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Editorial

Asset-liability management with ultra-low interest rates

Insights from a conference jointly organized by SUERF, the OeNB and the Austrian Society for Bank Research

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In reply to the financial crisis, the Great Recession and sovereign debt crisis, many central banks have pursued ultra-easy and far reaching unconventional monetary policies for several years. Yields on various bond classes – including euro area sovereign bond yields since the sovereign debt crisis has subsided – have reached extremely low levels. Prices on stocks and real assets have soared. In several countries, markets have been expecting a reversal of the interest rate cycle for some time now. As a result, the risk of – possibly substantial – price corrections in all these asset classes may be seen to have increased.

This environment poses challenges for banks' asset-liability and risk management as well as earnings. Institutional investors facing yield pressure may resort to more risky strategies, established forms of investment strategies may no longer be viable. Also official investors, like central banks and sovereign wealth funds, feel the pressure from lower current or future earnings and potential future risk from the current ultra-low yield and rather high pricing levels.

To discuss relevant issues, scenarios, options and risks in this environment, SUERF in cooperation with the Oesterreichische Nationalbank (OeNB) as well

[1] Helpful comments by Morten Balling are gratefully acknowledged.

as the Austrian Society for Bank Research (BWG) organized a full-day conference, which brought together financial practitioners, academics, supervisors and policy makers. Lessons from history were explored, a bird's eye perspective from academia and international institutions as well as inside views from industry practitioners were provided. Possible consequences for financial stability, the macroeconomy at large as well as adequate policy responses were discussed.

The **main findings** *were the following:*

- *Pressure on profitability, excessive risk taking, delayed balance sheet repair (evergreening of loans) and distortion in credit allocation are among the potential risks to the* **banking sector** *arising from ultra-low interest rates and unconventional monetary policy.*
- *There is evidence that banks initially profit from ultra-low interest rates (lower funding costs, positive effects of a downward shift of the yield curve as the duration of deposits is shorter than that of assets); but a protracted period of ultra-low interest rates* **harms banks' profitability** *(interest margin compression because of a flattening of the yield curve, zero interest rate floor on deposits).*
- *From a microprudential perspective, in response to negative rates, banks also need to pay attention to the following three areas: first, whether their business infrastructure (e.g. derivative models) and their IT systems can handle negative rates; second, whether customer behaviour will change and deposit models are still valid with negative interest rates; third, interest rate risk arising from a lengthening of duration needs to be adequately captured.*
- *Low interest rates have become a threat to the solvability and stability of* **life insurers.** *Austrian and German life insurers are particularly strongly exposed to interest rate risk (high guaranteed returns, large duration mismatch). There are two possible consequences from this: one is that insurance firms diversify into higher risk investments thus hoping for survival ("gambling for resurrection"). Alternatively, they might be locked into low-yielding low-risk fixed income securities, just barely being able to cover their guarantees.*
- *Currently, not only are interest rates low, but so are expected returns in any investment class (such as equities, corporate bonds, or real estate) because any investment now has an underlying negative real return. Investors need to recognize this new reality. It is at this point not clear* **how long the current period of ultra-low nominal and real returns will last.** *In a benign scenario, as the European economy would recover gradually, so would the level of interest rates normalize over the medium run. In a scenario of "secular stagnation", the current situation might last for many years to come. Conversely, in the longer run, some observers would not rule out a period of considerably higher*

inflation, implying a substantial increase in nominal yields as well. These three scenarios have very different implications for banks' and institutional investors' optimal asset liability management strategies, requiring a careful evaluation of **risks and shock-bearing capacity under the different scenarios.**

