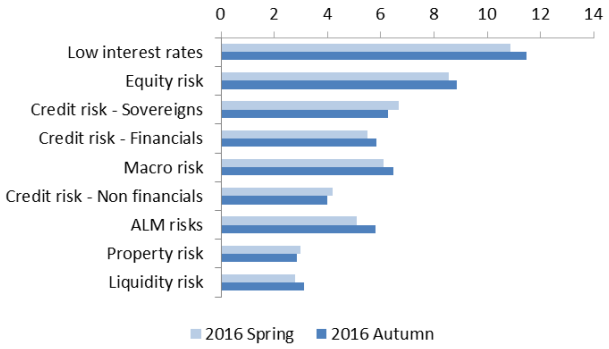


Figure 5.2: Risk assessment for the pension funds sector



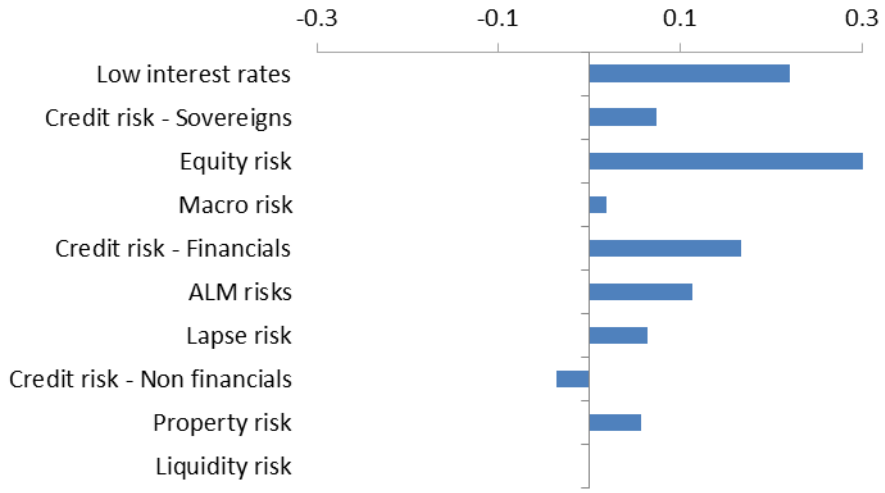
Source: EIOPA

Note: 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.

Future risks stemming from the low interest rate environment are described below (Figure 5.3). A deteriorating business cycle has a negative impact on insurance and pension fund business, e.g. higher lapse rates in insurance. The survey points out that lapses might rise in the future.

Figure 5.3. Supervisory risk assessment for insurance and pension funds - expected future development

Note: EIOPA members indicated their expectation for the future development of these risks. Scores were provided in the range -2 indicating considerable decrease and +2 indicating considerable increase.



Solvency II (SII) will eventually have an impact on insurance products and hence on insurers' investment portfolios. Solvency I was setting no incentive for risk-based pricing. SII on the other hand is risk-based and leads to an alignment of pricing, risk and capital management. The design of new insurance products will take the risk-return profile into account, and products with high market risk exposure may have to be redesigned or replaced. There will most likely be shifts towards less capital-intense products and changes in asset allocation due asset liability management (ALM) links and Solvency II. Transitional measures could delay the alignment of risk and capital management with Solvency II in the transitional period until 2032.

Insurers' investment portfolios have been changing slightly recently. On the one hand, in order to reduce SII requirements, some undertakings adopted a form of de-risking policies, by increasing their exposure to "AAA"-rated counterparties or by decreasing their equity exposure. On the other hand, in order to face the ongoing low interest rate environment, some undertakings shifted their investment risk profile. Others also implemented hedging strategies using derivatives.[27] Some tendencies for

[27] Equity hedging can enclose using options and futures on indices and individual securities, whereas bond hedging uses instruments such as interest rate options and swaps as well as credit default swaps.

infrastructure investment categories can also be seen although the overall proportion of such investments is still limited.

Q2 2016 data regarding the composition of the investment portfolio allows appreciating the similarities and the differences in the style of the asset allocation between life and non-life insurers (Figure 5.4 a and 5.4b). [28] Both life and non-life insurers invest approximately half of their portfolio in fixed-income securities and rely heavily on collective investments (around 20 per cent)[29]. Life insurers tend to invest in particular in government bonds; non-life insurers invest more in equities, i.e. 21 per cent as opposed to 8 per cent for life insurers. The reason for this is the products insurance companies offer. Due to the long maturity of their liabilities, life insurers are focused on asset-liability matching. Non-life insurers with typically lower maturities of their liabilities might be shifting their investment risk profile in search for higher yields.

Figure 5.4 a) Composition of the investment portfolio of the life insurance sector in Q2 2016

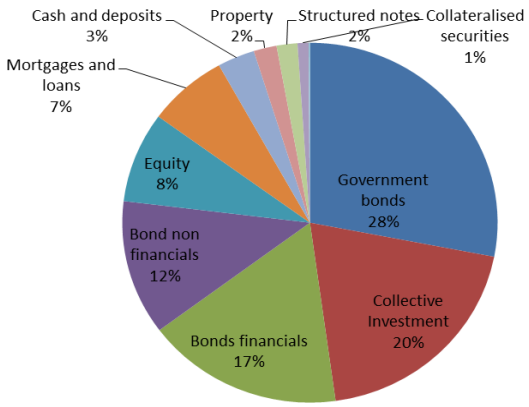
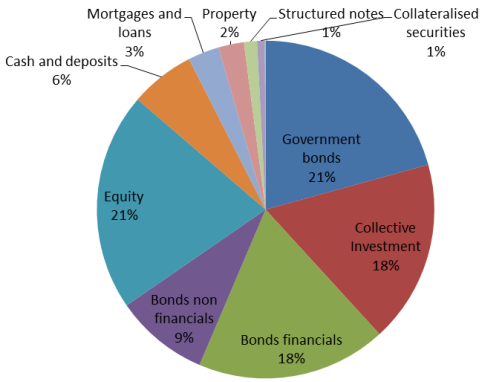


Figure 5.4 b) Composition of the investment portfolio of the non-life insurance sector in Q2 2016



Source: EIOPA (sample based on 2600 solo insurance undertakings in EEA)

Reporting reference data: 30/06/2016

[28] Figures on the composition of the investment portfolio do not consider assets held for index and unit-linked products because the policyholder has the risk for these products.

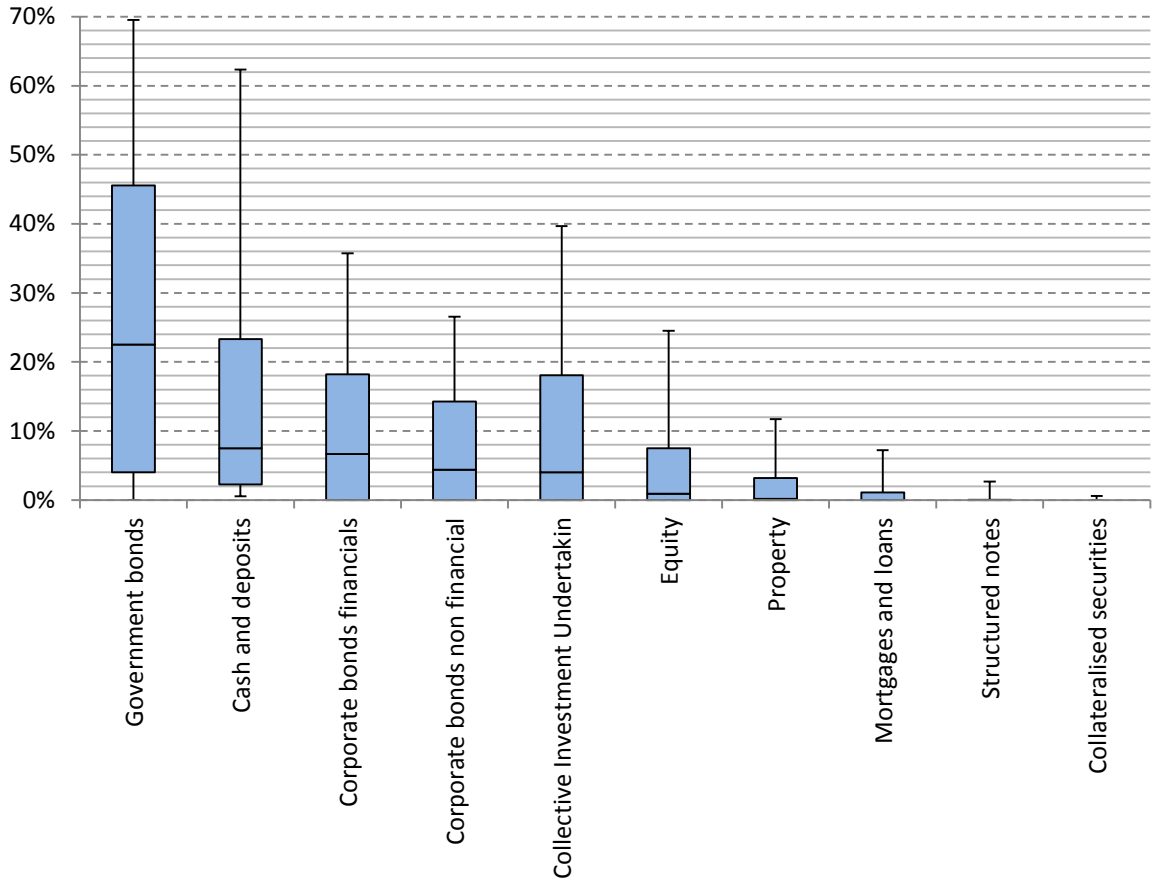
[29] The underlying of these "collective investments" might encompass all types of assets, but a more precise breakdown is currently not possible.

The change should be seen in the context of the new Solvency II framework where mismatch will be charged with solvency capital, triggering higher demand, e.g. for fixed-income instruments aligning asset with liability durations.

Holdings of different type of investments exhibit a large heterogeneity across individual insurers (Figure 5.5). Holdings of government bonds, as a share of investment, for example, range from zero per cent to almost 70 per cent for the 10th and 90th percentile respectively. It is likely that the 10th and 90th percentile are small undertakings, which tend to invest in plain, low risk or highly diversified financial instruments such as government bonds, cash and deposits or collective investment undertaking. When looking at these numbers one should keep in mind that the previous figure focuses on aggregates and the investments of larger undertakings tend to weigh relatively more.[30]

[30] Basically, Figure 5.5 is mainly representative for the composition of the investment portfolio of large insurance companies.

Figure 5.5: Type of investment as a share of total investment. Cross-sectional distribution in per cent for the median, interquartile range and 10th and 90th percentile



Source: EIOPA (sample based on 2600 solo insurance undertakings in EEA)

Reporting reference data: 30/06/2016

Insurers make use of derivatives to hedge their portfolios risk (Figure 5.6 and Figure 5.7). It is mainly life insurers who make use of derivatives. Based on SII values, derivatives are less than 1 per cent of the total investments. Insurers hold derivatives mainly for hedging purposes. Put (call) options can be used to hedge (or leverage up i.e. increase the risk exposure) equity, whereas the purchase (selling) of credit default swaps can be used to hedge (leverage up) default risk. Swaps are used to hedge interest rate risk. Insurers may aggregate and hedge risks associated with certain blocks of invested assets or liabilities together (a portfolio hedge), or may hedge individual assets against one or more risks.

Life insurance undertakings use extensively swaps (63 per cent) and calls (19 per cent) and put (16 per cent) options (Figure 5.6). Similarly, non-life insurers (Figure 5.7) tend to make use of interest rate swaps (40 per cent), but also use forwards (48 per cent). EIOPA will monitor this development to ensure that investments in derivatives are not for speculative purposes.

Figure 5.6: Life insurers' SII value in derivatives in Q2 2016

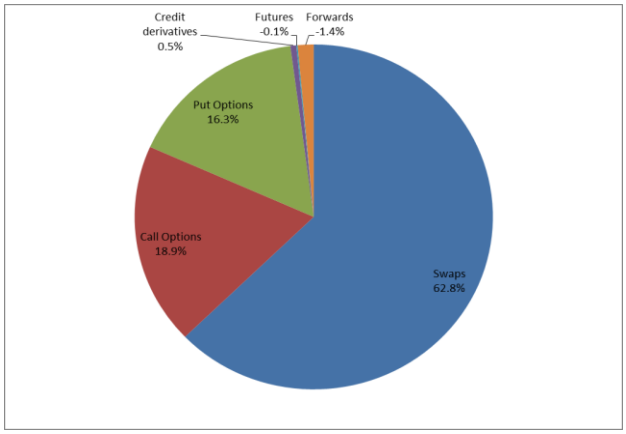
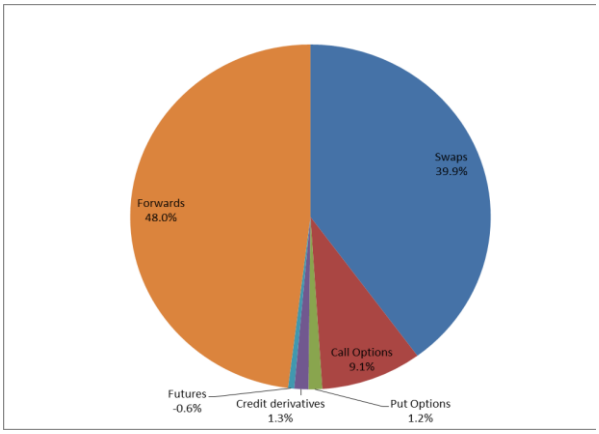


Figure 5.7: Non-life insurers' SII value in derivatives in Q2 2016



Source: EIOPA (sample based on 2600 solo insurance undertakings in EEA)

Reporting reference data: 30/06/2016

The change in the regulatory framework and the search for yield behaviour could be the main triggering events for the reallocation of the investments. The need to increase cash inflows and income should be read in the light of the new Solvency II framework that favours diversification of the investments. At this stage none of the two triggers can be ruled out and the evolution of the investments in a low yield environment shall be further scrutinised to assess the potential deterioration of the quality of the assets held by insurers.

5.2. Quantitative risk assessment

The chapter investigates the impact of the risks previously presented in this report. In detail, the section elaborates on insurers' exposure towards the banking sector.

The implementation of bail-in of creditors, as foreseen in the new banking regulation (Bank recovery and Resolution Directive) which prevents government intervention in rescuing defaulting banks, implies that the distribution of losses, in case of bank

default, takes place among equity holders, but also other creditors such as bond holders and depositors.

New banking regulation reduces the size of government contingent liabilities associated with efforts to limit the effect of risks on economic stability and growth stemming from banking sector stress. The distribution of losses among bank equity holders, bond holders and other safety net tools (such as deposit insurance) will decrease the potential public finance costs of extreme banking sector stresses. Bail-in is an important instrument to reduce tax payers' costs of financial crises and weaken the sovereign-banking loop. By allocating losses to the creditors, moral hazard and excessive risk-taking is addressed. In the past, senior creditors' involvement in the bank failure burden-sharing has been limited.

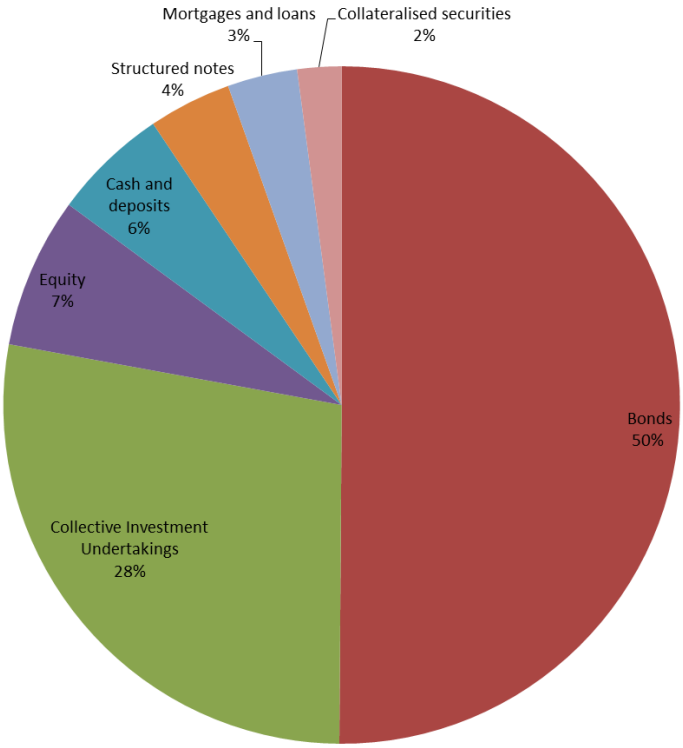
Who bears the bank recovery or resolution bail-in losses is a crucial matter for the stability of the financial system. Bank debt is large, especially when measured against the balance sheet size of other domestic institutional sectors. Transparency about the structure of bank creditors would be desirable.

The insurance sector is extensively exposed towards the banking sector (Figure 5.8). Total investments in financial instruments, issued by the banking sector, amount to approximately EUR 2.211trn.[31] This corresponds to 23.8 per cent and 32.9 per cent of insurers' total assets and total investments respectively.

The largest exposure is on bonds (50 per cent) followed by equity (7 per cent), cash and deposit (6 per cent), structured notes (4 per cent), mortgages and loans (3 per cent) and collateralised securities (2 per cent). Collective investment undertakings (28 per cent), is also included for informative purposes.

[31] The data presented in the following paragraphs are obtained by filtering the issuer with the NACE code K64. i.e. Financial service activities, except insurance and pension funding and by excluding K64.1.1 central banking.

Figure 5.8: Insurance sector exposure towards the banking sector, by investment category



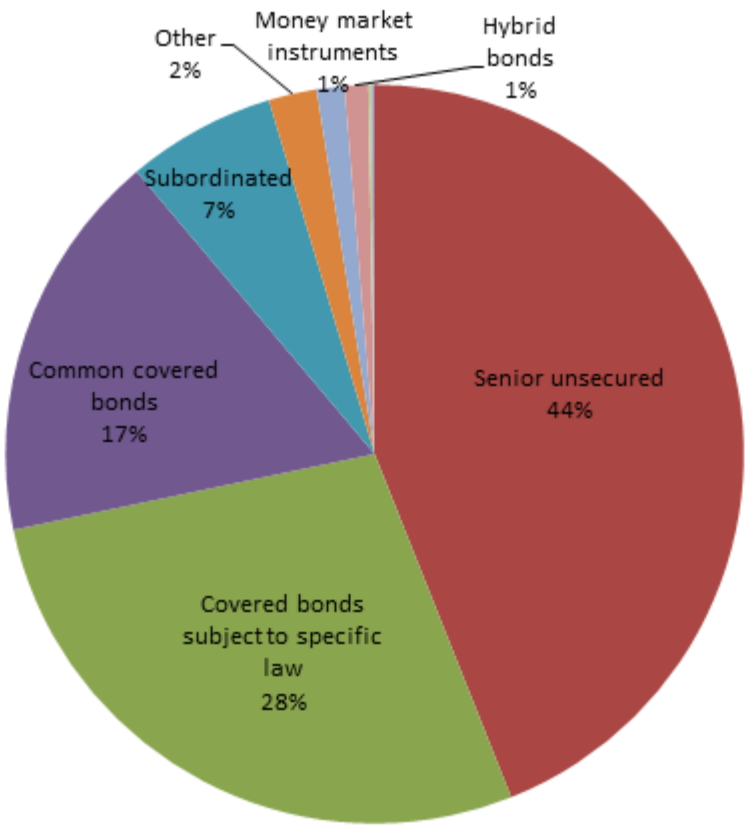
Source: EIOPA (sample based on 2600 solo insurance undertakings in EEA)

Reporting reference data: 30/06/2016

Insurance undertakings hold various types of assets issued by banks (Figure 5.9). These are equity, different forms of debt (i.e. junior, senior or covered/secured), cash and deposit and others. Equity is the most risky item, but also the other assets such as subordinated debt or senior unsecured debt participate to losses with different seniority in case of bank resolution or recovery. Cash and deposit enjoys the highest seniority and covered bonds are not bailed-in.

The largest exposure is on senior unsecured bonds (44 per cent) followed by covered bonds subject to specific law (28 per cent), common covered bonds (17 per cent), subordinated bonds (6 per cent), money market instruments (1 per cent) and hybrid bonds (1 per cent) and others (2 per cent).

Figure 5.9: Holdings of debt instrument issues by banks, by type

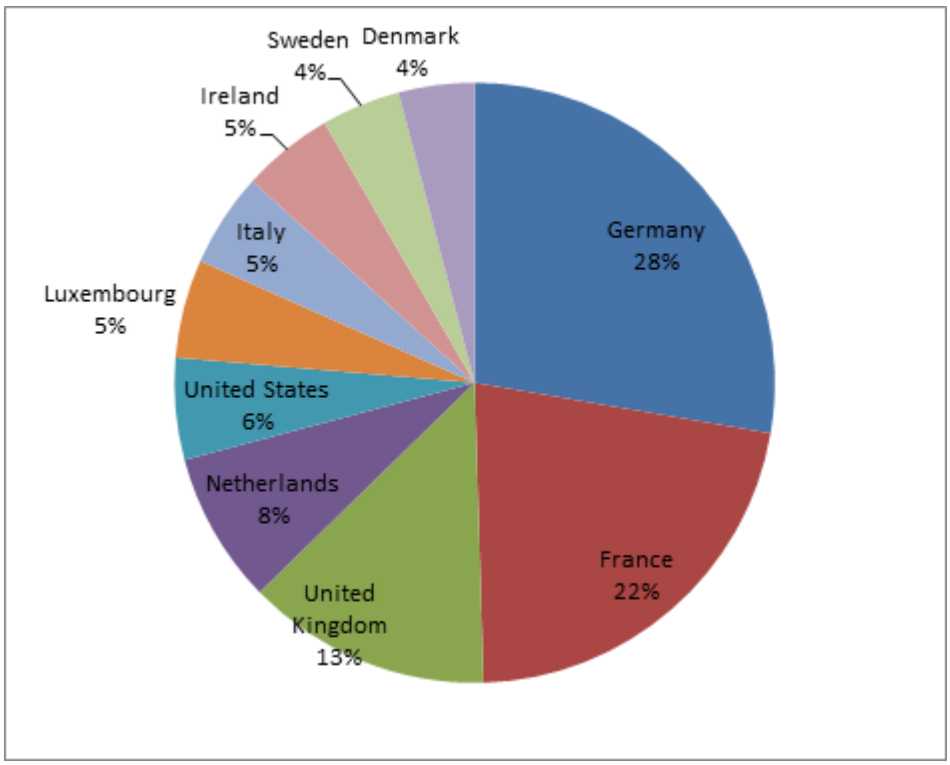


Source: EIOPA (sample based on 2600 solo insurance undertakings in EEA)

Reporting reference data: 30/06/2016

Assets held by EU insurers are mainly issued by banks located in the following countries (Figure 5.10). Germany, France and the United Kingdom rank highest. This is most likely due to the fact that these three economies are at the same time the largest.

Figure 5.10: EU insurers exposure towards the banking sector by country of issuer



Source: EIOPA (sample based on 2600 solo insurance undertakings in EEA)

Reporting reference data: 30/06/2016

There is exposure of the insurance sector towards to both domestic and cross-border banking sector (Figure 5.11). Insurers are not only exposed to the domestic banking sector, but are also cross-border. Some countries such as Croatia (87 per cent), Denmark (84 per cent) and Poland (78 per cent) tend to be more domestically exposed, while others such as Belgium (82 per cent) and Ireland (87 per cent) tend to be more cross-border.

Cross-border exposure is a potential channel of risk transmission. Financial turmoil in the banking sector of one country might spill over due to cross-border holdings by insurers. But also, excessive domestic exposure, which can be seen as a lack of diversification, might be a potential weakness or source of risk.

Figure 5.11: Insurance sector exposure towards the banking sector, domestic versus cross-border in per cent.

Home country of insurer	domestic	cross-border
Germany	62.4	37.6
France	54.9	45.1
United Kingdom	45.2	54.8
Italy	32.1	67.9
Netherlands	54.2	45.8
Denmark	84.9	15.1
Sweden	73.7	26.3
Norway	49.5	50.5
Austria	57.8	42.2
Belgium	17.4	82.6
Ireland	12.2	87.8
Finland	29.6	70.4
Luxembourg	39.7	60.3
Portugal	51.1	48.9
Czech Republic	47.5	52.5
Poland	78.5	21.5
Malta	20.0	80.0
Greece	23.9	76.1
Slovenia	35.9	64.1
Slovakia	52.3	47.7
Cyprus	24.3	75.7
Hungary	67.4	32.6
Bulgaria	18.1	81.9
Croatia	87.0	13.0
Liechtenstein	26.9	73.1
Estonia	18.5	81.5
Romania	45.8	54.2
Lithuania	18.6	81.4
United States	14.5	85.5
Latvia	49.3	50.7

Source: EIOPA, Reporting reference date: 30/06/2016

As insurers tend to be largely exposed towards banks, they benefit from the health of the banking sector. At the same time insurers provide a sizable source of funding to the banking sector. If undertakings are more domestically exposed, the negative feed-back loop between the insurance and banking institutions will most likely be stronger.

A banking crisis can be idiosyncratic or systemic. Mainly two issues have to be taken into account in the case of an idiosyncratic bank default. The first is the size of the insurers' exposure towards the defaulting bank. The second is the level of capitalisation of the insurer. Large bank defaults might have a small impact on the insurance industry if insurers have small exposures and/or are well capitalised. In the case of a systemic banking crises and multiple banks' default the implications are more complex and less predictable. Fire-sales due to the de-leveraging of risky banks holdings by insurers might trigger downward spirals for asset prices and create further troubles for the banking sector and in turn for the insurance sector.

6. Background information and Data description

Insurance sector

EIOPA bases the analysis for this report on Quarterly Financial Stability reporting Group (QFG) and Solo (QFS) and Quarterly reporting Solo (QRS). QFG refers to insurance entities that have more than EUR 12bn assets, whilst QFS refers to solo undertakings that also have more than EUR 12bn in assets but don't belong to groups. QRS refers to all EAA (excluded Switzerland) insurance entities that are subject to reporting under SII. At the time of writing the last available data for Solos was 30/06/2016 (Q2) and for Groups 31/03/2016. [32]

Solvency models are of a complex nature, as is the consistency with which SII will be implemented across jurisdictions. With regard to the required solvency margin, a distinction is made between the Solvency Capital Requirement (SCR) and the Minimum Capital Requirement (MCR).[33]

The SCR should be calculated at least once a year according to the standard formula or by applying a full or partial internal model or a combination of both. The capitalization of an insurance company that is part of a group depends on the group's management strategy. Hence, the impact of this on individual companies' coverage SCR ratios can be significant and needs to be taken into account when comparing and interpreting SII results.[34]

The solvency margin has a high level of volatility, which is due to changes in the market environment. Hence, a comparison that only involves SCR coverage ratios should be treated with caution. The MCR should be calculated at least quarterly and it can neither be lower than 25 per cent of the SCR nor exceed 45 per cent of the SCR. If a given insurance company holds insufficient funds to cover the MCR, the supervisory authority may withdraw the authorisation granted to the insurance

---

[32] In particular, reporting of opening prudential information (day-1) was due on 20th May 2016 for solo undertakings and 1st July 2016 for groups. Furthermore, solo undertakings and groups have started the submission of Solvency II regular reporting on a quarterly basis, with a transitional deadline of 8 weeks for solos and 14 weeks for groups after the end of each quarter during 2016.

[33] Minimum Capital Requirement (MCR): Insurance companies should also hold eligible own funds in the amount not lower than the MCR. The MCR is not available for groups.

[34] The SCR calculated on the basis of the standard formula is the sum of the Basic Solvency Capital Requirements, the capital requirement of operation risk and the adjustments for the capacity to absorb unexpected losses of technical provisions and deferred taxes (Article 103 of the Directive). The SCR coverage ratio is defined as the ration between Eligible Own Funds and the SCR.

undertaking to pursue insurance business. If insurers do not hold sufficient own funds to meet these requirements, supervisory consequences with various levels of severity will be the consequence.

EIOPA Guidelines *are provided for the use of internal models*. These aim to provide guidance for supervisory authorities and insurance or reinsurance undertakings. In order to cope with the challenging macroeconomic reality, companies need to re-think their business models and look for innovative approaches. To this regard, Solvency II transitional measures provide companies with the additional time to re-consider their business models. The time given by transitionals should be used if there is a reason to change and not simply to extend the current situation.

The Long-Term guarantee package

The crisis has highlighted that volatility and its consequences are an important element to be addressed. It is EIOPA's view that volatility is a fact, which is shown by market consistent valuation, and should be an integral part of the risk management of companies, both as a risk and a potential business opportunity. At the same time, if not appropriately understood, it may lead to "artificial" - in the sense of unnecessary - consequences or actions, including supervisory action, which should be avoided, in particular regarding short-term volatility. The simultaneous application of the three pillars of Solvency II will allow dealing with undesirable impacts and pro-cyclicality. A further challenge is the transition between Solvency I and Solvency II in order to allow for a smooth introduction without market disruptions, while at the same time providing policyholder protection.

This has set the background to introduce a number of measures in Solvency II. These are designed to avoid undesirable impacts in the treatments of insurance business with long-term guarantees, ensuring that such measures function effectively in light of the principles of the internal market and ensure a level playing field across the Union: the long-term guarantee (LTG) Package.

The Omnibus II Directive, published in the Official Journal of the European Union in May 2014, finally adopted the following LTG measures:

a) Volatility adjustment (VA). This is an adjustment of the risk-free curve used to evaluate technical provisions by addition of a constant spread. This spread is derived from the difference between the interest rates that can be earned from a reference portfolio and the basic risk-free rate for each currency. Additionally, if market spreads are very wide in a country, a conditional country spread could be added to the

currency spread. The VA aims to prevent pro-cyclical investment behaviour (which might trigger "forced sales") by mitigating the effect of exaggerations of bond spreads.

b) Matching adjustment (MA). The MA is a constant addition to the risk-free curve for portfolios where the cashflows of assets and insurance obligations are matched and that matching can be uphold in the future. A combination of MA and VA or transitional measures is not permitted.

Omnibus II also defines a set of transitional measures to favour a smooth progression from the current solvency regime to Solvency II. Unlike these measures of the LTG package described above, the relaxation of requirements applies for a certain period, and is phased out over time. The aim is to put insurance undertakings in a position to be able to comply with the full spectrum of Solvency II requirements over time.

c) Transitional measures on interest rates. The Directive allows for an adjustment of risk-free interest rates that may be applied to (re)insurance obligations. The adjustment is equal to the difference between the interest rate as determined under Solvency I at the last date at which Solvency I is in force, and the annual effective rate as determined under Solvency II. The adjustment will be fully applied in 2016 and reduced in a linear manner to zero per cent in 2032. Those undertakings that apply the volatility adjustment have to account for the volatility adjustment before performing the described adjustment.

d) Transitional measures on technical provisions. As an alternative to the transitional measure on the risk-free interest rate, undertakings can seek approval for a transitional deduction to technical provisions The transitional deduction is equal to the difference of (a) technical provisions net of recoverable from reinsurance and special purpose vehicles as prescribed under Solvency II, and (b) technical provisions net of recoverable from reinsurance as prescribed under Solvency I. Similar to the transitional measure on risk-free interest rates, the deduction will be fully applied in 2016 and reduced in a linear manner to 0 per cent in 2032. It may be combined with the volatility adjustment, but not with the matching adjustment.

Extension of recovery period should also be mentioned in this context. Under normal circumstances, the time period for recovery is six months from the observation of non-compliance with the solvency capital requirement. In exceptional circumstances this period can be extended. Increased flexibility on the side of the supervisors might contribute to greater stability in times of financial distress.

The implementation of long term guarantees measures should be allowed by the national supervisory authorities. However, some Member States may require prior approval. The impact of the various adjustments on the financial position of an undertaking should be disclosed in order to ensure transparency.

The percentage of undertakings applying these various long term guarantees is shown below (Table 6.2).

Table 6.2: Use of transitional measures by undertakings in per cent

	Yes	No
Transitional measures on interest rates	3	97
Transitional measures on technical provisions	38	62
Volatility adjustment (VA)	59	41
Matching adjustment (MA)	16	84

Source: EIOPA, Reporting reference date: 30/06/2016

Reinsurance sector

The section is based on information released in the annual and quarterly reports of the largest European reinsurance groups. The global and European market overview is 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 highlights the main developments that occurred in the European occupational pension fund sector, based on feedback provided by EIOPA Members. Not all EU countries are covered, in some of them IORPs (i.e. occupational pension funds falling under the scope of the EU IORPs Directive) are still non-existent or are just starting to be established. Furthermore, in other countries the main part of occupational retirement provisions is treated as a line of insurance business respectively held by life insurers, and is therefore also not covered. The country

coverage is 87 per cent (27 out of 31 countries).[35] Data collected for 2015 was provided to EIOPA with an approximate view of the financial position of IORPs during the covered period. Several countries are in the process of collecting data and in some cases 2015 figures are incomplete or based on estimates which may be subject to major revisions in the coming months. In addition, the main valuation method applied by each country varies due to different accounting principles applied across the EU. Moreover, data availability varies substantially among the various Member States which hampers a thorough analysis and comparison of the pension market developments between Member States. For RO, the data refers to 1st Pillar bis and 3rd Pillar private pension schemes only.

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

[35] Countries that participated in the survey: AT, BE, BG, DE, DK, EE (only qualitative information), ES, FI, HR, GR, HU, IE, IS, IT, LI, LU, LV, MT, NL, NO, PL, PT, RO, SE, SI, SK and the UK.

PART II

Thematic Article

The Impact of the Monetary Policy Interventions on the Insurance Industry

Loriana Pelizzon*, Matteo Sottocornola**[36]

The content of this study does not reflect the official opinion of EIOPA. Responsibility for the information and the views expressed therein lies entirely with the authors.

Abstract

This paper investigates the effect of the conventional and unconventional (e.g. Quantitative Easing) monetary policy intervention on the insurance industry. We first analyse the impact on the stock performances of 166 (re)insurers of the last Quantitative Easing programme launched by the ECB by constructing an event study around the announcement date. Then we enlarge the scope by looking at the monetary policy surprise effects on the same sample of (re)insurers over a timeframe of 8 years. Our evidences suggest that a single intervention extrapolated from the comprehensive strategy cannot be utilized to estimate the effect of the monetary policy intervention on the market. On the impact of monetary policies we show how the effect of interventions changes over time. The expansionary monetary policy interventions, when generating an instantaneous reduction of interest rates, had an immediate positive effect on the stock market and on the insurance industry from 2008 till 2013. However, the effect fades away in 2014-2015. This period includes the

[36] * Program Director Systemic Risk Lab and Chair of Law and Finance, Research Centre SAFE, Theodor W. Adorno Platz 3, Goethe University Frankfurt, D-60629 Frankfurt am Main, Germany and Full Professor in Economics, Ca' Foscari University of Venice, Fondamenta San Giobbe 873, 30100 Venice, Italy. Contact: telephone +49 6979830047, e-mail pelizzon@finance.uni-frankfurt.de.

** EIOPA, Westhafenplatz 1, D-60327 Frankfurt am Main, Germany and Center of Excellence SAFE Sustainable Architecture for Finance in Europe, Theodor W. Adorno Platz 3, Goethe University Frankfurt, D-60629 Frankfurt am Main., Germany. Contact: telephone +49 69951119416, e-mail matteo.sottocornola@eiopa.europa.eu.

The authors thank Marcello Pericoli for the useful advices. The authors are grateful to Francesco Brunello, Jannic Cutura, Nicola Mano and Luciano Sandel for the excellent research assistance.

last ECB QE intervention and it is characterized by already extreme low interest rates shows statistically non-significant effects on the (re)insurers stock returns.

Introduction and literature review

To contrast the economic stagnation affecting Europe, the European Central Bank (ECB) is enforcing since 2013 a series of conventional and unconventional expansionary monetary intervention, including Quantitative Easing (last QE announced in January 2015).[37] These expansionary interventions, in addition to the welcomed stimulus on the economy, result in extremely low interest rates exacerbating the problems arising from the low yield environment.

The persistent low yield environment is heavily affecting the EU financial services industry and it is becoming a severe threat for the life insurers in terms of solvency and sustainability of their business models.

From a policymakers' perspective an increasing attention on the stability and profitability of life insurers is expressed by EIOPA. These constantly rank the low yield environment as the major source of risk for the life insurers (EIOPA, 2013, 2014 and 2015). Concerns are specifically addressed towards companies with a relevant outstanding portfolio of products entailing guaranteed rates of return and profit participation features. The lack of sufficiently remunerable rated assets on the market substantially reduce the capability for (re)insurers to match by a return and duration perspective the outstanding portfolio of guaranteed policies underwritten in high-yield years. Concerns are shared by the national authorities overseeing markets traditionally active on saving products with minimum guaranteed returns such as Germany. For instance, Deutsche Bundesbank (2013), from the 2013 stress test exercise inferred that a persistent low yield environment would heavily affect the solvency situation of German insurers. Moreover, the report concluded that under particularly adverse conditions more than 30 per cent of the German life insurers won't meet Solvency II capital requirements by 2023. Comparable results are obtained by Berdin and Gruendel (2014) in their model based analysis on a stylised German life insurer's solvability under the Solvency II regime. Wedow and Kablau (2011) analyse the German market once more and reached less pessimistic conclusions. As a matter of fact they empirically conclude that given the outstanding stock of guaranteed products the solvency situation will be threatened only in extremely adverse scenarios. Nevertheless, the authors argue that a prolonged low

[37] See: European Central Bank (2015).

yield scenario would progressively worsen the solvency capability of insurance companies offering minimum guaranteed products. In the literature there is a common understanding in considering these kinds of products as the most exposed to the drop in the interest rates. In particular duration mismatches between assets and liability are considered to be the vulnerable point of these products, as qualitatively shown by Holsboer (2000) and theoretically expressed by Lee and Stock (2000). In addition to the minimum guaranteed benefits, the profit participation component seems to cause trouble to insurers as pointed out by Grosen and Lochte Jorgensen (2000) in their theoretical work. Profit distribution policies have been empirically investigated by Kling et al. (2007a) both by a general and local perspective (Kling et al. 2007b). An additional element of vulnerability of the life insurers exposed to a persistent low yield environment comes from surrender options potentially embedded in the contracts. Gatzert (2008) and Albizzati and Geman (1994) explain how in periods of low profit sharing returns, policyholders can opt for more attractive investments enhancing the lapse risk.

All these studies investigate the issue from a theoretical point of view of a numerical simulation; with this work we aim to shed light on the empirical evidence related to stock market evaluation of the impact of unconventional monetary policies on the insurance industry.

In fact, if on the one hand there is a common understanding on the relation between monetary interventions and the interest rate term structure, on the other hand the effect on conventional and unconventional expansionary monetary policy on the market does not provide conclusive elements, especially in a low or negative yields environment.

The impacts of the monetary policy on market valuations have been vastly investigated. Specifically, the role of monetary policy announcements on asset pricing is well documented (see Cook and Hahn (1989), Bernanke and Kuttner (2005), Gurkaynak, Sack, and Swanson (2005), Ehrmann and Fratzscher (2004), Bjornland and Leitemo (2009) and Ippolito, Ozdagli, and Perez (2015), among others). However, the literature on Quantitative Easing and near-zero rates is still in its initial phase and has thus far mainly concentrated on measuring the effects of unconventional monetary policies on aggregates such as inflation and GDP (see Chen, Curdia, and Ferrero (2012), Chung et al. (2012), Gambacorta, Hofmann and Peersman (2014), and Kapetanios et al. (2012) amid others). A number of papers investigates the effect of unconventional policies on financial markets, with a focus on

interest rates and equities in the U.S. and developed European countries. Instances for works in this area are Krishnamurthy and Vissing-Jorgensen (2011), D'Amico et al. (2012), D'Amico and King (2013), Banerjee, Latto, and McLaren (2014), Li and Wei (2013) and Pericoli and Veronese (2016).

It is worth mentioning various studies that implement the event-study methodology in order to properly investigate the effects of unconventional monetary policies. Regarding the Eurozone, Luciu and Lisi (2015) have identified announcements that can be considered as complete surprises: they then simply added up the jumps in asset prices in short-time windows bracketing these announcements. Nevertheless, complete surprises do not account for market expectations. A way to bypass this issue is offered by Joyce et al. (2011) and Cahill et al. (2014), by normalising data looking at the surveys periodically conducted by financial institutions such as bank and insurances, with the purpose to measure in a more realistic manner the market surprise to monetary policy announcements. However, due to the limited availability of surveys, this measure does not represent a viable alternative for many fields. A more effective approach, proposed by Rogers, Scotti and Wright (2014), turned out to be helpful in order to measure the effects of monetary measures on different asset prices relatively to changes in government bond yields and relies on a particular definition of monetary policy surprise centred on the intraday changes in government bond yields right after the announcement.

Despite the ample sources, no analysis has been specifically devoted to the insurance industry. We therefore focus our attention on how and to what extent the 2015 ECB QE and the convention and unconventional expansionary monetary policy strategy deployed by Central Banks impact the market performances of the (re)insurers.

Our approach is twofold. The first part of the analyses elaborates over a simple event study bases on a market model (Mackinlay, 1997) around the last ECB QE announcement (22 January 2015). Subsequently, we extend the analysis to a broader sample of announcements by following the approach of Pericoli and Veronese (2016) who compare monetary policy announcement and non-announcements days in different sub-periods. In this second part, our paper builds on the latter intuition. The idea underlying this approach is that the periods are characterised by different "structural parameters", in the spirit of Rigobon (2003). Within these periods, estimates of impacts obtained by separately pooling announcement and non-announcement days.

The paper is structured in five sections. At first this introduction provides a review of the main related researches and presents the overall content of the study. We devote section two and three to present the applied methodology and to describe the utilised dataset respectively. Section four summarises the empirical evidences on the effect of monetary policies on the insurance industry. The article concludes with the presentation of the main findings and of the further implications (Section five).

Methodology

To evaluate the effect of the non-conventional monetary policy interventions enforced by the ECB we focus on the QE program launched on the 22nd of January 2015. More specifically we design an event study based on a market model around the announcement of the QE program.[38] The Cumulative Abnormal Returns of insurers are computed against different samples in order to insulate the effect of the QE on the broad insurance market and on a set of subsamples defined according to geographical areas and sizes defined in term of total assets. In detail we split the full sample by a geographical perspective into: i) US (re)insurers, ii) EU (re)insurers, iii) EMU (re)insurers and iv) EU-non EMU (re)insurers. Size-wise we dissect the sample into big and small (re)insurers. It is worth noting that in this article we utilise the notation "big and small" in a relative extent. The sample includes large listed (re)insurers, nevertheless to understand whether and to what extent size acts as determinant of the impacts of monetary policy intervention on insurers. We use the following divide: threshold of EUR 50bn used by FMI and IAIS as a size criteria to identify G-SII insurers (IAIS, 2016).

We compute for each group the Cumulative Abnormal Returns (CAR) around the announcement date using a two-day event window as in Chen et.al. (2014) as follows: [39]

$$CAR_{i,t} = \sum_{j=1}^{t} AR_{i,j} \qquad (1)$$

where i represents the institution and j represents the time. The Abnormal Return (AR) of an institution i is computed according to equation (2).

$$AR_{i,t} = OR_{i,t} - \mathrm{IR}_{i,t} \qquad (2)$$

[38] For a more detailed treatment of the applied event study methodology and of the strength and weaknesses of the market based approach refer to MacKinlay (1997).