- *For* **central bank reserve management** *the current situation implies that first of all central banks should consciously position themselves within the "reserve management triangle" as central bank reserve management has elements of economic policy, market liaison and of financial management. On this basis, a central bank should determine the relative importance of security, liquidity and return among its investment objectives and how it can pursue these objectives in a sustainable manner.*
- *Historically,* **bubbles** *occurred in a wide range of assets. Most bubbles were* **largely financed by debt,** *and importantly bank credit, thus increasing the likelihood of a banking crisis. Bubbles were usually triggered by technological or financial innovations or by political events.*
- *In response to bubbles, a policy of* **early leaning against the wind is preferable to a late pricking of bubbles.** *The use of macroprudential instruments was sometimes (but by no means always) successful. Macroprudential measures are more targeted than interest rate policies because they can focus on specific sectors but at the same time they can be more easily circumvented. All in all, there are therefore* **no simple prescriptions** *– no instrument works in all circumstances.*
- *Currently, there is a* **build-up of risk** *in many markets due to search for yield. However, there is no clear threat to financial stability as long as there is no sharp expansion of credit. Furthermore, financial crises usually only arise from ultra-low interest rates if additionally other incentives to take on risk are present. It is therefore unlikely that the current ultra-low interest rate environment will lead to a financial crisis as long as there is no substantial macroeconomic upswing.*
- *However, the* **exit from ultra-low interest rates will pose risks to financial stability.** *Thus, the* **exit should be carefully planned and well communicated.** *Furthermore, policy makers should be aware of a potential* **shifting of risks to other, less regulated sectors** *(e.g. shadow banks).*

***

The conference was opened by *SUERF President Professor Urs Birchler* and *OeNB Vice Governor Andreas Ittner. Andreas Ittner* in his **introductory remarks** mentioned that the conference is highly topical and that the questions addressed at the conference are more and more on the agenda of financial stability committees at both the national and the European levels. Central banks substantially lowered

policy rates and engaged in various forms of unconventional monetary policy in order to achieve their inflation targets and to ensure the smooth functioning of the monetary transmission mechanism. In addition, the current ultra-low interest rates can be traced back to structural factors that increased the supply of loanable funds and reduced the demand for capital. Regarding banks, ultra-low interest rates could lower net interest income and as a consequence negatively affect their profitability. In recent years important changes in the asset and liability structure of euro area banks took place. They considerably increased their capital and reduced their assets. However, deleveraging did not substantially affect loans to the real economy as it mainly took place through the decline of interbank loans. These developments are welcomed from a financial stability perspective. However, a protracted period of ultra-low interest rates poses also a number of risks to financial stability: Low interest rates provide incentives to increase indebtedness, they could lead to a search for yield and compromise the sustainability of the business models of banks and insurance companies. Furthermore, there are serious risks associated with a reversal of the interest rate cycle.

According to *Urs Birchler* the current situation of ultra-low or even negative interest rates reminds one of the theories put forward by Silvio Gesell who argued that negative interest rates are beneficial. However, the current low interest rate environment creates difficulties for various groups, e.g. baby boomers that need to save for their pension income, portfolio managers, supervisors, banks and central banks. Referring to the theories of capital and interest by Böhm-Bawerk and Mises, Birchler observed that Austria is the natural place for a conference on this topic.

Session 1 chaired by *Doris Ritzberger-Grünwald, Director of the Economic Analysis Department, OeNB,* featured a presentation by *Professor Richard S. Grossman, Wesleyan University in Middletown, CT and Visiting Scholar at the Institute for Quantitative Social Science at Harvard University,* on **Interest rate cycles and implications for the financial sector – a long term view**. In his presentation Grossman focused on the relationship between the level of interest rates and financial crises. From a historical perspective, interest rates are currently not only low when compared to the recent past but also when compared to the 19th century. Data from 20 countries and the period from 1880 to 1970 reveal that interest rates remain low after a financial crisis for quite some time. Specifically, after four years interest rates were about four percentage points lower than at the outbreak of a crisis. A prolonged period of ultra-low interest rates could lead to asset-price inflation, greater risk-taking and boom and bust cycles. Historically, boom-bust crises were preceded by rapid economic growth (e.g. good harvest, recovery from war or some other aggregate demand shock), speculation aided by new techniques (e.g. trains) or new financial instruments (e.g. establishment of limited liability companies) and they were fed by the expansion of liquidity. Busi-