[39] The use of a longer window does not allow insulating the effect of the analysed event as other elements may generate movements in the stock prices.

where the OR express the observed market return of the institution$i$, whereas IR expresses the implied return of the same institution. We compute implied returns on the (re)insurer i on an estimation windows spanning form 26 August, 2013 to 20 January, 2015 according to equation 3.

$$\mathrm{IR_{i,t}} = \hat{\beta}_i * \mathrm{ORt}_{i,t} \tag{3}$$

where $\hat{\beta}_i$ is derived via OLS according to equation 4:

$$\mathrm{Return}_{i,t} = \alpha_i + \beta_i * \mathrm{market}_t + \varepsilon_{i,t} \tag{4}$$

In the second part of our analyses, in order to identify the causal relationship of the monetary policy, we estimate an ordinary least square regression of daily returns of the (re)insurance companies on monetary policy surprises. Based on the fact that at a first instance conventional and unconventional monetary policies affect the risk free rate term structure, we define, according to Kuttner (2001) and Rogers et al. (2014), the monetary policy surprise as the linear combination of the changes on the whole term structures of the interest rates. We then estimate the impact of the monetary policy surprise on the market returns of a panel of listed companies via OLS regressions according to equation 5.

$$\Delta y_t = \alpha + \beta * \Delta RFR^{FED}_{t=t_{aFED}} + \gamma * \Delta RFR^{ECB}_{t=t_{aECB}} + \sum_j \phi_j * X_{t,j} + u_t \tag{5}$$

where Δy_t is the change in the market return, $RFR^{FED}_{t=t_{aFED}}$ and $\Delta RFR^{ECB}_{t=t_{aECB}}$ are the Fed and ECB monetary-policy surprises (defined as the first principal component factor – PCA – of the changes in 2-year, 3-year, 5-year, 7-year and 10-year zero-coupon interest rates).[40] In line with Pericoli and Veronese (2016) we use a set of control variables represented by $X_{t,j}$, namely the US Citi Economic Surprise Index (CESI), the Euro-area CESI and the VIX. Equation (5) is estimated only on ECB ($t = t_{aECB}$) or Fed ($t = t_{aFED}$) announcement days split into four periods: as follows.

1st period, from January 1, 2002 to July 31, 2007. We define it as a tranquil period characterised by conventional monetary policies conducted both by ECB and Fed.

2nd period, from August 01, 2007 to December 31, 2009. We define it as the period of the US sub-prime crisis and its subsequent global spillover. The Troubled Asset Relief Program (TARP) process and conventional and

[40] For the EU we utilise the zero-coupon interest rate implied in government bonds irrespective of their rating (ECB computation). For the US we utilize the FED zero-coupon rate.

unconventional monetary policies (QE1 announced in November 2008 and ceased in March 2010) enforced by the Fed reduced the US at near-zero interest rate. The ECB stared in October 2008 the progressive reduction of the interest rates to a near-zero level complemented by unconventional policy as Long Term Refinancing Operations (LTRO) announced in May 2009 and Asset Purchases Programme (APP).

3rd period, from January 01, 2010 to May 31, 2013. The focus moved from the US to Europe. The period is characterised by the severe tensions on the EURO originated by speculative attacks to the currency and by the sovereign debt crisis of the peripheral countries of the euro area. The nearly default of Greece represents the peak of this crisis. The ECB reaction was anticipated in the "Whatever it takes" London speech of President Draghi and enforced by conventional monetary policy interventions (reduction of interest rate on deposit facilities to 0 per cent) and unconventional monetary policy intervention (the launch of Outright Monetary Transactions - OMT). In order to contrast the US economy downturn, the Fed proceeded along the path of conventional expansionary monetary policy complemented by unconventional monetary policies launching in November 2010 the QE2 and in September 2012 the QE3.

4th period, from June 01, 2013 to September 15, 2015. The low yield environment is the key topic to be mentioned. In order to contrast the prolonged stagnation of the economy in the euro area and to fulfil its mandate of keeping the inflation close to 2 per cent, the ECB launched in April 2014 the Quantitative Easing program which was extended in 2015 further. TLTROs initiatives complemented the set of enforced unconventional monetary policies. Interest rate on deposit facilities turned to negative from June 2014 onwards. In the US, the recovery of the economy led to a first increase on the Fed Funds rate at the end of 2015 (outside our period of observation).

This specification allows to investigate whether conventional and unconventional monetary policies have been effective over time in fostering favourable conditions for the (re)insurers when policy rates were stuck at the zero lower bound, and if their transmission operated through a decrease in term premia benefit the insurance industry.

Dataset

We conduct the event study on a panel of 96 US and 70 European listed insurers selected among the largest in term of total assets.[41] Data consist of the total return index and market capitalisation retrieved via Thomson Reuters Datastream® of the (re)insurers over a time window of 370 trading days from August 26, 2013 to January 24, 2015. We use as an estimation panel a set of indices for each geographical area containing all relevant listed companies, namely excluding all the small caps and the (re)insurers encompassed in our panel (i.e. only the largest companies that jointly account for 80 per cent of the total market capitalisation were used to compute the country level market indices). Additionally, we remove all insurance companies and all companies which had less than 120 active trading days in any year. Based on end year market capitalisation figures, we compute weighted country market returns.

We then build a set of country based indices based on the market capitalization of the companies in order to scrutinize the effect of the QE i) at European and US level and ii) at a country level. Also we split the sample according to the size of the insurers to understand whether and to what extent size acts as a determinant of the impacts of monetary policy intervention on insurers.[42] Table 1 provides a detail of the sample of the (re)insurers.

Table 1: Descriptive Statistics (Event Study)

Sample	Obs (#)	Mean (%)	Std. Dev. (%)	Min (%)	Max (%)
All companies	166	-0.90	6.80	-71.20	19.30
US companies	96	-1.50	8.10	-71.20	19.30
EU companies	55	0.10	3.50	-8.70	12.70
EMU companies	29	-0.10	3.60	-8.70	9.80
EU non EMU companies	26	0.40	3.40	-3.80	12.70
Big companies	41	-1.00	3.40	-15.10	3.00
Small companies	125	-0.80	7.60	-71.20	1.73

Note: This table reports the summary statistics for the Total Return Index (TR) of the (re)insurers included in the different sample for the period from 26/08/2013 to 20/01/2015. Subsamples are created according to geography and size. Data downloaded from Thomson Reuters Datastream® on 08/06/2015.

For the second part of our analyses, we complement the returns of the (re)insurers with the change in the risk free rate term structure and the list of the monetary policy days built on the scheduled and unscheduled central bank board meetings as well as

[41] Total assets observed at end-2014. Data retrieved via SNL Financial®.

[42] Our sample consists of large insurance groups therefore to dissect the panel according to the size we use the threshold of EUR 50bn defined by FMI and IAIS as a size criteria to identify G-SII insurers (IAIS, 2016).

on those days when relevant news on monetary policies were disclosed (Table 2 displays the summary statistics of the returns).[43]

Table 2: Descriptive Statistics (Market returns)

Period 1															
	ECB annnouncement days					Fed annnouncement days					Other days				
Δy (%)	Obs(#)	Mean	Std. Dev.	Min	Max	Obs(#)	Mean	Std. Dev.	Min	Max	Obs(#)	Mean	Std. Dev.	Min	Max
ALL	335	-0.12	1.19	-3.08	4.68	305	0.16	0.88	-1.75	2.51	6,640	0.05	1.03	-4.99	7.63
EU	201	-0.21	1.86	-5.40	5.35	183	0.29	1.12	-2.90	4.10	3,984	0.04	1.58	-8.18	9.00
EMU	67	-0.24	2.18	-7.03	7.04	61	0.34	1.26	-2.91	5.04	1,328	0.03	1.68	-8.67	9.62
EUnonEMU	67	-0.06	0.97	-3.79	1.78	61	0.17	1.05	-2.78	2.77	1,328	0.13	0.98	-6.31	7.07
US	67	-0.09	1.02	-3.05	4.41	61	0.09	0.95	-2.39	2.23	1,328	0.05	0.98	-4.25	6.97
Period 2															
	ECB annnouncement days					Fed annnouncement days					Other days				
Δy (%)	Obs(#)	Mean	Std. Dev.	Min	Max	Obs(#)	Mean	Std. Dev.	Min	Max	Obs(#)	Mean	Std. Dev.	Min	Max
ALL	165	-0.66	2.33	-7.91	4.60	190	0.45	3.33	-7.75	7.67	2,815	0.04	2.14	-7.69	13.14
EU	99	-0.51	2.50	-8.78	5.99	114	0.34	3.46	-6.90	11.48	1,689	0.02	2.24	-8.20	12.86
EMU	33	-0.48	2.57	-7.77	6.81	38	0.26	3.50	-7.21	10.39	563	0.00	2.26	-8.44	12.29
EUnonEMU	33	-0.41	1.84	-5.74	2.14	38	0.20	2.19	-4.33	5.81	563	-0.01	1.68	-9.09	6.05
US	33	-0.78	2.49	-7.14	3.20	38	0.49	4.20	-9.79	9.23	563	0.04	2.58	-10.35	16.14
Period 3															
	ECB annnouncement days					Fed annnouncement days					Other days				
Δy (%)	Obs(#)	Mean	Std. Dev.	Min	Max	Obs(#)	Mean	Std. Dev.	Min	Max	Obs(#)	Mean	Std. Dev.	Min	Max
ALL	230	0.24	1.45	-3.91	3.11	205	0.27	1.43	-3.17	5.02	4,020	0.06	1.25	-6.63	7.28
EU	138	0.35	1.76	-3.41	4.98	123	0.15	1.48	-2.35	5.63	2,412	0.05	1.49	-5.72	9.85
EMU	46	0.33	1.93	-3.58	4.65	41	0.13	1.70	-2.74	6.49	804	0.04	1.65	-6.43	11.58
EUnonEMU	46	0.23	1.07	-2.48	2.46	41	-0.07	1.13	-5.54	2.28	804	0.09	1.00	-5.48	6.41
US	46	0.16	1.52	-4.36	3.08	41	0.38	1.81	-4.49	7.34	804	0.06	1.31	-8.37	6.03
Period 4															
	ECB annnouncement days					Fed annnouncement days					Other days				
Δy (%)	Obs(#)	Mean	Std. Dev.	Min	Max	Obs(#)	Mean	Std. Dev.	Min	Max	Obs(#)	Mean	Std. Dev.	Min	Max
ALL	140	0.40	0.65	-0.75	1.94	130	0.21	0.80	-0.95	1.93	2,715	0.04	0.79	-4.19	2.70
EU	84	0.45	1.00	-1.91	2.37	78	0.08	0.80	-1.28	2.09	1,629	0.04	0.94	-3.92	2.96
EMU	28	0.43	1.14	-2.31	2.47	26	0.07	0.86	-1.44	2.36	543	0.04	1.03	-3.68	3.37
EUnonEMU	28	0.09	0.83	-2.05	1.71	26	0.20	0.81	-2.28	1.99	543	0.07	0.91	-4.62	3.46
US	28	0.36	0.74	-0.94	2.31	26	0.29	0.99	-1.80	2.17	543	0.04	0.87	-4.33	3.20

Note: The table reports the summary statistics of the total return of the stocks of the insurance companies included in the sample. Statistics are reported for the ECB announcement days, the Fed announcement days and the other days of the observation window.

The OLS regression includes also the VIX, the CEIS and the CEIS US as control variables. Table 3 displays the summary statistics of the regressors.

[43] The full list of monetary policy days divided between US and EU is provided in Appendix A and is from the Pericoli and Veronese (2016) paper. The lists are divided into 2 periods of observation with the oldest slots that only reports scheduled meetings and the more recent ones that complement scheduled meetings with unscheduled meetings and relevant speeches.

Table 3: Descriptive Statistics (Monetary Policy Surprise)

Period 1															
	ECB annnouncement days					Fed annnouncement days					Other days				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
CESIEur	41	27.67	62.14	-105.20	146.50	34	25.94	60.24	-100.40	147.30	826	25.35	58.95	-119.70	162.50
CESIUsd	41	-0.98	39.68	-104.40	72.90	34	1.01	38.39	-102.50	73.10	816	-0.14	39.58	-110.50	73.50
VIXX	41	13.51	1.96	10.44	18.35	34	13.22	2.29	10.23	20.34	796	13.65	2.35	9.89	24.17
$\Delta RFR^{ECB}_{t=t_{aECB}}$	67	-0.71	28.06	-64.64	54.37	61	1.84	20.97	-101.77	46.21	1,322	-0.50	23.24	-130.72	76.15
$\Delta RFR^{FED}_{t=t_{aFED}}$	67	-2.65	21.37	-75.41	48.24	61	1.39	26.40	-60.76	59.00	1,322	-0.12	23.23	-183.82	89.67
Period 2															
	ECB annnouncement days					Fed annnouncement days					Other days				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
CESIEur	32	-25.05	76.69	-188.60	88.10	38	-36.27	75.10	-186.50	77.40	545	-25.34	73.94	-185.30	94.30
CESIUsd	32	-5.36	53.89	-120.30	73.60	38	-11.64	54.81	-136.10	76.90	545	-7.00	51.37	-140.60	83.20
VIXX	33	30.46	12.91	18.44	63.68	37	33.44	14.38	18.53	69.96	543	30.29	12.53	16.12	80.86
$\Delta RFR^{ECB}_{t=t_{aECB}}$	33	1.06	41.42	-101.41	65.37	38	14.20	37.02	-69.93	110.91	557	0.30	31.92	-144.82	114.18
$\Delta RFR^{FED}_{t=t_{aFED}}$	33	-0.66	28.54	-70.87	52.37	38	8.32	47.28	-102.35	141.07	557	0.56	30.22	-167.72	132.78
Period 3															
	ECB annnouncement days					Fed annnouncement days					Other days				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
CESIEur	46	7.29	54.34	-91.70	121.20	41	4.49	54.35	-104.20	110.30	789	5.43	52.77	-103.40	131.00
CESIUsd	46	4.40	45.16	-98.20	86.10	41	-2.69	48.10	-98.50	77.30	790	4.18	44.72	-117.20	97.50
VIXX	46	20.27	6.07	13.06	36.27	41	20.90	6.26	12.67	37.32	771	20.57	6.59	11.30	48.00
$\Delta RFR^{ECB}_{t=t_{aECB}}$	46	1.67	31.15	-86.56	69.27	41	-3.22	29.29	-126.94	55.76	798	0.74	25.25	-131.11	95.75
$\Delta RFR^{FED}_{t=t_{aFED}}$	46	0.20	17.02	-44.14	44.94	41	-0.98	18.06	-56.86	43.31	798	0.60	14.86	-82.51	54.09
Period 4															
	ECB annnouncement days					Fed annnouncement days					Other days				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
CESIEur	28	0.48	31.95	-54.10	55.30	26	1.25	27.18	-41.10	51.70	536	1.03	29.86	-57.30	64.90
CESIUsd	28	-3.99	33.34	-55.00	63.90	26	-5.63	31.79	-71.90	50.70	536	-2.86	33.21	-73.30	72.70
VIXX	27	14.54	2.82	10.32	25.61	26	14.25	2.19	10.61	20.44	524	14.95	3.43	10.62	40.74
$\Delta RFR^{ECB}_{t=t_{aECB}}$	28	-0.83	20.67	-47.31	34.68	26	0.95	13.58	-39.19	27.02	538	-0.02	15.39	-122.25	49.84
$\Delta RFR^{FED}_{t=t_{aFED}}$	28	-2.01	11.86	-29.19	14.64	26	0.32	23.46	-42.91	48.69	538	-0.40	15.03	-74.45	41.67

Note: The table reports the summary statistics of: i) the control variables – CEIS EUR, CEIS US and VIX; ii) the first principal component of the change in 2-year, 3-year, 5-year, 7-year and 10-year zero-coupon interest rate for the US and the EU. Statistics are reported for the ECB announcement days, the Fed announcement days and the other days of the observation window.

The ECB announcement days had a different impact on the interest rates according to the periods of observation. Period 1 and period 4 display an average decrease of the rates in the announcement days with an average of interest rate changes of -0.71bp and -0.83bp respectively with a significant variations from -64.64bp to +54.37bp. Period 2 and period 3 show the opposite reaction of the rates with on average a positive change in the interest rates (+1.06bp and +1.67bp) with a significant variations from -101.41bp to 69.27bp. The behaviour can be explained by the fact that the intervention either was in the direction of an increase of the interest rates or, despite being for a reduction of interest rates, did not match the expectation of the market that reacted in the opposite direction.

Empirical evidence

In this section we report the application of the approach explained in the section two. At first we show the results of the event study centred on the ECB announcement of the last QE (22/01/2015) on the defined samples of (re)insurers. Subsequently, with the aim of scrutinizing the general effect of a series of several interrelated monetary policy interventions, we display the outcome of the analysis on the monetary policy surprise effect by enlarging the timeframe of our analysis and the number of interventions announced by the Central Banks.

Event Study

We design the event study on a -2/+2 days event window (see shaded cells in Table 3 below). We select a 4-day event window because we want to capture the expectation effect that shall be reflected in prices in the few days before the announcement on the one hand the adjustments subsequent the announcement on the other hand. A longer event window would be prone to capture spurious effects originated by other events that may happen in the market. According to this specification the QE has a significant negative impact on the return of the full sample of (re)insurers (column "Total"). The same can be observed regarding the different geographical and size-based subsamples. In this respect, however, the level of significance is insufficient. The only exception is represented by the US subsample (column "US"). This subsample reports still small but higher significant impacts in comparison to the full sample. The result cannot be explained from the information available. It also cannot be connected to the ECB intervention. Therefore, it may be related to other concurrent events and hence deserves further analyses. The evolution of the Cumulative Abnormal Returns over time for the country based subsamples is provided in Appendix B.

Table 4: Event Study

Parameters		Cumulative Abnormal Return									
		Total		mean(small)-		EU		EMU		US	
event window (days)	estimation window (days)	Value (%)	Sig.	Value (%)	Sig.	Value (%)	Sig.	Value (%)	Sig.	Value (%)	Sig.
-2/+2	100	**-1.376**	*	-0.588	-	0.124	-	0.028	-	**-2.456**	*
-2/+2	250	**-0.854**	*	0.220	-	0.140	-	-0.075	-	**-1.530**	**
-2/+2	350	**-0.836**	**	0.386	-	-0.011	-	-0.223	-	**-1.397**	***
-1/+1	100	-0.017	-	0.752	-	-0.031	-	**-0.603**	*	-0.053	-
-1/+1	250	0.338	-	1.291	-	-0.016	-	**-0.683**	*	0.536	-
-1/+1	350	0.337	-	1.394	-	-0.140	-	**-0.770**	*	0.622	-
0/0	100	**0.460**	*	-0.299	-	0.245	-	0.420	-	0.494	-
0/0	250	**0.573**	*	-0.040	-	0.272	-	0.324	-	**0.656**	*
0/0	350	**0.551**	***	-0.017	-	0.213	-	0.290	-	**0.656**	*
0/+1	100	0.148	-	0.791	-	-0.014	-	-0.521	-	0.098	-
0/+1	250	0.382	-	1.151	-	-0.020	-	-0.639	-	0.495	-
0/+1	350	0.376	-	**1.208**	*	-0.110	-	-0.701	-	0.544	-
0/+2	100	-0.133	-	0.404	-	0.048	-	-0.240	-	-0.487	-
0/+2	250	0.199	-	0.930	-	0.011	-	-0.404	-	0.117	-
0/+2	350	0.197	-	**1.012**	*	-0.091	-	-0.495	-	0.179	-
0/+3	100	-0.025	-	0.146	-	-0.001	-	-0.278	-	-0.336	-
0/+3	250	0.457	-	0.797	-	-0.001	-	-0.380	-	0.515	-
0/+3	350	**0.496**	*	0.911	-	-0.120	-	-0.487	-	**0.665**	*

*Note: The table reports for the different combinations of event and estimation windows' length the mean of the cumulative abnormal returns of the (re)insurers under the different samples. Significance of the parameter expressed via T-statistics *=10% level, **=5%level, ***2.5%level.*

As a robustness check we tested other specifications of the event windows without obtaining statistically significant results. Furthermore, the direction and the significance of the impacts of the QE announcement are strongly dependent form the parameters of the event study, namely the size of the event window and of the estimation window (see Table 4 above in the non-shaded cells). In fact, when restricting the event window to the day of the announcement (-0/+0), the empirical evidence offer the same picture although the sign is the other way round and the magnitude lower. The smaller coefficients, despite their significance, show how the market reflected the expected monetary action in the previous days leaving some adjustments for the day of the announcement.

From the event study we are not able to infer a clear-cut indication on the impact of the last ECB QE announcement on the (re)insurers. The limited and somehow contradictory evidences suggest that the 2015 QE was not well received by the insurance market. However, the limited magnitude and the volatility of the sign of the impact claim for a wider approach that evaluates the general monetary policy strategy encompassing several interventions enforced by the Central Banks.

Monetary Policy Surprise

Monetary policy interventions cannot be considered on as standalone actions, they are at the same time the cause and consequence of complex and interrelated macroeconomic circumstances. The analysis of a standalone event (e.g. a QE announcement) excerpted from the larger set of monetary policy actions

encompassed in the overall monetary policy strategy, may lead to partial and potentially misleading results.

In order to overcome this, we propose an identification approach that takes direct inspiration from Rogers, Scotti and Wright (2014) and Pericoli and Veronese (2016). According to the authors, the monetary policy interventions are transmitted to the market through the variation in yields over the whole interest rate term structure. The effect of the Central Banks' announcements is signalled by a statistically significant higher monetary policy surprise during the event days compared to the non-event days. These evidences can be observed on each of the 4 periods (Table 4 – Monetary Policy Surprise - Volatility of the first component of the interest rate term structure). Also market returns of (re)insurers and other listed institutions reflect the announcement events but with a statistically significant increase in the volatility only in two specific periods (Table 4 – Insurers' return and Other financials' return).

Table 4: Monetary Policy Surprise - Volatility of the first component of the interest rate term structure

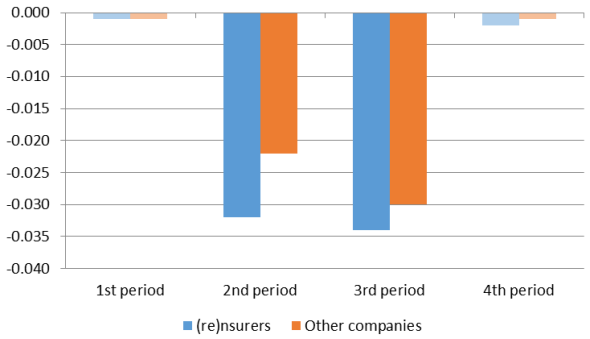
		ECB			Fed		
	Period	σ_{event}	$\sigma_{no-event}$	***p-val***	σ_{event}	$\sigma_{no-event}$	***p-val***
Monetary Policy Surprise	1	27.85	23.08	0.00	26.19	23.08	0.00
	2	40.81	32.25	0.00	46.67	29.81	0.00
	3	30.82	25.35	0.00	17.85	14.92	0.00
	4	20.31	15.22	0.00	23.02	14.81	0.00
Insurers' return	1	2.18	1.98	0.00	2.01	1.99	0.04
	2	3.33	3.57	0.98	4.30	3.51	0.00
	3	2.39	2.12	0.00	2.25	2.13	0.03
	4	1.46	1.49	0.68	1.54	1.49	0.17
Other financials' return	1	1.48	1.34	0.00	1.25	1.35	1.00
	2	2.21	2.12	0.09	2.96	2.06	0.00
	3	1.58	1.45	0.00	1.34	1.47	1.00
	4	1.38	1.30	0.63	1.62	1.39	0.00

Note: The table reports the volatility of i) the first PCA factor using the 2-year, 3-year, 5-year, 7-year and 10-year bond yield dissected for the Euro area and the US and for the different periods of observations; ii) the market returns of the (re)insurers included in the sample and iii) the market returns of the indices of the financial services deducted by the (re)insurers. Additionally the P-value for the one sided F-test of difference in variances is reported, namely H_0: σ_(event)>σ_(no-event).

Expansionary monetary policy interventions that generate an immediate reduction of interest rates, tested via equation 5, seem to be positively received by the markets especially during crises periods (the opposite for an increase of interest rates) i.e. period 2 and 3 in our analysis (ref. Figure 1). As a matter of fact sensitivity of stock returns to the monetary policy surprise interest rate change, when statistically significant, is always associated to negative signs (Detailed results are provided in Appendix C). These negative coefficients indicate that, when the monetary policy announcement generates a positive change in the interest rates, stock returns

decreases; when instead it generates a negative change in the interest rates (i.e. a reduction of the interest rates) stock returns increases. The negative coefficient is even larger for (re)insurance companies indicating that insurance stock returns reacts more to monetary policy announcements with respect to the rest of the market. Even in this case, when the announcement has an immediate positive effect on the interest rates (interest rates increases) stock returns are negative, when the announcement generates an immediate reduction of the interest rates stock returns are positive. However, Figure A1.1 also shows that, the effect of expansionary monetary policy intervention on stock returns tend to fade away in the fourth period. This could be due to the fact that markets are somehow "addicted", therefore having already included in the stock price all further enforcement of the monetary policy. On the other side, it could be interpreted as the fact that, in the fourth period, the positive impact of a reduction of interest rates on the asset side of the insurance balance sheet is largely offset by the negative impact on the liability side in a period of ultra-low interest rates. Unfortunately, with the current approach we cannot provide a clear-cut interpretation on that.

Figure A1.1: ECB coefficient over time – Full sample



Note: This figure graphically represents the coefficient of the monetary policy surprise explanatory variables as described in equation (5) and reported in Appendix A). Transparent bars represent non-significant coefficients (T-statistics > 10% level).

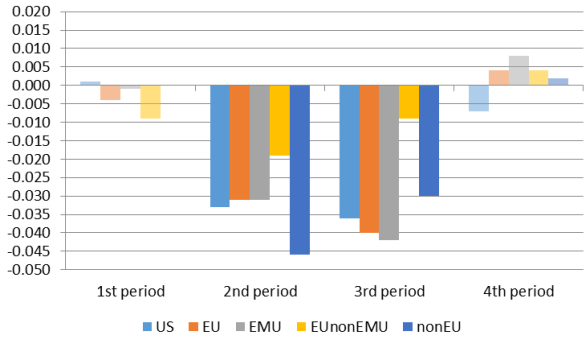
The results are confirmed when we analyse geographical subsamples based on macro-areas but with some distinctions. Beside the confirmation of the significance of the second and third period, the evidences show how the impact of ECB monetary policies on the EMU institutions is higher than the one on the other geographical subsamples. The relatively small difference in the coefficients can be explained by the cross-border nature of the business run by the institutions included in the analysis. Indeed we are investigating the impacts of monetary interventions on listed groups operating globally. Therefore, despite to some extent geographical criteria is respected (EMU and US subsamples for ECB and Fed interventions respectively), any action on specific

currency only partially affects the returns of those institutions. Interestingly, the sign of the coefficients observed in the fourth period turns to positive confirming the negative impact both on the (re)insurers and on the other companies of the sample. Even when the expansionary monetary interventions by ECB lead to a decrease in the interest rates observed in the announcement days, these movements are reflected by negative returns on the market. This finding is in line with the evidences obtained by the event study.

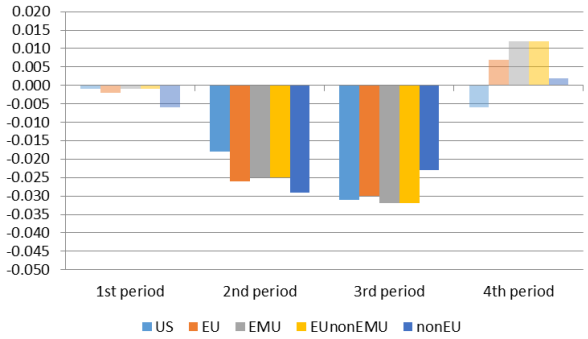
The actions taken by Fed and ECB do not produce the same effects on the markets. According to our evidences, the Fed interventions' impacts, despite the higher magnitude of the (positive) coefficients of the monetary policy surprise both on (re)insurers (1.830) and non-insurers (1.406), appear limited to the US market and focused on the first time-window. These considerations can be extended to both (re)insurers and other listed companies but with some distinctions (Figure A1.2).

Figure A1.2: ECB coefficient over time – Full sample

a) (re)insurers



b) other listed companies



Note: These figures graphically represent the coefficient of the monetary policy surprise explanatory variables as described in equation (5) and reported in Appendix A). Transparent bars represent non-significant coefficients (T-statistics > 10% level).

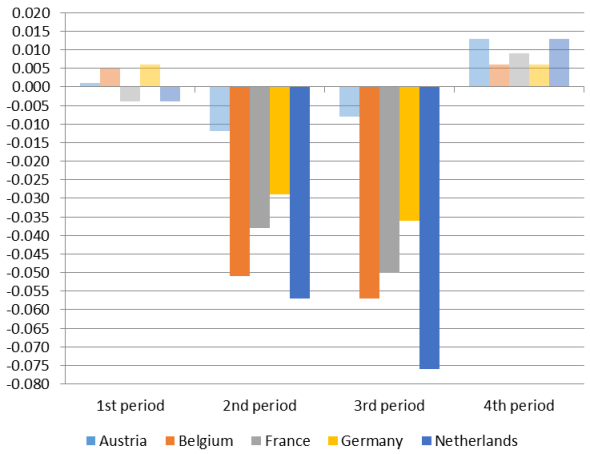
Despite ECB coefficients maintaining the same sign, (re)insurers are more affected by the monetary policy actions than other listed companies. According to our analysis, the expansionary monetary policy interventions, independently by the impact on the interest rates in the day of the announcement (positive in period 2 and 3, negative in 1 and 4), negatively affect the market return of (re)insurers. The long term structure of the liabilities and the asset-liability mismatch characterize the insurance industry, therefore the market does not welcome any intervention aimed at reducing the term structure of the risk free rate independently by the immediate effects they can have. Hence, all over the period of observation of our analysis, the negative effects that originate from the potentially harmful consequences of a long period of negative

interest rate on insurers (low profitability, contraction of the solvency margin, potential reinvestment risk) seem to prevail.

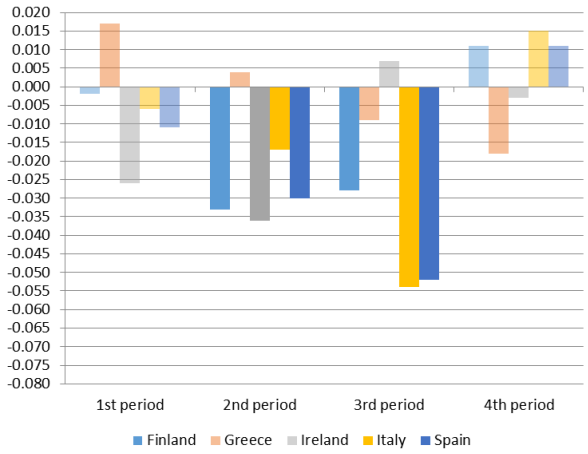
The local perspective confirms the general outcomes (Figure A1.3). The most significant results are provided by period number two and three. Belgium, Germany, Finland, show very close coefficients between the second and third period, around -0.03. Spain, Italy, France and Netherlands experience an increase in the magnitude of the coefficient from the second to the third period. This can be due to the less stable inner financial situation of these countries, which have likely benefit of many easing efforts from the ECB. Ireland shows impact only in the second period, while Greece shows no impact at all. This is coherent with the period of severe stress shown by the Greek market in several periods of the recent years, with more than one default and several doubts about Greece's Euro-reversibility. The comparison among industries does not report homogeneous indications. In fact, countries like Belgium, France, Italy, Germany and Spain show a lover impact on (re)insurers than on non-insurers and countries like Austria, Finland and Denmark behave oppositely. At this stage we are not able to provide a meaningful explanation to the different reactions.

Figure A1.3: ECB intervention monetary policy surprise: country based impact on (re)insurers

a) core euro area



b) peripheral euro area



Note: These figures graphically represent the coefficient of the monetary policy surprise explanatory variables as described in equation (5) and reported in Appendix A). Transparent bars represent non-significant coefficients (T-statistics > 10% level).

In the replication of the Pericoli and Veronese approach, our findings substantially depart form their results on the market returns, in particular when referring to the impacts on the stock market indexes of Germany, France, Italy, the US, and the UK. Specifically, Pericoli and Veronese obtain positive statistically significant coefficients

associated to the ECB monetary policy surprise in their first two periods of observation and negative non-significant coefficient in the third period. Even if the time-windows we defined do not perfectly match the ones used by Pericoli and Veronese we can by large state that our empirical evidences point in the opposite direction with negative significant coefficient in the central periods and positive coefficient in period 1 and 4.

Concluding about (re)insurances, we recognize that, by a global perspective, all companies in the Eurozone seem to move in the same direction of markets. Differences in magnitude of impacts are pretty thin. It is not easy to say to which extent these differences are due to actual consideration made on insurance fundamentals or simply to a more pronounced portfolio effect driven by the positive spillovers that QE and very accommodating financing conditions should have on financial companies such as banks and insurance companies. For the moment, the effects produced by the monetary policy intervention, independently by their immediate effect on the interest rates seems to negatively affect (re)insurers.

Conclusion and way forward

In this paper we investigate the impact of conventional and unconventional monetary policies on the insurance industry by looking at the impact of the actions taken by the ECB on the market returns of (re)insurers.

We investigate it via a twofold approach. At first we run an event study on the announcement date of the last ECB Quantitative Easing program. We scrutinize the cumulative abnormal return of a sample of 166 (re)insurers split into different subsamples according to size and geographical criteria comparing it with the behaviour of the other market participants. Subsequently, with the aim of understanding the impact of the general enforced monetary policy strategy and not of a single event, we enlarge the scope of our analysis by investigating the effects on the markets in general and on insurers in particular, of a series of announcements made by the ECB and the Fed. To do so we replicate the approach proposed by Rogers, Scotti, and Wright (2014) and Pericoli and Veronese (2016) analysing how and to what extent the Central Banks' announcements are signalled by the markets via changes in the term structure of the risk free rate.

The event study suggests a moderate negative effect of the QE on the insurance industry. The different specifications we tested show how the outcomes of the event study are strongly dependent to the observation periods. Furthermore, we do not obtain statistically significant results for the subsamples.

By applying the monetary policy surprise based model, we document i) how the effect of monetary policy interventions on interest rates in the announcement days changes over time and ii) the subsequent impact of the expansionary monetary policy interventions on the market in general and on the insurance industry in particular. For the two periods from 2008 till 2013 we find that when the monetary policy announcement generates an immediate reduction in the interest rates, the stock market returns increases and the effect on the insurance industry is even stronger and positive. One potential explanation of this result could be that the asset/liability structure of the insurance companies, serves as justification for the slight larger impact of the expansionary monetary policy actions on the (re)insurers. However, in the fourth period, when ECB started the QE program, the impact of monetary policy announcements on stock returns is not statistically significant.

The two applied models return consistent results. Nevertheless this work shows how a single intervention extrapolated from the comprehensive strategy should be utilized with caution to estimate the effect of the monetary policy intervention on the market.

We run our analysis without taking into account the characteristics of the (re)insurers, therefore we plan to complement this paper with additional researches aimed at understanding if and to what extent the fundamentals of an insurer, namely the composition of the assets and liability side, are significant determinants for the reaction to monetary policy. Additional effort shall be devoted to understand the behaviour of statistically non-significant companies: what are the rationales that detach these companies from the general reaction of the market to the monetary policy actions? Additionally, we do not provide a clear-cut explanation to the documented scarce effectiveness of the ECB intervention in the last period of observation: does it come from the negative interest rate environment or from the prolonged application of these interventions over time?

We believe that this work provides an initial valuable contribution to the literature on the analyses of the monetary policy enriching it with a specific focus on the insurance industry. Also, the evidence we provide can be of interest for policymakers offering them a wider perspective on the impacts that monetary policy actions have on a specific sector.

References

Albizzati, M.-O. and Geman, H. (1994) Interest rate risk management and valuation of the surrender option in life insurance policies. Journal of Risk and Insurance, 61(2):616–637

Bacchiocchi, E. (2010) Identification through heteroskedasticity: A likelihood-based approach. Working Paper

Banerjee, R., Latto, D. and McLaren, N. (2014) Using changes in auction maturity sectors to help identify the impact of QE on gilt yields. Economic Journal, (124):453-479

Berdin, E. and Gründl, H. (2015) The effect of a low interest rate environment on life insurers. The Geneva Papers on Risk and Insurance-Issues and Practice 40 (3), 385-415

Bernanke, B. S. and Kuttner, K. (2005) What explains the stock market's reaction to federal reserve policy? The journal of Finance, (60):1221-1257

Bernanke, B. S. and Mihov, I. (1998) Measuring monetary policy. Quarterly Journal of Economics, (113), 869-902

Briciu, L. and Lisi, G. (2015) An event study analysis of ECB balance sheet policies since October 2008. European Union Economic Brief, (1)

Chen, H., Curdina, V. and Ferrero, A. (2012) The macroeconomic effect of large-scale asset purchase programmes. Economic Journal, (122):289-315

Chung, H., Laforte, J., Reifschneider, D. and Williams, J. (2010) Have we underestimated the likelihood and severity of zero lower bound events? Journal of Money, Credit and Banking, (44):47-82

Cook, T. and Hahn, T. (1989) The effect of changes in the federal funds rate target on market interest rates in the 1970s. Journal of Monetary Economics, (24):331-351

D'Amico, S., English, W., Lopez-Salido, D. and Nelson, E. (2012) The federal reserve's large-scale asset purchase programmes: Rationales and effects. Economic Journal, F (122):415-446

Deutsche Bundesbank (2013). Financial stability review 2013. Technical report, Deutsche Bundesbank

ECB (2015) Press Release: ECB announces expanded asset purchase programme. Available at: http://www.ecb.europa.eu/press/pr/date/2015/html/pr150122_1.en.html

Ehrmann, M., Fratzscher, M., Guerkanyak, R. and Swanson, E.T. (2011) Convergence and anchoring of yield curves in the euro area. Review of Economics and Statistics, (93):350- 364

EIOPA (2013) Financial stability report, second half year report 2013. Available at: https://eiopa.europa.eu/Pages/Financial-stability-and-crisis-prevention/Financial-Stability-Reports.aspx

EIOPA (2014) Financial stability report, second half year report 2014. Available at: https://eiopa.europa.eu/Pages/Financial-stability-and-crisis-prevention/Financial-Stability-Reports.aspx

EIOPA (2015) Financial stability report, second half year report 2014. Available at: https://eiopa.europa.eu/Pages/Financial-stability-and-crisis-prevention/Financial-Stability-Reports.aspx

ESRB (2015) Report on systemic risks in the EU insurance sector. Available at: https://www.esrb.europa.eu/pub/pdf/other/2015-12-16-esrb_report_systemic_risks_EU_insurance_sector.en.pdf?d171a63f6e1d433f82e477d67416fbd5

Fratzscher, M., Lo Duca, M. and Straub, R. (2013) On the international spillovers of US quantitative easing. ECB working paper 1557

Fratzscher, M., Lo Duca, M. and Straub, R. (2014) ECB unconventional monetary policy actions: Market impact, international spillovers and transmission channels: IMF Working Paper

Gambacorta, L., Hofmann, B. and Peersman, G. (2014) The effectiveness of unconventional monetary policy at the zero lower bound: A cross-country analysis. Journal of Money, Credit and Banking, (46):615-642

Gatzert, N. (2008) Asset management and surplus distribution strategies in life insurance: An examination with respect to risk pricing and risk measurement. Insurance: Mathematics and Economics, 42(2):839–849.

Grosen, A. and Løchte Jørgensen, P. (2000) Fair valuation of life insurance liabilities: the impact of interest rate guarantees, surrender options, and bonus policies. Insurance: Mathematics and Economics, 26(1):37–57

Holsboer, J. H. (2000) The impact of low interest rates on insurers. Geneva Papers on Risk and Insurance- Issues and Practice, 25(1):38–58.

IAIS (2016) Global Systemically Important Insurers: Updated Assessment Methodology. Available at: http://www.iaisweb.org/page/supervisory-material/financial-stability-and-macroprudential-policy-and-surveillance//file/61179/updated-g-sii-assessment-methodology-16-june-2016

Jarrow, R.A., Li, H. (2012) The Impact of Quantitative Easing on the U.S. Term Structure of Interest Rates. Johnson School Research Paper No. 2-2012

Joyce, M., Lasosa, A., Stevens, I. and Tong, M. (2011) The financial market impact of quantitative easing in the United Kingdom. International Journal of Central Banking, 7:113-161

Kapetanios, G., Haroon, I.S.M. and Theodoridis, K. (2012) Assessing the economy-wide effects of quantitative easing. Economic Journal, (122):316-347

Kapetanios, G., Mumtaz, H, Stevens, I., Theodoridis, K. (2012) Assessing the Economy-Wide Effects of Quantitative Easing. Bank of England Working Paper No. 443.

King, R. G., Plosser, C., Stock, J. and Watson, M. (1991) Stochastic trends and economic fluctuations. American Economic Review, (81):819-840

Kling, A., Richter, A., and Ruß, J. (2007a) The impact of surplus distribution on the risk exposure of with profit life insurance policies including interest rate guarantees. Journal of Risk and Insurance, 74(3):571–589.

Kling, A., Richter, A., and Ruß, J. (2007b) The interaction of guarantees, surplus distribution, and asset allocation in with-profit life insurance policies. Insurance: Mathematics and Economics, 40(1):164–178.