ness cycles that culminate in banking crises exhibit a higher rate of GDP expansion. Furthermore, there is a stronger increase in the number of commercial banks, a larger increase in commercial bank assets, higher inflation and higher interest rates because of the stronger expansion of aggregate demand. However, crises are not always preceded by low interest rates. Even if this is the case, this does not necessarily imply that the crisis was caused by low interest rates. For example, low interest rates contributed to the subprime crisis but they would not have caused the crisis without the massive incentives brought about by the tremendous fiscal stimulus. Furthermore, a prolonged period of ultra-low interest rates does not necessarily lead to a crisis. The clear counter example is Japan with ultra-low rates for a very long time. Financial crises usually only arise if in addition to low interest rates other incentives to take on risk are present. As a consequence, without some substantial macroeconomic upswing, there is no imminent danger of a financial crisis because of the current low interest rate environment.

Session 2, chaired by *Professor Otto Lucius, Österreichische Bankwissenschaftliche Gesellschaft,* treated the conference topic from a **banking perspective**.

Philip Molyneux, Professor of Banking and Finance, Bangor University, talked on **Banking – Conceptual and Related Issues** taking into account what we have learned about the impact of ultra-low interest and quantitative easing (QE) on banks from the experience of Japan, the USA and the UK. Research from the Bank of Japan suggests that quantitative easing (i.e. zero interest rates and the commitment to maintain zero interest rates, expansion of the central bank's balance sheet and changes in the composition of assets held by the central bank) primarily affects the yield curve as it has effectively lowered long-term yields. Regarding the effect on financial markets, there is some evidence that it depends on the type of assets the central bank acquires and the US experience indicates that the purchase of mortgage based securities is particularly effective. Concerning the impact on the wider economy, quantitative easing has a modest impact on output, growth and inflation. The impact on banks is relatively small and rather indirect. This is also a likely reason why there has been little research of the effects of quantitative easing on banks. The limited available evidence suggests a modest influence on bank lending. In addition, banks are potentially affected by quantitative easing by, amongst other things, a compression of net interest rate margins or revaluation of assets. It was also discussed that exchange rate effects, i.e. the depreciation of the euro, could be an important channel in the euro area. However, this question needs to be investigated in more detail.

Frederic Lambert, IMF, addressed **the effects of ultra-low interest rates and unconventional monetary policy on bank profitability, risk-taking and soundness** showing results from a joint paper with his colleague Kenichi Ueda from the IMF's Global Financial Stability Review. The research is motivated by the idea that

a protracted period of low interest rates can create incentives for banks to take on greater risk thereby undermining financial stability. Different types of unconventional monetary policy entail different risks. A prolonged period of low interest rates (including forward guidance) is associated with pressure on the profitability and solvency of financial institutions, excessive risk taking ("search for yield") and evergreening of loans. Quantitative easing as conducted e.g. by the FED implies the risk that banks become dependent on central bank financing. The same risk is involved in indirect credit easing (e.g. the ECB's LTRO) which could additionally lead to delays in balance sheet repair, distortion in credit allocation, and a possible weakening of underwriting standards. Direct credit easing (e.g. the ECB's CBPP) is associated with the risk of a distortion to price and market functioning. An event study approach that observes the effect of new information about monetary policies on the prices of banks' stocks and bond spreads suggests that unconventional monetary policy entails a significant negative effect on bank credit risk as measured by the spread between bank bond yields and government bond yields. A regression approach using data from US banks and including explanatory variables that account for unconventional monetary policy points to a small negative effect of unconventional monetary policy on the profitability of banks. This effect becomes the more pronounced, the longer unconventional monetary policies are pursued. Note that from a theoretical point of view, the impact of unconventional monetary policy is ambiguous as on the one hand there are positive effects from lower funding costs and asset price valuation but on the other hand the flattening of the yield curve lowers the return from maturity transformation (interest margin compression). Concerning the risk taking of banks, the empirical results suggest that – in contrast to theoretical reasoning – banks reduce their leverage, though only to a very small degree. Furthermore, as expected, banks increase their risky assets. Regarding balance sheet repair, there is empirical evidence for both effects that should be expected from a theoretical point of view. First, low interest rates reduce the cost of rolling over non-performing loans (evergreening), and, second, banks take advantage of lower long term interest rates to extend the maturity of their debt and reduce the risk of maturity mismatches. Overall, empirical results do not point to an imminent negative impact on financial stability. However, risks are likely to rise if ultra-low rates remain in place for a longer time. Additional challenges arise from the eventual exit from ultra-low interest rate policy. Here the main channels are the effect on the interest rate margin and on the value of fixed income securities. To contain risks, changes in policies should be gradual and predictable. The exit from unconventional monetary policies should be carefully planned and well communicated. Furthermore, policy makers should be aware of a potential shifting of risks to other sectors (e.g. shadow banks).