Krishnamurthy, A., Vissing-Jorgensen, A (2011) The effects of quantitative easing on long-term interest rates. Brookings Papers on Economic Activity, 2:215-265

Krishnamurthy, A., Vissing-Jorgensen, A (2011) The Effects of Quantitative Easing on Interest Rates: Channels and Implications for Policy. NBER Working Paper No. 17555

Lewbel, A. (2008) Using heteroskedasticity to identify and estimate mismeasured and endogenous regressor models. MiMeO

Li, C. and Wei, M. (2013) Term structure modelling with-supply factors and the Federal Reserve's large-scale asset purchase programs. International Journal of Central Banking, (9):3-39

Luetkepohl, H. and Netsunajev, A. (2012) Disentangling demand and supply shocks in the crude oil market: How to check sign restrictions in structural vars. Discussion Paper 1195, Deutsches Institut fuer Wirtschaftsforschung

Mamaysky, Harry, The Time Horizon of Price Responses to Quantitative Easing (January 15, 2014). Available at SSRN: http://ssrn.com/abstract=2278567

Pericoli, M. and Veronese, G. (2016) Monetary policy surprises and channels of transmission. Working Paper - Banca d'Italia

Rogers, J. H., Scotti, C. and Wright, J. H. (2014) Evaluating asset-market effects of unconventional monetary policy: A cross-country comparison. International Finance Discussion Papers, 1101

Schmeiser, H. and Wagner, J. (2012) The influence of interest rate guarantees and solvency requirements on the asset allocation of life insurers. Working Papers on Risk Management and Insurance No. 111

Swanson, E. T. (2011) Let's twist again: A high-frequency event-study analysis of operation twist and its implications for QE2. Brookings Papers on Economic Activity, 1:151-188

Swiss Re (2012). Facing the interest rate challenge. Sigma Series, 2012(4):1–44

Wedow, M. and Kablau, A. (2011) Gauging the impact of a low-interest rate environment on German life insurers. Deutsche Bundesbank Discussion Papers No. 02/2011

Xuetao, S (2014) QE and Unemployment: A Financial Friction DSGE Model with LSAPs and Labor Market Search. Available at SSRN: http://ssrn.com/abstract=2420985

Appendix A

ECB Monetary Policy Days (Detailed - from 08.2008 onwards)

Date	Event
2-Aug-07	GC meeting
09. Aug 07	Special fine tuning operations
22-Aug-07	Supplementary LTRO (announcement)
23-Aug-07	Supplementary LTRO (allotment)
6-Sep-07	GC meeting
4-Oct-07	GC meeting
8-Nov-07	GC meeting
6-Dec-07	GC meeting
10-Jan-08	GC meeting
7-Feb-08	GC meeting
6-Mar-08	GC meeting
28-Mar-08	introduce 6-m LTROs
10-Apr-08	GC meeting
8-May-08	GC meeting
5-Jun-08	GC meeting
3-Jul-08	GC meeting, MRO increased to 4.25%
7-Aug-08	GC meeting
4-Sep-08	GC meeting
8-Oct-08	GC meeting, MRO decreased to 3.75%, , Fixed-rate full allotment (FRFA) on MRO
6-Nov-08	GC meeting, MRO decreased to 3.25%
4-Dec-08	GC meeting, MRO decreased to 2.50%
15-Jan-09	GC meeting, MRO decreased to 2.00%
5-Feb-09	GC meeting
5-Mar-09	GC meeting, MRO decreased to 1.50%
2-Apr-09	GC meeting, MRO decreased to 1.25%
7-May-09	GC meeting, MRO decreased to 1.00%, 3year LTROs, CBPP
4-Jun-09	GC meeting, CBPP details announced
2-Jul-09	GC meeting
6-Aug-09	GC meeting
3-Sep-09	GC meeting
8-Oct-09	GC meeting
5-Nov-09	GC meeting
3-Dec-09	GC meeting, Phasing out of 6m LTROs, indexation of 1y LTROs
14-Jan-10	GC meeting
4-Feb-10	GC meeting
4-Mar-10	GC meeting, Phasing out of 3m LTROs, indexation of 6m LTROs
8-Apr-10	GC meeting
6-May-10	GC meeting
9-May-10	GC meeting, Securities Market Programme (SMP)
10-Jun-10	GC meeting
8-Jul-10	GC meeting
28-Jul-10	Collateral rules tightened, revised haircuts
5-Aug-10	GC meeting
2-Sep-10	GC meeting
7-Oct-10	GC meeting
4-Nov-10	GC meeting
2-Dec-10	GC meeting
13-Jan-11	GC meeting
3-Feb-11	GC meeting
3-Mar-11	GC meeting, FRFA extended to July 2011
7-Apr-11	GC meeting, MRO increased to 1.25%
5-May-11	GC meeting
9-Jun-11	GC meeting
7-Jul-11	GC meeting, MRO increased to 1.50%
4-Aug-11	GC meeting, SMP covers Spain and Italy
7-Aug-11	SMP on Italy and Spain acknowledged by ECB
8-Sep-11	GC meeting
6-Oct-11	GC meeting, CBPP2 launched
3-Nov-11	GC meeting, MRO decreased to 1.25%
8-Dec-11	GC meeting, Two 3-year LTROs, reserve ratio to 1%, MRO rate decreased to 1%
21-Dec-11	Results of first 3-year LTRO
12-Jan-12	GC meeting
9-Feb-12	GC meeting, ECB approved criteria for credit claims for 7 NCBs
28-Feb-12	Results of second 3-year LTRO
8-Mar-12	GC meeting
4-Apr-12	GC meeting
3-May-12	GC meeting
6-Jun-12	GC meeting
5-Jul-12	GC meeting, MRO rate decreased to 0.75%, deposit facility rate to 0
26-Jul-12	"Whatever it takes" London speech
2-Aug-12	GC meeting, OMT
6-Sep-12	GC meeting, OMT details
4-Oct-12	GC meeting
8-Nov-12	GC meeting
6-Dec-12	GC meeting
10-Jan-13	GC meeting
7-Feb-13	GC meeting
7-Mar-13	GC meeting
22-Mar-13	Collateral rule changes for some uncovered gov-guaranteed bank bonds
4-Apr-13	GC meeting
2-May-13	GC meeting, MRO rate decreased to 0.5%, FRFA extended to July 2014
6-Jun-13	GC meeting
4-Jul-13	GC meeting, forward guidance: 'expects the key ECB interest rates to remain at present or lower levels for an extended period of time'
1-Aug-13	GC meeting
5-Sep-13	GC meeting
2-Oct-13	GC meeting
7-Nov-13	GC meeting, MRO rate decreased to 0.25%
5-Dec-13	GC meeting
9-Jan-14	GC meeting
6-Feb-14	GC meeting
6-Mar-14	GC meeting
25-Mar-14	QE announcement Draghi (Science Po - Paris): A consistent strategy for a sustained recovery
3-Apr-14	GC meeting
24-Apr-14	QE announcement Draghi (NDL Conf - Amsterdam): Monetary policy communication in turbulent times
8-May-14	GC meeting
5-Jun-14	GC meeting, MRO rate decreased to 0.15%, announcement of TLTROs
3-Jul-14	GC meeting, details of TLTROs
7-Aug-14	GC meeting
4-Sep-14	GC meeting, MRO rate decreased to 0.05%, announcement of CCBP3 & ABSPP
2-Oct-14	GC meeting, details of ABSPP CBPP3
6-Nov-14	GC meeting
4-Dec-14	GC meeting, introduction of the QE-PSPP - Draghi: 'More stimulus is likely on the way, but the final decision won't be taken until early next year'
22-Jan-15	GC meeting, announcement of PSPP
9-Mar-15	start of the PSPP purchases
5-Mar-15	GC meeting
15-Apr-15	GC meeting
3-Jun-15	GC meeting
16-Jul-15	GC meeting
3-Sep-15	GC meeting, possible extension of QE program (Draghi)
22-Oct-15	GC meeting
03-Nov-15	Draghi: willing and able to act by using all instruments within its mandate

ECB Monetary Policy Days (Synntetic - from 01.1999 to 07.2007)

Date	Event
14-Jan-99	GC meeting
04-Feb-99	GC meeting
04-Mar-99	GC meeting
08-Apr-99	GC meeting
06-May-99	GC meeting
02-Jun-99	GC meeting
01-Jul-99	GC meeting
29-Jul-99	GC meeting
09-Sep-99	GC meeting
07-Oct-99	GC meeting
04-Nov-99	GC meeting
02-Dec-99	GC meeting
05-Jan-00	GC meeting
03-Feb-00	GC meeting
02-Mar-00	GC meeting
30-Mar-00	GC meeting
05-May-00	GC meeting
08-Jun-00	GC meeting
06-Jul-00	GC meeting
03-Aug-00	GC meeting
31-Aug-00	GC meeting
05-Oct-00	GC meeting
02-Nov-00	GC meeting
30-Nov-00	GC meeting
04-Jan-01	GC meeting
01-Feb-01	GC meeting
01-Mar-01	GC meeting
11-Apr-01	GC meeting
10-May-01	GC meeting
07-Jun-01	GC meeting
05-Jul-01	GC meeting
02-Aug-01	GC meeting
30-Aug-01	GC meeting
11-Oct-01	GC meeting
08-Nov-01	GC meeting
06-Dec-01	GC meeting
03-Jan-02	GC meeting
07-Feb-02	GC meeting
07-Mar-02	GC meeting
04-Apr-02	GC meeting
02-May-02	GC meeting
06-Jun-02	GC meeting
04-Jul-02	GC meeting
01-Aug-02	GC meeting
12-Sep-02	GC meeting
10-Oct-02	GC meeting
07-Nov-02	GC meeting
05-Dec-02	GC meeting
09-Jan-03	GC meeting
06-Feb-03	GC meeting
06-Mar-03	GC meeting
03-Apr-03	GC meeting
08-May-03	GC meeting
05-Jun-03	GC meeting
10-Jul-03	GC meeting
31-Jul-03	GC meeting
04-Sep-03	GC meeting
02-Oct-03	GC meeting
06-Nov-03	GC meeting
04-Dec-03	GC meeting
08-Jan-04	GC meeting
05-Feb-04	GC meeting
04-Mar-04	GC meeting
01-Apr-04	GC meeting
06-May-04	GC meeting
03-Jun-04	GC meeting
01-Jul-04	GC meeting
05-Aug-04	GC meeting
02-Sep-04	GC meeting
07-Oct-04	GC meeting
04-Nov-04	GC meeting
02-Dec-04	GC meeting
13-Jan-05	GC meeting
03-Feb-05	GC meeting
03-Mar-05	GC meeting
07-Apr-05	GC meeting
05-May-05	GC meeting
02-Jun-05	GC meeting
07-Jul-05	GC meeting
04-Aug-05	GC meeting
01-Sep-05	GC meeting
06-Oct-05	GC meeting
03-Nov-05	GC meeting
01-Dec-05	GC meeting
12-Jan-06	GC meeting
02-Feb-06	GC meeting
02-Mar-06	GC meeting
06-Apr-06	GC meeting
04-May-06	GC meeting
08-Jun-06	GC meeting
06-Jul-06	GC meeting
03-Aug-06	GC meeting
31-Aug-06	GC meeting
05-Oct-06	GC meeting
02-Nov-06	GC meeting
07-Dec-06	GC meeting
11-Jan-07	GC meeting
08-Feb-07	GC meeting
08-Mar-07	GC meeting
12-Apr-07	GC meeting
10-May-07	GC meeting
06-Jun-07	GC meeting
05-Jul-07	GC meeting

Fed Monetary Policy Days (Detailed - from 10.2008 onwards)

Date	Event	Date	Event
8-Oct-08	Joint Statement by Central Banks, FOMC decrease fed funds rate by 0.5% pp to 1.50%	25-Apr-12	FOMC meeting
29-Oct-08	FOMC meeting	20-Jun-12	FOMC meeting
25-Nov-08	Fed announces results of auction of $150 billion in 13-day credit	1-Aug-12	FOMC meeting
1-Dec-08	Federal Reserve announces results of auction of $150 billion in 84-day credit	31-Aug-12	Ben Bernanke Jackson Hole speech
16-Dec-08	FOMC meeting	13-Sep-12	FOMC meeting
28-Jan-09	FOMC meeting	24-Oct-12	FOMC meeting
18-Mar-09	FOMC meeting	12-Dec-12	FOMC meeting
29-Apr-09	FOMC meeting	30-Jan-13	FOMC meeting
24-Jun-09	FOMC meeting	20-Mar-13	FOMC meeting - Bernanke warns of 'premature tightening' in monetary policy (taper tantrum)
12-Aug-09	FOMC meeting	1-May-13	FOMC meeting
23-Sep-09	FOMC meeting	22-May-13	Bernanke warns of 'premature tightening' in monetary policy (taper tantrum)
4-Nov-09	FOMC meeting	19-Jun-13	FOMC meeting - Bernanke warns of taper tantrum again
16-Dec-09	FOMC meeting	31-Jul-13	FOMC meeting
27-Jan-10	FOMC meeting	18-Sep-13	FOMC meeting
16-Mar-10	FOMC meeting	16-Oct-13	unscheduled FOMC meeting
28-Apr-10	FOMC meeting	30-Oct-13	FOMC meeting
9-May-10	unscheduled FOMC meeting	18-Dec-13	FOMC meeting
23-Jun-10	FOMC meeting	29-Jan-14	FOMC meeting
10-Aug-10	FOMC meeting	4-Mar-14	unscheduled FOMC meeting
27-Aug-10	Ben Bernanke Jackson Hole speech	19-Mar-14	FOMC meeting
21-Sep-10	FOMC meeting	30-Apr-14	FOMC meeting
15-Oct-10	unscheduled FOMC meeting	18-Jun-14	FOMC meeting
3-Nov-10	FOMC meeting	15-Jul-14	Semiannual Monetary Policy Report to the Congress
14-Dec-10	FOMC meeting	30-Jul-14	FOMC meeting
26-Jan-11	FOMC meeting	22-Aug-14	Janet Yellen Jackson Hole speech
15-Mar-11	FOMC meeting	17-Sep-14	FOMC meeting
27-Apr-11	FOMC meeting	29-Oct-14	FOMC meeting
22-Jun-11	FOMC meeting	17-Dec-14	FOMC meeting
1-Aug-11	unscheduled FOMC meeting	28-Jan-15	FOMC meeting
9-Aug-11	FOMC meeting	24-Feb-15	Semiannual Monetary Policy Report to the Congress
26-Aug-11	Ben Bernanke Jackson Hole speech	18-Mar-15	FOMC meeting
21-Sep-11	FOMC meeting	29-Apr-15	FOMC meeting
2-Nov-11	FOMC meeting	17-Jun-15	FOMC meeting
28-Nov-11	unscheduled FOMC meeting	29-Jul-15	FOMC meeting
13-Dec-11	FOMC meeting	17-Sep-15	FOMC meeting
25-Jan-12	FOMC meeting	28-Oct-15	FOMC meeting
13-Mar-12	FOMC meeting	16-Dec-15	FOMC meeting

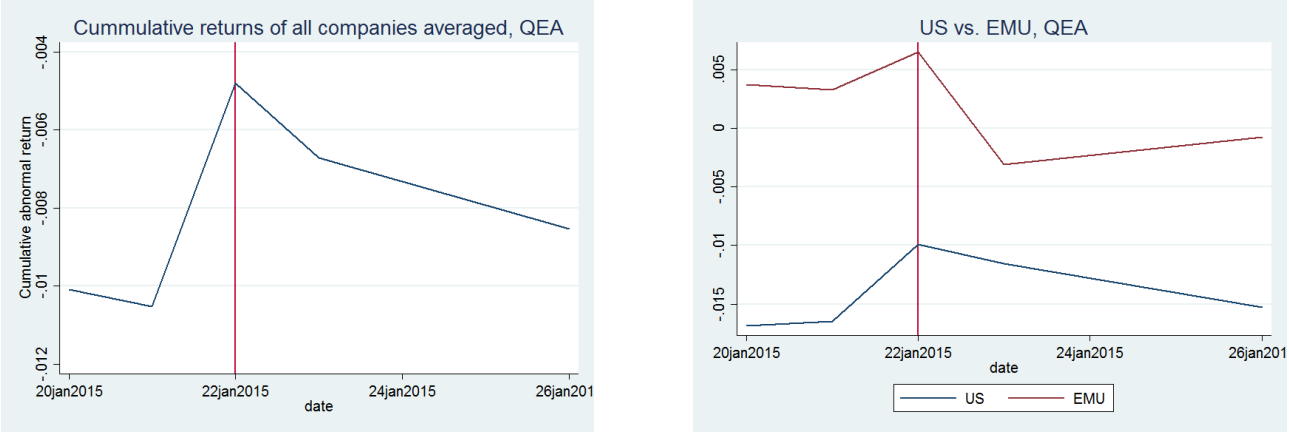
Fed Monetary Policy Days (Synntetic - from 05.1999 to 10.2008)

Date	Event	Date	Event
30-Mar-99	FOMC meeting	28-Jan-04	FOMC meeting
18-May-99	FOMC meeting	11-Feb-04	FOMC meeting
30-Jun-99	FOMC meeting	16-Mar-04	FOMC meeting
22-Jul-99	FOMC meeting	04-May-04	FOMC meeting
24-Aug-99	FOMC meeting	30-Jun-04	FOMC meeting
05-Oct-99	FOMC meeting	20-Jul-04	FOMC meeting
16-Nov-99	FOMC meeting	10-Aug-04	FOMC meeting
21-Dec-99	FOMC meeting	21-Sep-04	FOMC meeting
02-Feb-00	FOMC meeting	10-Nov-04	FOMC meeting
17-Feb-00	FOMC meeting	14-Dec-04	FOMC meeting
21-Mar-00	FOMC meeting	02-Feb-05	FOMC meeting
16-May-00	FOMC meeting	16-Feb-05	FOMC meeting
28-Jun-00	FOMC meeting	22-Mar-05	FOMC meeting
20-Jul-00	FOMC meeting	03-May-05	FOMC meeting
22-Aug-00	FOMC meeting	30-Jun-05	FOMC meeting
03-Oct-00	FOMC meeting	20-Jul-05	FOMC meeting
15-Nov-00	FOMC meeting	09-Aug-05	FOMC meeting
19-Dec-00	FOMC meeting	20-Sep-05	FOMC meeting
03-Jan-01	FOMC meeting	01-Nov-05	FOMC meeting
31-Jan-01	FOMC meeting	13-Dec-05	FOMC meeting
13-Feb-01	FOMC meeting	31-Jan-06	FOMC meeting
20-Mar-01	FOMC meeting	15-Feb-06	FOMC meeting
11-Apr-01	FOMC meeting	28-Mar-06	FOMC meeting
18-Apr-01	FOMC meeting	10-May-06	FOMC meeting
15-May-01	FOMC meeting	29-Jun-06	FOMC meeting
27-Jun-01	FOMC meeting	19-Jul-06	FOMC meeting
18-Jul-01	FOMC meeting	08-Aug-06	FOMC meeting
21-Aug-01	FOMC meeting	20-Sep-06	FOMC meeting
13-Sep-01	FOMC meeting	25-Oct-06	FOMC meeting
17-Sep-01	FOMC meeting	12-Dec-06	FOMC meeting
02-Oct-01	FOMC meeting	31-Jan-07	FOMC meeting
06-Nov-01	FOMC meeting	14-Feb-07	FOMC meeting
11-Dec-01	FOMC meeting	21-Mar-07	FOMC meeting
30-Jan-02	FOMC meeting	09-May-07	FOMC meeting
27-Feb-02	FOMC meeting	28-Jun-07	FOMC meeting
19-Mar-02	FOMC meeting	18-Jul-07	FOMC meeting
07-May-02	FOMC meeting	07-Aug-07	FOMC meeting
26-Jun-02	FOMC meeting	10-Aug-07	FOMC meeting
16-Jul-02	FOMC meeting	16-Aug-07	FOMC meeting
13-Aug-02	FOMC meeting	18-Sep-07	FOMC meeting
24-Sep-02	FOMC meeting	31-Oct-07	FOMC meeting
06-Nov-02	FOMC meeting	06-Dec-07	FOMC meeting
10-Dec-02	FOMC meeting	11-Dec-07	FOMC meeting
29-Jan-03	FOMC meeting	09-Jan-08	FOMC meeting
11-Feb-03	FOMC meeting	21-Jan-08	FOMC meeting
18-Mar-03	FOMC meeting	30-Jan-08	FOMC meeting
25-Mar-03	FOMC meeting	27-Feb-08	FOMC meeting
01-Apr-03	FOMC meeting	10-Mar-08	FOMC meeting
08-Apr-03	FOMC meeting	18-Mar-08	FOMC meeting
16-Apr-03	FOMC meeting	30-Apr-08	FOMC meeting
06-May-03	FOMC meeting	25-Jun-08	FOMC meeting
25-Jun-03	FOMC meeting	15-Jul-08	FOMC meeting
15-Jul-03	FOMC meeting	24-Jul-08	FOMC meeting
12-Aug-03	FOMC meeting	05-Aug-08	FOMC meeting
15-Sep-03	FOMC meeting	16-Sep-08	FOMC meeting
16-Sep-03	FOMC meeting	29-Sep-08	FOMC meeting
28-Oct-03	FOMC meeting	07-Oct-08	FOMC meeting
09-Dec-03	FOMC meeting		

Appendix B

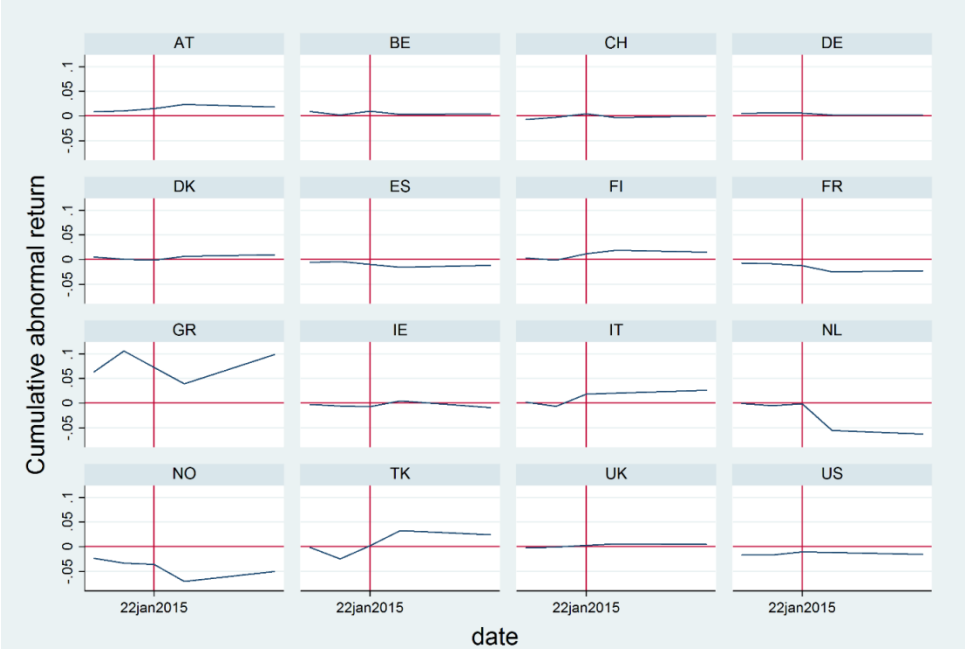
Figure A1.4: The impact of the announcement of Quantitative Easing on the insurance sector

(a) *(b)*



Note: The averaged cumulative abnormal return is plotted against time. The red vertical on 22/01/2015 indicates the event, i.e. the announcement of Quantitative Easing by the European Central Bank. It was averaged for firms based in the US and in the European Monetary Union (EMU).

Figure A1.5: The impact of the announcement of Quantitative Easing on the insurance sector - EU Country level breakdown



Note: The cumulative abnormal return is plotted against time. It was averaged for each country. The red vertical on 22/01/2015 indicates the event, i.e. the announcement of Quantitative Easing by the European Central Bank.

Impact of monetary policy surprise

		1st period						2nd period						3rd period						4th period					
		FED	sig	R^2	ECB	sig	R^2	FED	sig	R^2	ECB	sig	R^2	FED	sig	R^2	ECB	sig	R^2	FED	sig	R^2	ECB	sig	R^2
ALL	Insurances	**0.012**	*	0.202	-0.001	-	0.141	0.007	-	0.130	**-0.032**	***	0.508	0.016	-	0.049	**-0.034**	***	0.535	0.003	-	0.086	-0.002	-	0.071
	No Insurances	0.010	-	0.118	-0.001	-	0.199	-0.001	-	0.204	**-0.022**	***	0.511	0.014	-	0.079	**-0.030**	***	0.518	0.005	-	0.131	-0.001	-	0.056
EU	Insurances	0.006	-	0.060	-0.004	-	0.167	-0.005	-	0.058	**-0.031**	**	0.380	0.009	-	0.011	**-0.040**	***	0.489	0.011	-	0.155	0.004	-	0.113
	No Insurances	0.005	-	0.053	-0.002	-	0.166	-0.002	-	0.115	**-0.026**	**	0.524	0.006	-	0.019	**-0.030**	***	0.488	0.004	-	0.117	0.007	-	0.142
EMU	Insurances	0.006	-	0.042	-0.001	-	0.153	-0.003	-	0.062	**-0.031**	**	0.384	0.011	-	0.014	**-0.042**	***	0.463	0.007	-	0.119	0.008	-	0.102
	No Insurances	0.008	-	0.056	-0.001	-	0.190	0.001	-	0.153	**-0.025**	**	0.476	0.008	-	0.022	**-0.032**	***	0.439	0.004	-	0.165	0.012	-	0.124
EUnonEMU	Insurances	0.006	-	0.079	-0.009	-	0.190	-0.004	-	0.116	**-0.019**	**	0.279	0.000	-	0.024	**-0.009**	*	0.076	0.005	-	0.125	0.004	-	0.041
	No Insurances	0.008	-	0.056	-0.001	-	0.190	0.001	-	0.153	**-0.025**	**	0.476	0.008	-	0.022	**-0.032**	***	0.439	0.004	-	0.165	0.012	-	0.124
US	Insurances	**1.830**	**	0.260	0.001	-	0.069	1.574	-	0.144	**-0.033**	***	0.499	3.049	-	0.095	**-0.036**	***	0.521	-0.219	-	0.077	-0.007	-	0.052
	No Insurances	**1.406**	**	0.168	-0.001	-	0.091	-0.100	-	0.191	**-0.018**	***	0.386	2.001	-	0.099	**-0.031**	***	0.514	0.730	-	0.141	-0.006	-	0.046
Austria	Insurances	0.317	-	0.094	0.001	-	0.147	0.704	-	0.290	-0.012	-	0.247	2.458	-	0.113	-0.008	-	0.038	-0.087	-	0.310	0.013	-	0.041
	No Insurances	0.531	-	0.033	-0.002	-	0.166	0.871	-	0.141	**-0.036**	**	0.370	1.658	*	0.066	**-0.028**	***	0.269	-0.927	-	0.150	0.010	-	0.171
Belgium	Insurances	0.372	-	0.045	0.005	-	0.075	-2.468	-	0.128	**-0.051**	**	0.344	3.712	*	0.146	**-0.057**	***	0.323	1.969	-	0.055	0.006	-	0.106
	No Insurances	**0.842**	*	0.132	-0.011	-	0.096	0.301	-	0.118	**-0.025**	***	0.312	-0.117	-	0.022	**-0.022**	***	0.295	0.179	-	0.137	0.004	-	0.008
Denmark	Insurances	0.607	-	0.030	-0.011	-	0.196	-0.247	-	0.106	**-0.019**	**	0.260	-0.236	-	0.015	-0.009	-	0.058	0.574	-	0.153	0.003	-	0.050
	No Insurances	**1.494**	**	0.162	-0.003	-	0.112	-0.311	-	0.095	**-0.028**	***	0.498	1.175	*	0.118	**-0.016**	***	0.210	0.115	-	0.115	0.009	-	0.340
Finland	Insurances	0.927	-	0.043	-0.002	-	0.170	-0.338	-	0.120	**-0.033**	**	0.283	1.057	-	0.035	**-0.028**	***	0.268	0.610	-	0.023	0.011	-	0.143
	No Insurances	1.347	-	0.091	-0.004	-	0.126	0.248	-	0.123	-0.030	-	0.275	1.043	-	0.095	**-0.034**	***	0.396	1.178	-	0.169	0.005	-	0.074
France	Insurances	0.700	-	0.060	-0.004	-	0.115	-0.239	-	0.069	**-0.038**	*	0.418	0.789	-	0.015	**-0.050**	***	0.417	0.861	-	0.154	0.009	-	0.048
	No Insurances	0.055	-	0.036	0.000	-	0.113	0.189	-	0.062	**-0.023**	**	0.479	0.492	-	0.010	**-0.034**	***	0.429	0.205	-	0.086	0.006	-	0.047
Germany	Insurances	0.220	-	0.021	0.006	-	0.189	-0.131	-	0.038	**-0.029**	**	0.259	1.795	-	0.045	**-0.036**	***	0.406	0.190	-	0.081	0.006	-	0.111
	No Insurances	0.205	-	0.002	0.002	-	0.172	-0.365	-	0.442	**-0.021**	*	0.336	1.159	-	0.025	**-0.028**	***	0.353	-0.175	-	0.122	0.009	-	0.102
Greece	Insurances	0.166	-	0.137	0.017	-	0.109	-0.398	-	0.254	0.004	-	0.177	-3.752	-	0.061	-0.009	-	0.034	**4.231**	*	0.213	-0.018	-	0.129
	No Insurances	**1.770**	***	0.152	0.007	-	0.081	-0.386	-	0.074	-0.016	-	0.225	0.622	-	0.135	**-0.019**	***	0.084	-4.213	-	0.262	-0.008	-	0.084
Ireland	Insurances	-0.236	-	0.029	-0.026	-	0.104	**-3.083**	*	0.182	**-0.036**	***	0.305	-0.621	-	0.022	0.007	-	0.023	-1.928	-	0.164	-0.003	-	0.066
	No Insurances	0.965	-	0.132	-0.006	-	0.112	-1.763	-	0.160	**-0.032**	***	0.440	2.009	**	0.111	**-0.015**	***	0.137	0.891	-	0.263	0.008	-	0.052
Italy	Insurances	0.791	-	0.043	-0.006	-	0.123	-0.412	-	0.039	**-0.017**	*	0.355	0.529	-	0.017	**-0.054**	***	0.407	1.083	-	0.123	0.015	-	0.119
	No Insurances	0.637	-	0.054	0.003	-	0.184	0.614	-	0.051	**-0.027**	**	0.516	0.344	-	0.025	**-0.046**	***	0.497	0.476	-	0.112	0.020	-	0.186
Netherlands	Insurances	**2.115**	**	0.171	-0.004	-	0.115	0.379	-	0.169	**-0.057**	**	0.291	3.138	-	0.064	**-0.076**	***	0.411	1.657	-	0.191	0.013	-	0.173
	No Insurances	0.712	-	0.101	0.000	-	0.165	0.017	-	0.092	**-0.034**	***	0.605	0.050	-	0.014	**-0.023**	***	0.389	-0.037	-	0.054	0.005	-	0.086
Norway	Insurances	-0.462	-	0.051	0.001	-	0.166	1.217	-	0.399	**-0.039**	***	0.354	1.587	-	0.019	**-0.047**	***	0.388	0.314	-	0.121	-0.032	-	0.315
	No Insurances	-0.016	-	0.047	-0.001	-	0.150	-0.166	-	0.183	**-0.036**	**	0.443	0.812	-	0.039	**-0.026**	***	0.341	0.117	-	0.002	0.009	-	0.165
Spain	Insurances	0.251	-	0.013	-0.011	-	0.052	1.573	-	0.113	**-0.030**	**	0.398	0.042	-	0.003	**-0.052**	***	0.336	0.591	-	0.047	0.011	-	0.225
	No Insurances	0.833	-	0.112	-0.006	-	0.116	-0.003	-	0.057	**-0.023**	*	0.426	0.576	-	0.038	**-0.045**	***	0.397	0.535	-	0.156	0.010	-	0.089
Switzerland	Insurances	**1.697**	*	0.109	-0.001	-	0.108	1.068	-	0.121	**-0.043**	***	0.412	0.415	-	0.015	**-0.044**	***	0.492	0.558	-	0.129	-0.002	-	0.159
	No Insurances	-0.633	-	0.043	-0.004	-	0.158	0.114	-	0.127	**-0.024**	***	0.539	-0.658	-	0.029	**-0.021**	***	0.388	-0.243	-	0.113	0.000	-	0.053
Turkey	Insurances	0.393	-	0.017	-0.006	-	0.202	1.134	-	0.139	**-0.026**	**	0.312	1.471	-	0.046	**-0.016**	**	0.125	0.022	-	0.064	0.011	-	0.146
	No Insurances	0.272	-	0.079	-0.012	-	0.160	0.243	-	0.172	**-0.029**	***	0.273	1.825	-	0.089	**-0.023**	***	0.219	-1.430	-	0.115	0.000	-	0.015
UK	Insurances	0.190	-	0.092	-0.014	-	0.164	-1.298	-	0.059	**-0.038**	**	0.235	0.127	-	0.001	**-0.040**	***	0.437	1.951	-	0.183	-0.004	-	0.144
	No Insurances	-0.139	-	0.039	-0.002	-	0.147	-0.327	-	0.080	**-0.025**	**	0.540	0.176	-	0.010	**-0.030**	***	0.543	0.455	-	0.026	0.000	-	0.170

*The table reports the coefficients of equation 5. Significance of the parameter expressed via T-statistics *=10% level, **=5%level, ***2.5%level.*

Updating the Long Term Rate in Time: A Possible Approach

Petr Jakubik and Diana Zigraiova[44]

The content of this study does not reflect the official opinion of EIOPA. Responsibility for the information and the views expressed therein lies entirely with the authors.

Abstract

This study proposes the potential methodological approach to be utilized by regulators when setting up a Long-Term Rate (LTR) for the evaluation of insurers' liabilities beyond the last liquid point observable in the market. Our approach is based on the optimization of two contradictory aspects – stability and accuracy implied by economic fundamentals. We use U.S. Treasury term structure data over the period 1985-2015 to calibrate an algorithm that dynamically revises LTR based on the distance between the value implied by long-term growth of economic fundamentals in a given year and the regulatory value of LTR valid in a year prior. We employ both Nelson-Siegel and Svensson models to extrapolate yields over maturities of 21-30 years employing the selected value of the LTR and compare them to the observed yields using mean square error statistic. Furthermore, we optimise the parameter of the proposed LTR formula by minimising the defined loss function capturing both mentioned factors.

Keywords: Long term rate, Nelson-Siegel, Svensson, Term structure of interest rates, Extrapolation

JEL Codes: E43, G22, L51, M21

[44] Petr Jakubik: European Insurance and Occupational Pensions Authority (EIOPA) and the Institute of Economic Studies of Charles University, petr.jakubik@eiopa.europa.eu;
Diana Zigraiova: Czech National Bank and the Institute of Economic Studies of Charles University, diana.zigraiova@cnb.cz; diana.zigraiova@fsv.cuni.cz.

Introduction

The aim of this paper is to propose the methodological framework on updating the Long-Term Rate (LTR) based on the regulator's preference between stability and accuracy reflecting a theoretical value. By defining a quantitative definition on these two criteria, regulators would obtain a clear simple rule when updating the regulatory LTR value. As interest rates on investment instruments with very long maturities cannot be typically observed in the market, Long-Term Rate (LTR) is essential for valuation of long-term commitments of insurers.

The current low interest rate environment poses two types of risk for insurance companies (e.g. EIOPA Financial Stability Report, 2013). First, cashflow risks arise from a narrowing yield spread, as new premiums and returns on maturing investment are reinvested at lower yields relative to the yields that insurers have committed to pay. The available margin on this business is thus gradually eroded by a low yield environment if no action is taken to alter the underlying position. Second, valuation risks are linked to the calculation of present values of assets and liabilities of insurance companies. Under low interest rates, a decline in benchmark interest rates will be also reflected in the discount rate applied to liabilities. The fact that the duration of liabilities is typically greater than that of assets for life insurers in particular leads to the erosion of available net assets, because the present value of liabilities would increase more than that of assets. Consequently, insolvency risks of insurances are exacerbated.

At present, the LTR used for discounting insurers' long-term liabilities is not universal across countries. For instance, the European Insurance and Occupational Pensions Authority (EIOPA) recommends in its Technical Specification for the Preparatory Phase of Solvency II (2014) that the LTR (called UFR - ultimate forward rate) is set to 4.2 per cent until the end of 2016. In this specification, LTR is defined as a function of long-term expectations of the inflation rate, and of the long-term average of short-term real interest rates. Furthermore, variations in the recommended LTR are arranged for countries with different inflation expectations (EIOPA, March 2016). The LTR can either take the value of 3.2 per cent for currencies with low inflation expectations (Swiss Franc, Japanese Yen), or 4.2 per cent for EEA currencies and those non-EEA currencies that are not explicitly mentioned in any other category, or 5.2 per cent for Brazilian, Indian, Mexican, Turkish and South African currencies, for which inflation expectations are higher. In contrast, some national supervisors decided to implement their own LTR methodologies in the domestic financial markets. In this

spirit, the Swiss Financial Market Supervisory Authority (FINMA) implemented in July 2015 the LTR of 3.9 per cent while at the same time the Dutch National Bank adjusted the LTR for the Dutch pension sector. In its 2015 field testing package for the insurance capital standard, the International Association of Insurance Supervisors (IAIS) chose to apply the LTR equal to 3.5 per cent (EIOPA, April 2016). The EIOPA's LTR framework is, however, currently undergoing revisions. The new methodology for the calculation of the LTR on an ongoing basis is expected to be implemented in 2017 (EIOPA, April 2016).

With regard to how frequently the LTR should be revised, we propose in this paper a quantitative approach that reflects on two contradictory aspects – the LTR stability in time versus its distance from the derived theoretical benchmark value based on the economic fundamentals.

A Brief Literature Review

The low yield environment resulting from monetary policies followed by European central banks poses at present the most prominent risk to the insurance sector. Despite the fact that such policies contributed to financial stability in the short term (IMF Global Financial Stability Report, 2013), lower yields on corporate and sovereign bonds in many European countries have unfavourable implications for insurer companies' profitability, solvency and sustainability (EIOPA, June 2016).

Overall, insurance companies are seen as a relatively stable segment of the financial system. However, over time their interaction with other agents in the financial system, such as banks or pension funds, has intensified. The negative spill-overs and risk of bi-directional contagion led to an increased acknowledgement of the importance of the insurance sector for the overall financial stability (e.g. Bakk-Simon et al., 2012). This interconnectedness and the size of insurance segment make insurance firms important from a financial stability point of view and lay ground for further research in this area.

In terms of performance of insurance companies, there are several papers focusing on modelling their profitability. In line with research on drivers of bank profitability (e.g. Staikouras and Wood, 2004; Macit, 2012; Ameur and Mhiri, 2013, Goddard, Molyneux, and Wilson, 2004), Christophersen and Jakubik (2014) revealed a strong link between insurance companies' premiums, on one side, and economic growth and unemployment on the other side. Similarly, Nissim (2010) argues that the overall economic activity affects insurance carriers' growth, because the demand for their

products is affected by the available income. Moreover, Nissim underlines that investment income is highly sensitive to interest rates, both in the short and in the long run. D'Arcy and Gorvett (2000) argue that inflation heavily affects the liability side of property-liability insurers' balance sheets. As for insurer insolvencies, Browne et al. (1999) find a positive correlation between the number of insurers in the life-insurance industry, unemployment and stock market returns on one side and life-insurers' insolvency on the other side. Similarly, failure rate of property-liability insurers was also found to be positively correlated with the number of insurers in the industry (Browne and Hoyt, 1995).

Since interest rates were shown to affect income and profitability of insurance companies in previous research studies, we propose to further investigate in this paper the optimal time for revision of long-term interest rate used for discounting of insurance firms' long-term commitments which has substantial valuation implications.

The paper is organized as follows. Section 2 presents the term structure data used in our analysis, section 3 describes the methodology applied to the LTR setting, section 4 presents our results, section 5 discusses implications for insurance companies linked to LTR changes, and section 6 concludes.

Data

In our analysis we use the U.S. Treasury term structure data collected by Gurkaynak et al. (2006). The advantages of using U.S. data as opposed to European data stem from the availability of long historical time series of yield curves with maturities up to 30 years. The data set is compiled on a daily basis, with the first entry in 1961 and is being regularly updated. This data set includes all U.S. Treasury bonds and notes with the exception of the following:

i. Securities with option-like features, i.e. callable bonds or flower bonds.

ii. Securities with less than three months to maturity due to a specific behaviour of yields on securities with such short residual maturities.

iii. Treasury bills that seem to be affected by segmented demand from money market funds and other short-term investors (Duffee, 1996).

iv. Twenty-year bonds in 1996 owing to their cheapness relative to ten-year notes of comparable duration.

v. Securities with maturities of two, three, four, five, seven, ten, twenty and thirty years issued in 1980 or later owing to the fact that they trade at a

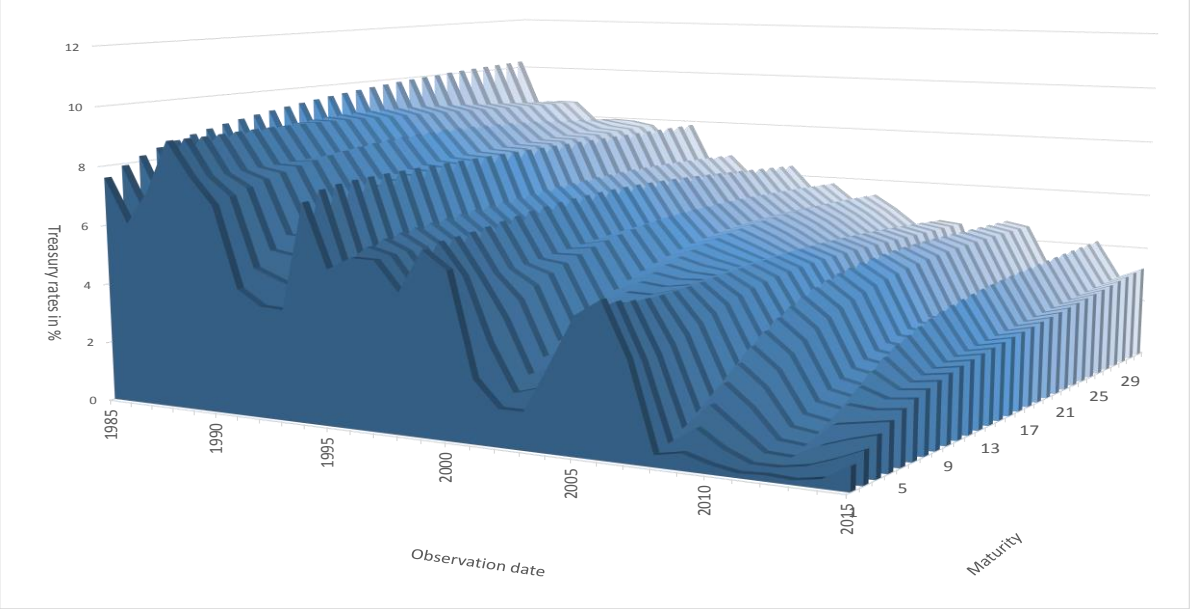
premium to other treasury securities given their greater liquidity in the repo market.

vi. Securities excluded on an ad hoc basis to deal with other data issues.

All in all, the treasury yield curve provided in this data set is estimated in a way that liquidity of the included securities is adequate and relatively uniform.

For the purposes of our analysis we extract from the data set by Gurkaynak et al. (2006) one yield curve per year from the 1985-2015 period. We opt for the last available yield curve in each calendar year, usually from December 31. Thus, our sample consists of 31 yield curves altogether. The starting date of our observed time period is conditional on the availability of Treasury zero coupon rates with maturities up to 30 years. In the data set by Gurkaynak et al. (2006) 30 years is the maximum available maturity for U.S. securities and the first year when a yield curve with this maturity becomes available is 1985 which also marks the start of our sample.

Figure A2.1: Term structure (1985-2015)



Note: X-axis shows maturities of U.S. Treasury securities, y- axis indicates the period of observation and z-axis depicts Treasury zero rates in per cent

Figure A2.1 shows the full U.S. Treasury term structure for the 1985-2015 period and maturities 1 to 30.

Next, we use the historical yield curve data for the 1985-2015 period extracted from the data set by Gurkaynak et al. (2006) to calibrate a simple framework for setting up the simple rule when to revise the Long-Term Rate (LTR).

Methodology

In this section we present a framework for setting up the LTR and for providing a LTR revision mechanism using a benchmark value for the long-term rate that reflects economic conditions in the long run using extrapolation of the term structure based on two different models.

Setting the Long Term Rate

EIOPA's Technical Specification for the Preparatory Phase of Solvency II (2014) defines the LTR as the sum of the long-term average of short-term real interest rates and long-term expectations of the inflation rate, usually captured by the central bank's inflation target.

In our framework we set the benchmark for the LTR equal to the average growth of nominal U.S. GDP over the previous twenty years.[45] Hence, the benchmark for LTR reflects average long-term growth of real GDP and inflation in the U.S. We obtain the data from the Federal Reserve Bank of St. Louis and use Equation 1 to calculate the average twenty-year growth rate of nominal GDP for each year in the 1985-2015 period:

$$g_t = \left(\frac{GDP_t}{GDP_{t-20}}\right)^{1/20} - 1, \quad (1)$$

where g is the average long-term growth rate and t indicates year from the 1985-2015 period.[46]

Next, we set the initial regulatory LTR equal to the average growth rate of nominal U.S. GDP over the previous twenty years in 1984 using Equation 1. Subsequently, we calculate UFR_t for every year over the 1985-2015 period using the following equation:

[45] There are many alternative ways to set up the benchmark for the LTR. However, the aim of this paper is to set up a framework providing a rule on the LTR revision rather than proposing the regulatory value.

[46] We opt for twenty-year average to capture the whole economic cycle and not being substantial affected by technological changes.

$$LTR_t = f(g_t, LTR_{t-1}) + LTR_{t-1}$$

$$f(g_t, LTR_{t-1}) = \begin{cases} g_t - LTR_{t-1} & if \quad |g_t - LTR_{t-1}| > p \\ 0 & if \quad |g_t - LTR_{t-1}| \leq p \end{cases}, \tag{2}$$

where g_t is obtained from Equation 1, t indicates a year from 1985 to 2015 and p is the distance between the long-term growth rate of nominal U.S. GDP at time t and LTR from time t-1. Equation 2 thus resets LTR at time t if the distance between the long-term nominal GDP growth at time t and regulatory LTR from the previous period t-1 exceeds the value given by p. As we prefer to express g_t in percentages in our analysis, the values we assign are also in percentages. Hence, p takes values of 0.1%, 0.2%, 0.3%, 0.4%, up to 3.5% and we calculate the LTR in each year of the 1985-2015 period for every assigned value of p from Equation 2.