Claude Moser, Head of Group Asset Liability Management, UBS, presented **the perspective of a large global bank.** Swiss banks are in a special situation

because of the earlier introduction of the exchange rate peg and the recent lifting of this peg. Market data suggest that Swiss and euro area forward curves price in a Japan-like outcome in Europe. The unpreceded easing by central banks could be regarded as a currency war and increases the risk of policy mistakes. Concerning banks, a protracted period of ultra-low interest rates is likely to influence the balance sheet structure of banks. On the liability side, customers tend to move from fixed-term deposits into non-maturing deposits and on the asset side customers increasingly prefer longer tenors for fixed rate loans. As a consequence, duration on both sides of the balance sheet increases. As asset duration is likely to increase more than the duration on the liability side, the net asset duration gap widens. As a result, the balance sheet exhibits a lower degree of natural duration netting capacity. This implies a higher reliance on external markets to hedge interest rate risk. Furthermore, low interest rates tend to compress net interest margins. Initially, banks profit from a downward shift in the yield curve because the duration of deposits is shorter than the duration of banks' assets. However, after some time the zero floor on deposit interest rates becomes binding and banks do not profit anymore from lower rates. As a result net interest rate margins become compressed. Furthermore, net interest rate income is less sensitive to interest rate changes when interest rates are low. Potential mitigating measures are amongst others the introduction of deposit fees for wholesale clients or improving the liability structure and reducing unwanted balances.

Paul Kocher, Chief Treasury Officer, Raiffeisen Bank International, talked about **the perspective of an Austrian internationally diversified universal bank.** He started with an overview of the potential drivers of net interest income. Net interest income is affected by competition (e.g. pressure on loan margins), the level of interest rates (e.g. lower interest rates tend to lower liability margins), balance sheet structure (e.g. tenors or currencies), the liquidity profile (when low interest rates provide incentives to hold higher liquidity buffers net interest income is under pressure), capitalisation (e.g. the increased need for high quality capital), non-performing loans (as low yields are normally observed in a low growth environment), the interest risk position (the yield curve does not provide incentives to take interest rate risk), and funds transfer pricing (as deficiencies lead to wrong pricing of products and hence eventually result in lower income). For an internationally active bank it is important to note that net interest margins in different currencies are quite different. Furthermore, although interest rates in Central and Eastern Europe are on a downward trend, they are still relatively high compared to e. g. the euro area. However, rates in Central and Eastern Europe are quite volatile and a slight positive correlation between net interest margin and risk can be observed. Regarding a flattening of the yield curve, Kocher noted that the flatter the yield curve, the more difficult it becomes to enter into a receiver position in an interest rate swap as a rebound is more likely and the reward for risk taking is lower. However, less risk

taking also implies that the net interest income suffers. Concerning negative rates, their impact on profit and losses depends on a bank's asset and liability structure. A bank that is active in various countries can react to the current situation by increasing flexibility (e.g. changing the currency structure into local currency), adapting the product structure (e.g. from term accounts to current accounts) or a shift in the client structure (more retail and fewer corporate customers). Franchise value is also quite important as it allows lowering deposit rates without losing too many customers. Higher stickiness of deposits provides longer term liquidity.