Extrapolation of Yield Curves

The next step in our framework for setting up the LTR and its optimal adjustment frequency is extrapolation of zero rates on U.S. Treasury securities for maturities beyond twenty years. Given that EIOPA Technical Standards (2016) set the last liquid point (LLP), i.e. the maturity up to which yields on securities are quoted on the market, to 20 years, we also adopt this definition and extrapolate yields on securities with maturities from 21 to 30 years, i.e. the maximum maturity available in the data set provided by Gurkaynak et al. (2006) from 1985.

For extrapolation we use the models by Nelson and Siegel (1987) and its extension by Svensson (1994) that are frequently employed by central banks and other market participants (e.g. BIS, 2005) to fit term structures of interest rates. Furthermore, the studies by Diebold and Li (2006) and De Pooter, Ravazzolo and van Dijk (2007) provide evidence that these models are a useful tool in forecasting exercises of term structures of interest rates.

Despite these advantages, Bjork and Christensen (1999) showed that the Nelson-Siegel model is not theoretically arbitrage-free, i.e. theoretical prices of securities resulting from the model and the actual prices observed on the market differ to such an extent that transaction costs do not prevent arbitrage. Since this condition between theoretical and observed prices is not hard-coded into the model, it was assumed that the model violates no-arbitrage condition. However, Coroneo et al. (2011) show on U.S. yield curve data from 1970 until 2000 that the Nelson-Siegel model is statistically arbitrage-free. In this sense, another popular model, Smith-

Wilson (2001) model used by EIOPA to extrapolate the yield curve for very long maturities, is arbitrage-free as it fits the yield curve exactly up to LLP.

The Nelson-Siegel (1987) model models the yield curve at a point in time as follows:

$$y(\tau) = \beta_1 + \beta_2 \left[\frac{1-\exp(-\tau/\lambda)}{\tau/\lambda}\right] + \beta_3 \left[\frac{1-\exp(-\tau/\lambda)}{\tau/\lambda} - \exp(-\tau/\lambda)\right], \quad (3)$$

where $y(\tau)$ is the zero rate for maturity τ, parameters β_1, β_2, β_3 and λ need to be estimated. β_1 is independent of the time to maturity and as such indicates the long-term yield; β_2 exponentially decays to zero with increasing τ, thus it only influences the short end of the yield curve. β_3 function first increases then decreases with increasing τ which adds a hump to the yield curve.

The Svensson (1994) model extends the Nelson-Siegel (1987) model by adding a second hump to the yield curve:

$$y(\tau) = \beta_1 + \beta_2 \left[\frac{1-\exp(-\tau/\lambda_1)}{\tau/\lambda_1}\right] + \beta_3 \left[\frac{1-\exp(-\tau/\lambda_1)}{\tau/\lambda_1} - \exp(-\tau/\lambda_1)\right] + \beta_4 \left[\frac{1-\exp(-\tau/\lambda_2)}{\tau/\lambda_2} - \exp(-\tau/\lambda_2)\right], \quad (4)$$

where $y(\tau)$ is again zero rate for maturity τ and six parameters, β_1, β_2, β_3, β_4, λ_1 and λ_2 need to be estimated. This model is able to better capture the shape of the yield curve as it allows for a second hump that usually occurs at long maturities (i.e. twenty years and more). The occurrence of the second hump can be attributed to convexity which pulls down the yields on long-term securities and as a consequence makes the yield curve's shape concave at long maturities.

In order to extrapolate U.S. Treasury yield curves for maturities 21-30 we use the R-project package "ycinterextra" by Moudiki (2013). The package allows us to extrapolate the term structure using the LTR calculated from Equation 2 for every yield curve over the 1985-2015 period and for every value of p. We thus extrapolate U.S. Treasury yields for maturities 21 to 30 using both, Nelson-Siegel and Svensson model.

Construction of a Loss Function

The last step in constructing our framework is to join the LTR setting and extrapolation of yields using the two yield curve models into a single statistic for each value of p. In particular, we take into account how stable the LTR set in the previous subsection is over the entire observed time period and how close the extrapolated yields using that particular LTR are to the actual yields at maturities 21-30. We call this aggregate statistic a loss function as it penalizes frequent changes in LTR setting and the distance of extrapolated yields from actual yields at maturities 21-30. We calculate the loss function for every value of p, which expresses the distance between the average long-term growth of nominal GDP and the regulatory LTR from the previous period, over the 1985-2015 period.

Our proposed loss function has the following form:

$$Loss_p = w_{Prec} \times MSE_p + w_{Stab} \times \left(\min_{t \epsilon T} (MSE_{p,t}) + k \times \left(\max_{t \epsilon T} (MSE_{p,t}) - \min_{t \epsilon T} (MSE_{p,t}) \right) \right) \quad (5)$$

$$T = \langle 1985; 2015 \rangle,$$

where T is the set of the observed time period, p is the distance between long-term growth rate of nominal U.S. GDP at time t and LTR from time t-1, k is the number of LTR changes over the total number of years in the observed period of 1985-2015 for the corresponding value of p, and w_{Prec}, w_{Stab} are the weights of the two loss function components. They can take values from 0 to 1 and express a regulator's preference towards either extrapolation precision or LTR stability. It needs to hold that $w_{Prec} + w_{Stab} = 1$. Therefore, the weights set to 0.5 would indicate there is no preference towards either precision of extrapolation or LTR stability as the two components are weighed equally in the loss function. MSE_t, mean square error, is a standard statistical concept that measures the average of the squares of the errors between the yields at maturities 21-30 obtained from extrapolation using Nelson-Siegel and Svensson models for the chosen regulatory LTR, and the actual yields at these maturities. For each value of p we calculate the corresponding average mean square error MSE_p over the observed time period defined as follows:

$$MSE_p = \frac{1}{31} \times \sum_{t=1985}^{2015} MSE_t = \frac{1}{31} \times \frac{1}{10} \times \sum_{t=1985}^{2015} \sum_{i=21}^{30} \left(\widehat{y_{i,t}} - y_{i,t} \right)^2, \quad (6)$$

where i takes values of maturities 21 to 30, t indicates a year in the 1985-2015 period and $\widehat{y_{i,t}}$ stands for an estimate of the yield at maturity i and year t obtained by

extrapolation from either Nelson-Siegel or Svensson model while $y_{i,t}$ is the actual yield at maturity i in year t.

As for the second component of the loss function, the LTR stability over the observed period, we approximate it with the ratio of the number of LTR changes for the corresponding p over the number of years in the period 1985-2015, i.e. 31 years. We also rescale this ratio to correspond numerically to the first component of the loss function MSE_p, as shown in Equation 5.

We are interested in the value of p that minimizes loss for the 1985-2015 period for the regulator's preferences towards extrapolation precision and LTR stability. Such a value of p would reveal by how much the long-term nominal GDP growth rate in a given year should deviate from the regulatory LTR from the previous year to have the LTR reset to the value given by Equation 2. The loss-minimizing value of p depends on a regulator's preference towards either precision or LTR stability.

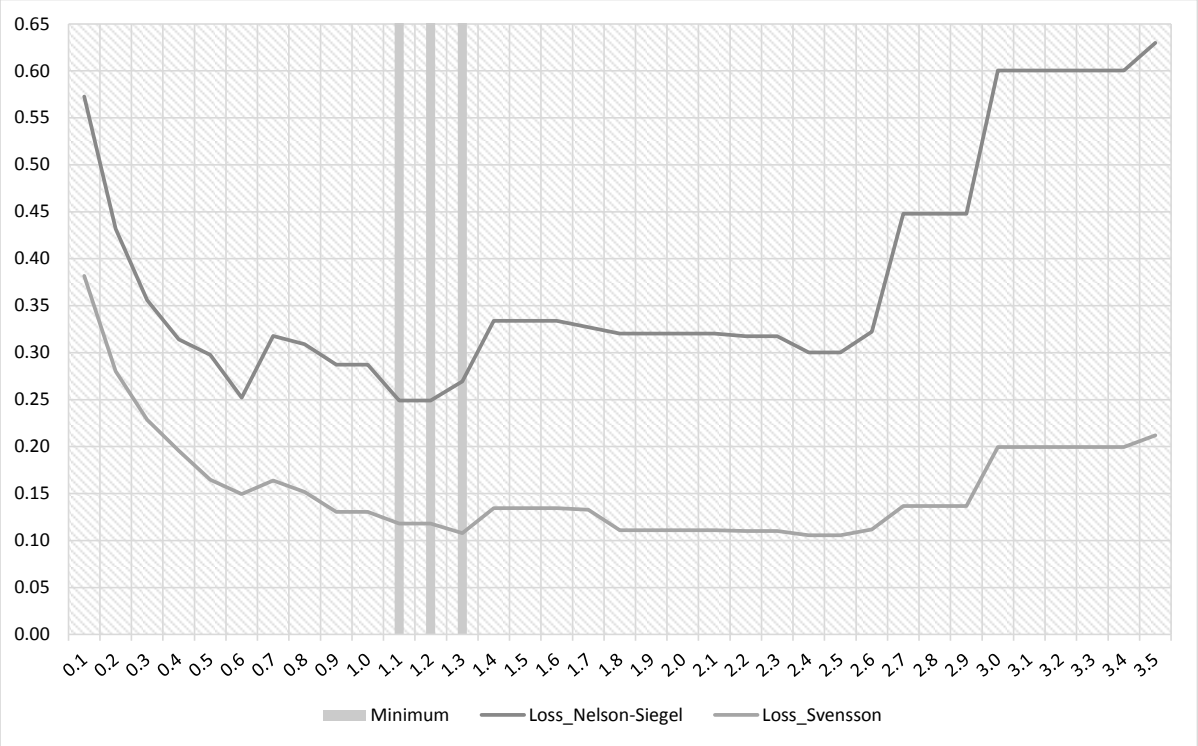
The next section presents the results of calculation of loss for the overall period across different values of p, using Nelson-Siegel and Svensson models and different regulator's preferences.

Results

In this section we present the results of the loss calculation over the 1985-2015 period and different values of p using both, Nelson-Siegel and Svensson model, and different preferences, i.e. weighting schemes.

First, we assume that a regulator places equal weight on LTR stability and extrapolation precision. In this case, the following condition holds for the weights in Equation 5: $w_{Prec} = w_{Stab} = 0.5$.

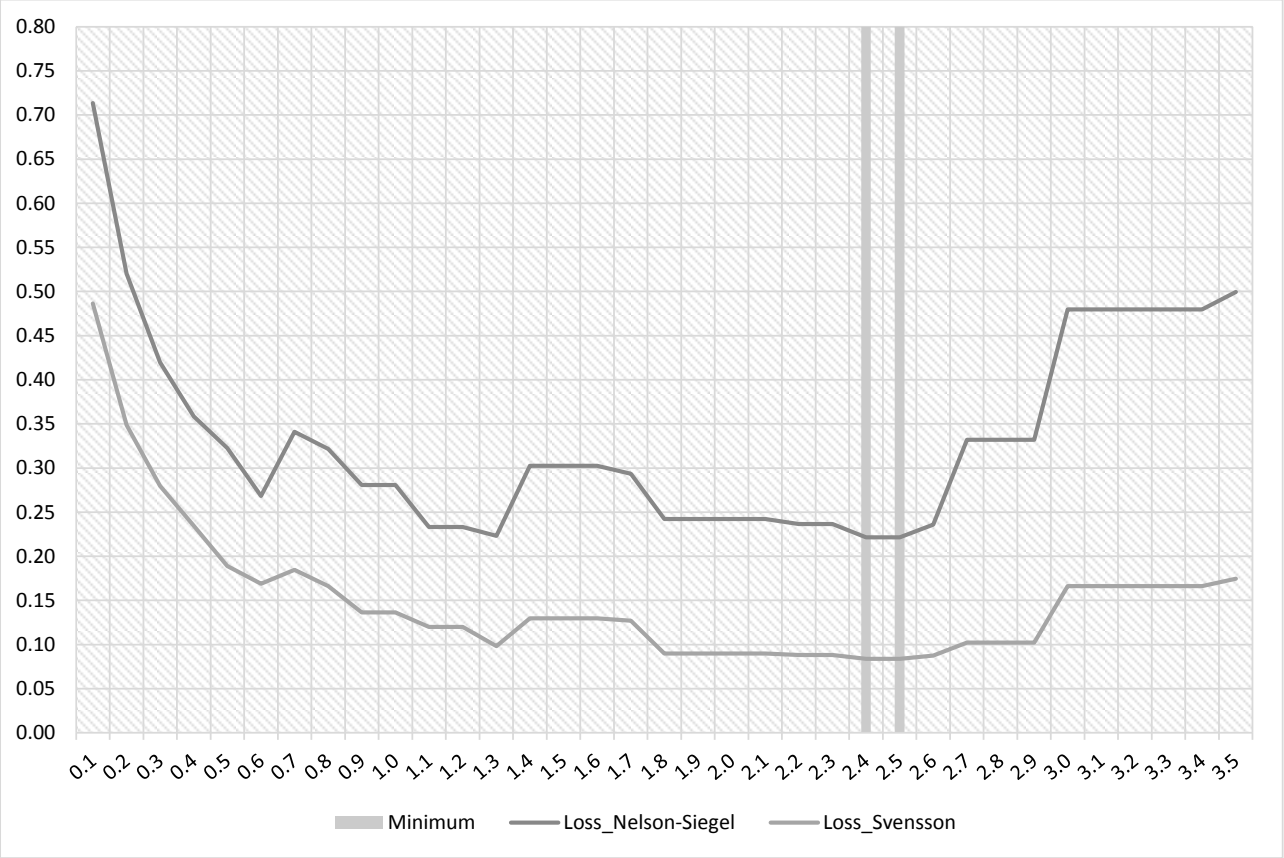
Figure A2.2: Loss for Different Values of p (weights: 0.50, 0.50)



Note: The dark grey line shows loss over the 1985-2015 period for different values of p (on horizontal axis) calculated from Nelson-Siegel model while the light grey line depicts the loss from Svensson model over the same period. The light grey bars highlight those values of p that minimize the loss function for both models. The vertical axis indicates magnitude of loss. The calculation uses equal weighing.

We can observe from the Figure A2.2 that the value of p equal to both 1.1% and 1.2% minimizes loss over the 1985-2015 period when yields are extrapolated using Nelson-Siegel model. For Svensson, the loss minimizing value of p equals to 1.3%. Next, we turn to alternative weighting schemes in case that a regulator considers either stability of LTR overtime more important than how closely a model can extrapolate long-term yields to their actual values (yields on Treasury securities for maturities of 21-30), and vice versa.

Figure A2.3: Loss for Different Values of p (weights: 0.33, 0.67)



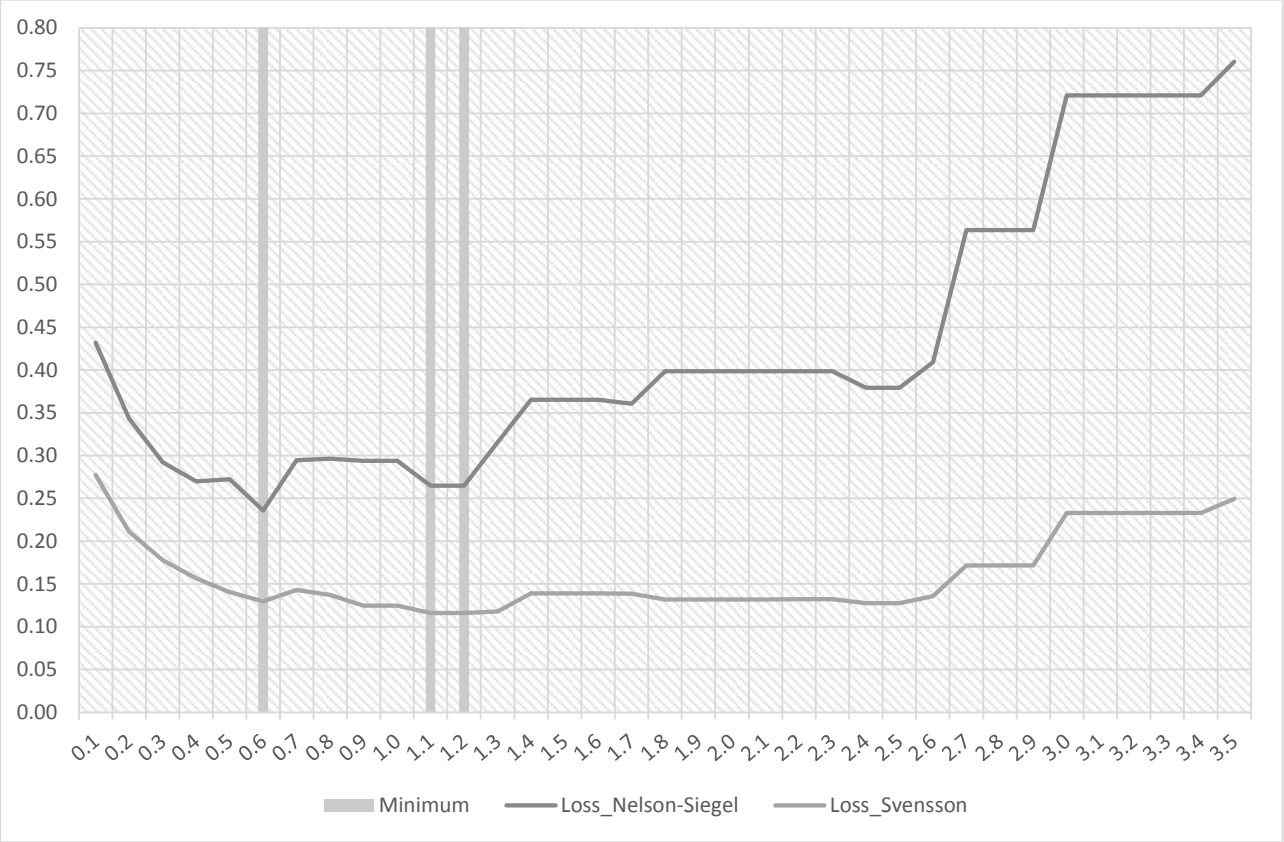
The dark grey line shows loss over the 1985-2015 period for different values of p (on horizontal axis) calculated from Nelson-Siegel model while the light grey line depicts the loss from Svensson model over the same period. The light grey bars highlight those values of p that minimize the loss function for both models. The vertical axis indicates magnitude of loss. The weight of 33% is placed on extrapolation precision while 67% is placed on LTR stability

The Figure A2.3 shows the loss minimizing value of p when weight of 33% is put on extrapolation precision and double of that is placed on LTR stability increases to 2.4% and 2.5% which is approximately double of the value of p that minimizes loss under equal weighting. All in all, the loss is minimized at p=2.4% and p=2.5% for both models under the given preferences.

Next, we choose to favour extrapolation precision over LTR stability in our calculation. We put weight of 67% on the first component of the loss function in Equation 5 and half of that weight on how stable LTR is in time.

In this case, the loss minimizing value of p drops to 0.6% when extrapolation is performed using Nelson-Siegel model. As for Svensson, the loss minimizing p equals to 1.1% and 1.2% under these preferences, which is quite close to the optimal value of p under equal weighting. Figure A2.4 presents the results.

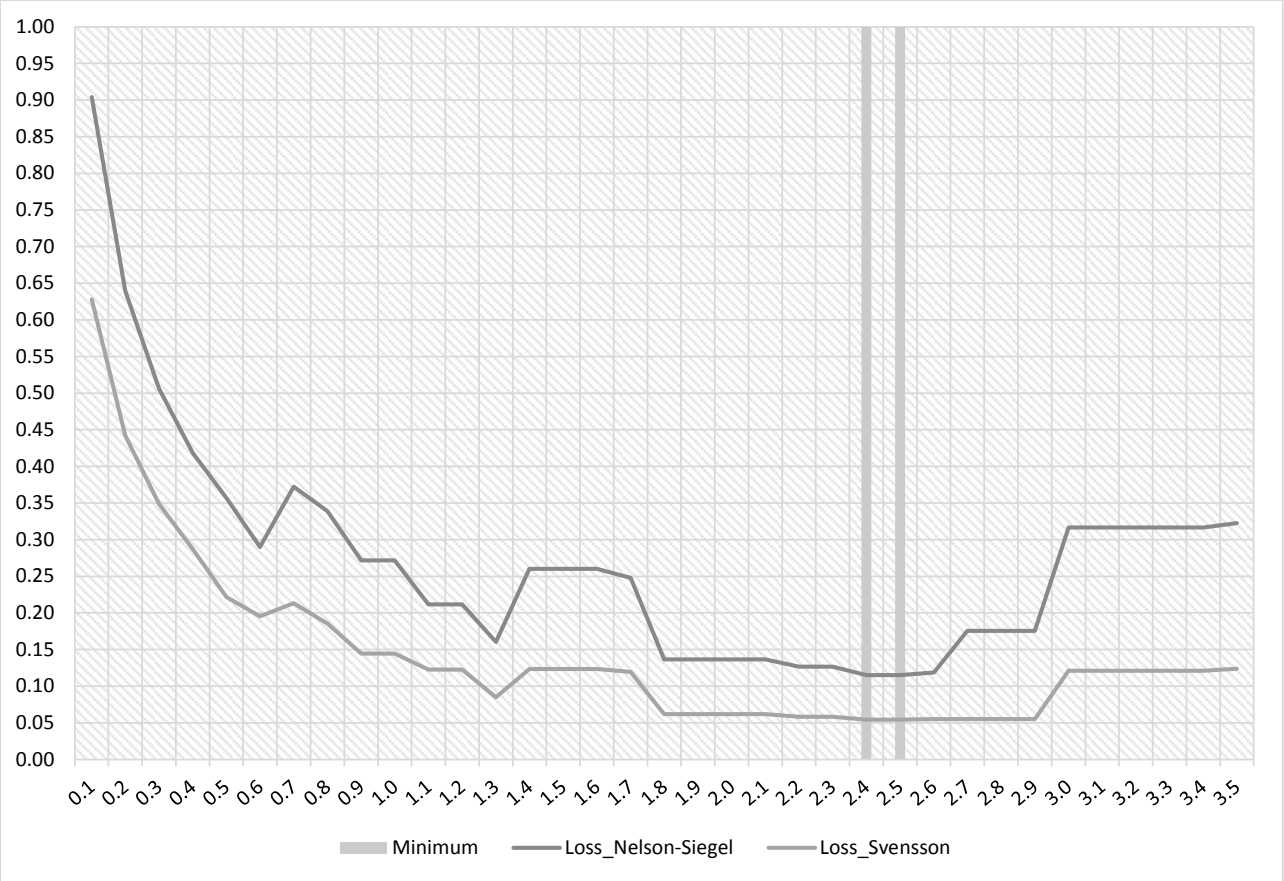
Figure A2.4: Loss for Different Values of p (weights: 0.67, 0.33)



The dark grey line shows loss over the 1985-2015 period for different values of p (on horizontal axis) calculated from Nelson-Siegel model while the light grey line depicts the loss from Svensson model over the same period. The light grey bars highlight those values of p that minimize the loss function for both models. The vertical axis indicates magnitude of loss. The weight of 67% is placed on extrapolation precision while 33% is placed on LTR stability.

For the last two weighting schemes, we suppose that a regulator cares very little about one component of the loss function, either MSE or LTR stability, while the other aspect is found to be crucial. Figure A2.5 presents the results.

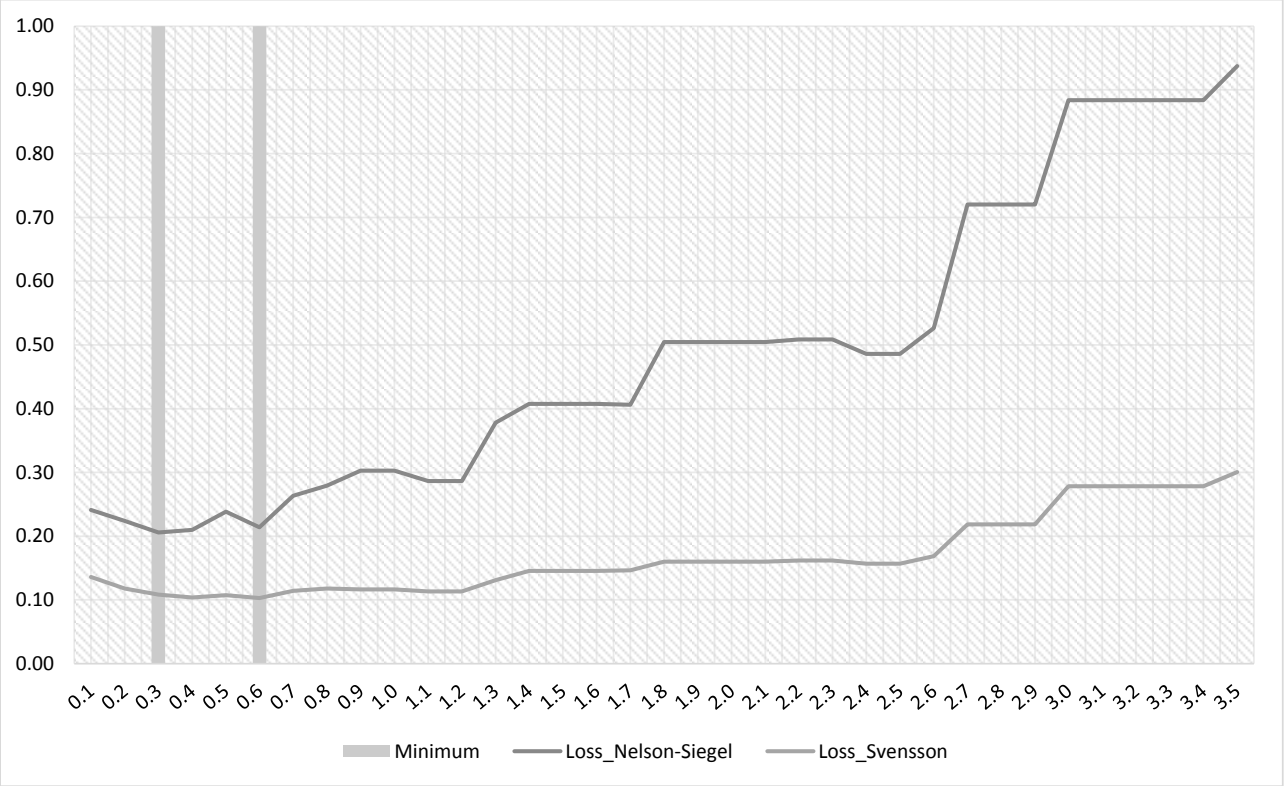
Figure A2.5: Loss for Different Values of p (weights: 0.10, 0.90)



The dark grey line shows loss over the 1985-2015 period for different values of p (on horizontal axis) calculated from Nelson-Siegel model while the light grey line depicts the loss from Svensson model over the same period. The light grey bars highlight those values of p that minimize the loss function for both models. The vertical axis indicates magnitude of loss. The weight of 10% is placed on extrapolation precision while 90% is placed on LTR stability.

The Figure A2.5 presents the loss minimizing values of p when the weight of only 10% is placed on extrapolation precision as opposed to the weight of 90% put on stability of LTR. For yield extrapolation by both Nelson-Siegel and Svensson model the optimal value of p is equal to 2.4% and 2.5%, which is the same as under the weighing scheme of 33% placed on extrapolation precision and 67% placed on LTR stability.

Figure A2.6: Loss for Different Values of p (weights: 0.90, 0.10)



The dark grey line shows loss over the 1985-2015 period for different values of p (on horizontal axis) calculated from Nelson-Siegel model while the light grey line depicts the loss from Svensson model over the same period. The light grey bars highlight those values of p that minimize the loss function for both models. The vertical axis indicates magnitude of loss. The weight of 90% is placed on extrapolation precision while 10% is placed on LTR stability.

In case of the reversed weighing of 90% for the precision component of the loss function and 10% for LTR (Figure A2.6), the stability of the value of p that minimizes loss under the Nelson-Siegel extrapolation drops to 0.3% while p equal to 0.6% is optimal for Svensson model (as shown in the Figure above).

All in all, under equal regulator's preferences, it appears that if the difference between the long term rate measured by average twenty-year growth of nominal GDP at time t and LTR valid in period t-1 exceeds 1.2% when Nelson-Siegel model is used for extrapolation, LTR at time t should be adjusted to reflect long-term average growth of nominal GDP at time t. This difference slightly increases to 1.3% for Svensson model. The optimal value of p equal to 1.1% and 1.2% for Nelson-Siegel model amounts to the total of three LTR adjustments over the 1985-2015 period while the optimal p=1.3% for Svensson model implies only two adjustments.

The loss minimizing value of p either rises or drops in response to changing regulator's preferences. With the regulator in favour of LTR stability overtime by at least two thirds compared to the MSE component, the distance indicative of resetting

LTR increases to 2.5%. On the other hand, the regulator caring very little about LTR stability would lean towards more frequent revisions of LTR. This is reflected by the optimal distance between economic fundamentals and the regulatory LTR as small as 0.3% and 0.6% under Nelson-Siegel and Svensson model, respectively.

Next, we use an insurer's hypothetical portfolio of liabilities to demonstrate valuation effects of changes in LTR.

Policy Implications

Under a low yield regime, a decline in benchmark interest rates translates into the reduced discount rate applied in an insurer's liabilities valuation overall. This in turn leads to a steeper increase in the present value of liabilities over assets, eroding an insurer's surplus and exacerbating insolvency risk of insurance entities. While actual market interest rates are applied in valuation of liabilities with short maturities, the long term interest rate is used for discounting liabilities with long maturities. In line with our assumption that LLP is set to 20 years, changes in LTR affect value of only those liabilities with maturities greater than 20 years. [47]

In this section we illustrate on long-term liabilities of different duration within a hypothetical insurer's portfolio how their present value changes in response to changes in long-term interest rate within the proposed framework. We take as the LTR benchmark value the long-term U.S. nominal GDP growth at reference year 2005. We assume LTR has been constant since then, i.e. fixed to 5.39% in 2015. We calculate alternative LTRs in 2015 from the formula given in Equation 2.

We choose those LTRs that correspond to a loss-minimizing value of p under different regulatory preferences from the previous section. Table 1 shows changes in the present value of long-term liabilities of different duration within a hypothetical portfolio given different regulatory preferences towards the LTR setting, and using both Nelson-Siegel and the Svensson model. We calculate the change in the present value of an insurance's long-term liabilities due to changes in LTR for average long-term maturities of 21, 22, 25, 28 and 30 years using the standard definition of modified duration:

$$\Delta PV_\tau = -\Delta IR_\tau \times MD$$

$$\tau = \{21,22,25,28,30\},$$

[47] This is in line with the EIOPA Technical Standards (March 2016).

where ΔPV_τ indicates a change in the present value of liabilities with average maturity τ, ΔIR_τ expresses change in discount rate of liabilities with average maturity τ with respect to difference between LTR setting and its benchmark, and MD stands for modified duration, i.e. the corresponding maturity bracket from the set τ.

Table A2.1: Impact of different regulatory preferences on the long-term liabilities within a portfolio

Nelson-Siegel Extrapolation

Preferences	benchmark	w_{Stab}=0.10	w_{Stab}=0.33	w_{Stab}=0.67
LTR value in 2015	5.39%	4.22%	4.56%	5.39%
AVERAGE modified duration of liabilities (in years)	21	10.18%	7.22%	0%
	22	11.32%	8.03%	0%
	25	14.79%	10.49%	0%
	28	18.28%	12.97%	0%
	30	20.61%	14.62%	0%

Svensson Extrapolation

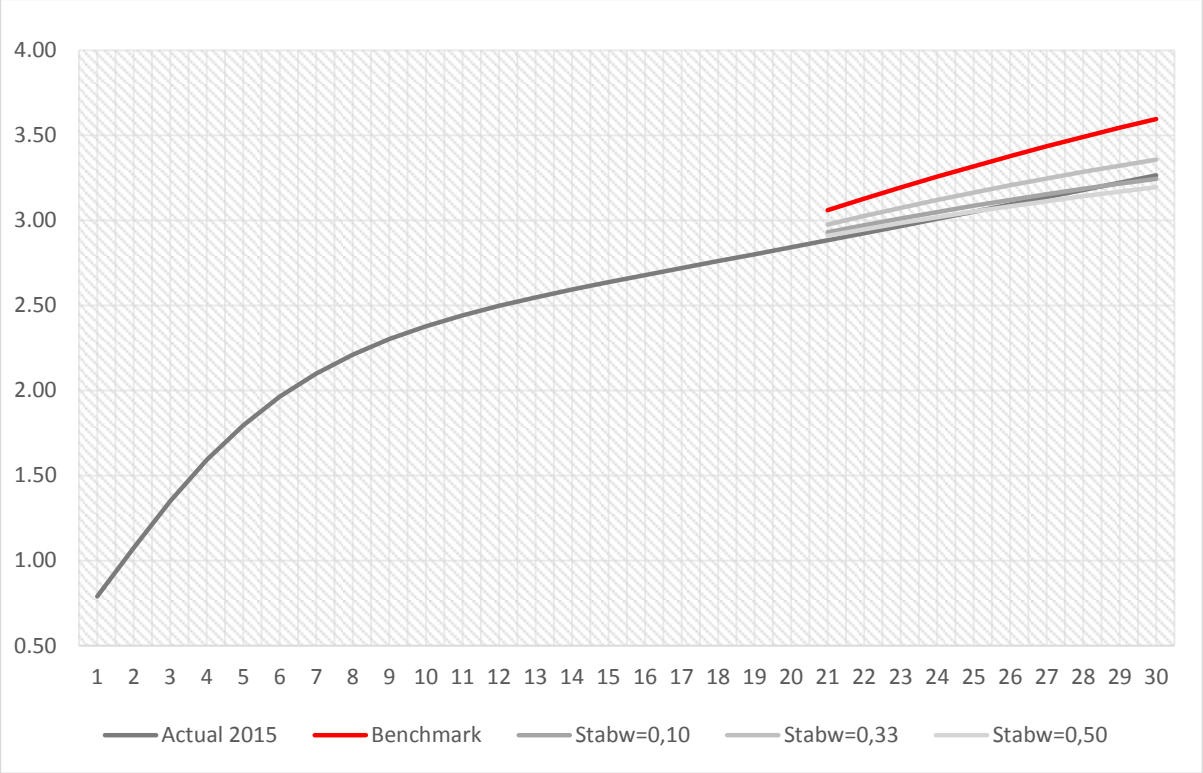
Preferences	benchmark	w_{Stab}=0.10	w_{Stab}=0.33	w_{Stab}=0.67
LTR value in 2015	5.39%	4.22%	4.56%	5.39%
AVERAGE modified duration of liabilities (in years)	21	2.72%	1.74%	0%
	22	3.42%	2.22%	0%
	25	5.82%	3.86%	0%
	28	8.55%	5.77%	0%
	30	10.52%	7.14%	0%

Note: The impact of deviations of the long-term interest rate from the benchmark given the different regulatory preferences on the present value of an insurer's long-term liabilities of different duration. The first row indicates preference of the regulator towards LTR stability. The second row states the corresponding LTR in 2015 calculated from Equation 2.

Overall, we observe a higher sensitivity of present value of liabilities with longer durations to changes in LTR. The greater the decrease in LTR with regards to the benchmark, the greater the increase in the present value of liabilities across different average durations. Therefore, for insurance firms whose portfolio consists of very long-term liabilities, such as life-insurers, a relatively small decline in the discount

rate of -0.83% to LTR=4.56% would result in an increase in the value of long-term liabilities with average duration of 30 years by more than 14% under Nelson-Siegel extrapolation and 7% under Svensson. The smaller impact on present value when Svensson model is used for extrapolation can be attributed to smaller deviations of spot yields under different regulatory LTRs from spot yields under benchmark LTR compared to Nelson-Siegel model. Figure A2.7 depicts extrapolated spot yields versus benchmark for Svensson model.

Figure A2.7: Svensson Extrapolation under different preferences



Note: The Figure shows the actual yield curve as of December 31, 2015 over maturities 1 to 30 years and extrapolated spot yields for maturities 21 to 30 years under LTR with different regulatory preferences, and benchmark using Svensson model. Benchmark corresponds to extrapolation with LTR equal to average twenty-year U.S. nominal GDP growth in 2005. Vertical axis shows spot yields in percentages, horizontal axis indicates maturities in years.

Figure A2.7 shows that extrapolated spot yields under regulatory LTRs with different preferences towards LTR stability are lower than the spot yields under constant LTR scenario (in red) for both models. However, the proximity of extrapolated yields under different regulatory preferences to the benchmark yields as well as to actual yields is greater for Svensson model. Therefore, under Svensson model changes in LTR affect present value of long-term liabilities in an insurer's portfolio to a lesser degree.

Conclusion

As liability side of insurer companies' balance sheets is typically formed by commitments with very long maturities. Hence, they need to be discounted by a corresponding long-term interest rate for valuation purposes. However, interest rates over very long maturities are seldom observable in the market. As a result, Long-Term Rate (LTR) needs to be estimated in order to evaluate such long-term contracts. Consequently, changes in LTR have valuation effects for insurers.

In this paper we show a possible approach for updating the interest rate for long-term contracts (LTR) in a dynamic way using long-term developments of economic fundamentals as a benchmark for LTR. In addition, our approach proposes a loss function that weighs two LTR aspects, estimation precision and LTR stability.

We propose an algorithm of LTR setting that compares by how much long-term economic fundamentals measured by average twenty-year nominal GDP growth in a given year differ from regulatory LTR from the previous year. If this difference is greater than some threshold value p LTR for this period is set to the value given by economic fundamentals. A difference smaller than the threshold makes regulatory LTR from the prior year also valid in a given year.

Next, we extrapolate yields over maturities of 21-30 years using Nelson-Siegel and Svensson models and compare them to the actual yields from U.S. Treasury term structure data over the period of 1985-2015 using mean square error (MSE) statistic.

We combine the two aspects, LTR stability (the ratio of changes in LTR over the observed period) and extrapolation precision (distance between actual and extrapolated yields) into a loss function. A preference for each component of the loss function is expressed by assigned weights.

We search for such p (distance between long-term growth of economic fundamentals and LTR set in previous period) that minimizes our proposed loss function.

Finally, we find that once the distance between average twenty-year growth of nominal GDP in a given year and regulatory LTR from the previous year exceeds 1.2% and 1.3% under preference neutrality for Nelson-Siegel and Svensson model, respectively, the LTR should be adjusted. This result changes in response to a regulator's preferences. When the preference towards LTR stability dominates, the distance for resetting LTR increases implying fewer changes to LTR over the period under investigation, and vice versa.

Finally, we illustrate the impact of changes in the long-term interest rates on insurance companies by means of a hypothetical portfolio of long-term liabilities. We show that extrapolated spot yields under regulatory LTRs with different preferences towards LTR stability are lower than the spot yields generated under the assumption of constant LTR fixed to average long-term GDP growth levels.

References

Ameur, I. G., Mhiri, S. M. (2013): Explanatory Factors of Bank Performance. International Journal of Economics, Finance and Management, Vol. 2, No. 1, pp. 143-152.

Bakk-Simon, K., Borgioli, S., Giron, C., Hempell, H. S., Maddaloni, A., Recine, F. and Rosati, S. (2012): Shadow banking in the Euro area: an overview, Occasional Paper Series 133, European Central Bank.

BIS (2005): Zero-Coupon Yield Curves: Technical Documentation (Bank for International Settlements, Basel).

Bjork, T., Christensen, B.J. (1999): Interest Rate Dynamics and Consistent Forward Rate Curves, Mathematical Finance, Vol. 9, pp. 323–348.

Browne, M.J., Carson, J.M., Hoyt, R.E. (1999): Economic and Market Predictors of Insolvencies in the Life-Health Insurance Industry, The Journal of Risk and Insurance, Vol. 66, No. 4, pp. 643-659.

Browne, M.J., Hoyt, R.E. (1995): Economic and Market Predictors of Insolvencies in the Property-Liability Insurance Industry, The Journal of Risk and Insurance, Vol. 62, No. 2, pp. 309-327.

Christophersen, C., Jakubik, P. (2014): Insurance and the Macroeconomic Environment, EIOPA-Financial Stability Report May 2014, pp. 44-55.

D'Arcy, S., Gorvett, R. (2000): Measuring the interest rate sensitivity of loss reserves. Proceedings of the Casualty Actuarial Society, Vol. 87, pp. 365-400.

Coroneo, L., Nyholm, K., Vidova-Koleva, R. (2011): How arbitrage-free is the Nelson-Siegel model?, Journal of Empirical Finance, Elsevier, Vol. 18, No. 3, pp. 393-407.

de Pooter, M.D., Ravazzolo, F., van Dijk, D. (2007): Predicting the Term Structure of Interest Rates: Incorporating Parameter Uncertainty, Model Uncertainty and Macroeconomic Information, Tinbergen Institute Discussion Papers 07-028/4, Tinbergen Institute.

Diebold, F. X. and Li, C. (2006): Forecasting the Term Structure of Government Bond Yields, Journal of Econometrics, Vol. 130, pp. 337-364.

Duffee, G. (1996): Idiosyncratic Variation of Treasury Bill Yields, Journal of Finance, Vol. 51, pp. 527-551.

Gurkaynak, R. S., Sack, B. and Wright, J. H. (2007): The U.S. Treasury yield curve: 1961 to the present. Journal of Monetary Economics, Elsevier, vol. 54(8), pp. 2291-2304, November.

Goddard, J. A., Molyneux, P. and Wilson, J. O. S. (2004): The Profitability of European Banks: A Cross-Sectional and Dynamic Panel Analysis. Manchester School, Vol. 72, No. 3, pp. 363-381.

Macit, F. (2012): Who responds more to monetary policy, conventional banks or participation banks? Journal of Economics, Finance and Administrative Science, Vol. 17, No. 33, pp. 10-14.

Moudiki, T. (2013): Yield curve or zero-coupon prices interpolation and extrapolation (ycinterextra), R-project package.

Nelson, C. R., Siegel, A. F. (1987): Parsimonious modeling of yield curves. Journal of Business, pp. 473-489.

Nissim, D., (2010): Analysis and Valuation of Insurance Companies, CEASA (Center for Excellence in Accounting and Security Analysis) Industry Study No. 2.

Staikouras, C., Wood, G. (2004): The determinants of European bank profitability, International Business and Economics Research Journal, Vol. 3, No. 6, pp. 57–68.

Smith, A., Wilson, T. (2001): Fitting yield curves with long term constraints. Technical report, Bacon & Woodrow. Research Notes, Bacon and Woodrow.

Svensson, L. E. O. (1994): Estimating and Interpreting Forward Interest Rates: Sweden 1992-1994, IMF Working Paper, WP/94/114 (September 1994).

Technical documentation of the methodology to derive EIOPA's risk-free interest rate term structures (March 2016): https://eiopa.europa.eu/Publications/Standards/Technical%20Documentation%20%287%20March%202016%29_07-03-2016.pdf

EIOPA Consultation paper on the methodology to derive the UFR and its implementation (April 2016): https://eiopa.europa.eu/Publications/Consultations/RFR%20CP%20on%20methodology%20to%20derive%20the%20UFR%20%28after%20BoS%29.pdf

EIOPA FSR (December 2013): https://eiopa.europa.eu/Publications/Reports/EIOPA_Financial_Stability_Report_-_2013_1H_01.pdf

EIOPA FSR (June 2016): : https://eiopa.europa.eu/Publications/Reports/Financial_Stability_Report_June_2016.pdf

EIOPA Technical Specification for the Preparatory Phase (Part II) (April 2014): https://eiopa.europa.eu/Publications/Standards/B_-_Technical_Specification_for_the_Preparatory_Phase__Part_II_.pdf

FRED, Federal Reserve Bank of St. Louis, Current Price Gross Domestic Product in United States [USAGDPNQDSMEI]: https://research.stlouisfed.org/fred2/series/USAGDPNQDSMEI, (downloaded on February 3, 2016).