Session 3, chaired by *Ernest Gnan, Secretary General SUERF* and *Head of Division OeNB,* took an **institutional investor's perspective.**

Professor Helmut Gründl, Goethe University Frankfurt, offered an **introduction** to the topic. German banks' profitability has been falling since the mid-1990s, reflecting decreasing yields in government bonds. Since 2008, the decline in banks' interest income has accelerated. As banks' financing costs have hardly fallen, banks' interest income has also significantly fallen since 2008. For the life insurance industry, low interest rates are becoming a threat to stability. This is especially so in countries such as Germany and Austria where products sold in the past had high guaranteed returns and still represent a large fraction of their portfolio. Given the duration mismatch between assets and liabilities, the low interest rate income reduces insurers' equity capital. Solvency II will make this problem very visible and urgent from 1 January 2016. A prolonged period of ultra-low interest rates will entail high cumulative default probabilities for less capitalized insurers. Thus, the safety of defined-benefit pension schemes is seriously at risk owing to the protracted ultra-low interest rates. For defined-contribution pension plans, in the future, lower investment returns will translate into lower annuities, unless employers and employees choose to increase their contributions or unless pension funds take on higher risk in their asset portfolios. There are two possible consequences from this: one is that the insurance firms diversify into higher risk investments thus ensuring their survival ("gambling for resurrection"). Alternatively, they might be locked into low-yielding low-risk fixed income securities, just barely being able to cover their guarantees and not having any leeway for higher-yielding investments. New insurance products with lower guarantees, with a shorter duration or with revolving guarantees, would create space for higher-yield, higher-risk policies. While the share of defined-contribution pension schemes differs across countries, a general trend towards this form of contracts has been observed over the past ten years. This helps to mitigate insurers' insolvency risk. The introduction of Solvency II as from 1 January 2016 offers an example of both regulatory capture and forbearance: there were several postponements as a result of pressure from the insurance industry and of regulators' fear of insolvencies becoming apparent once regulation enters into force. Another example is the introduction of the term structure of interest rates that

will be used for evaluating long-term guarantees. With a fairly high so-called ultimate forward rate of more than 4%, the combination with a volatility dampener leads to a lower value of insurers' long-term liabilities and thus a more favourable appearance of their solvency situation. Finally, insurers will have a very long 16 years of transition period during which the term structure will adjust to the Solvency II rules.

Antti Ilmanen, AQR Capital Management, took a **fund manager's perspective.** After all the rather pessimistic views in the conference so far, he announced he would add an even worse one. Not only are we in a world of low interest rates, but so are expected returns in any investment, such as equities, corporate bonds or real estate, the lowest seen over the past decades. The reason is that any investment now has an underlying negative real return. Investors need to recognize this reality. Within this overarching constraint, there are, however, some options to optimize portfolios in terms of their risk/return ratio. Referring to over a century of data, and using a combination of the Shiller earnings yield and the sum of dividend discount yield plus an estimate of long-term real growth of earning per share, he showed that not only does expected real return of 10-year US Treasuries currently lie in negative territory, but also the expected real return on US stocks at 3.7% currently is historically very low. By contrast, the expected real equity yield in emerging markets (6.6%), the UK (6.2%) and a weighted average of the five largest euro area countries (5.5%) is substantially higher. Combined bond-equity portfolios can currently expect a real yield of 2.2% (US-type 60/40 equity/bond ratio) and 1.1% (European-type 30/70 equity bond ratio). The period between the mid-1980s and the financial crisis was characterized by historically high and falling real yields, creating high current yields combined with big windfall valuation gains. Now is "pay back time". He sees two scenarios for the period lying ahead. In a "fast pain" scenario, the high real yields of the past return, but only after a sharp correction in bond and stock prices. A "slow pain" scenario, which he regards as more likely, implies that the current low real returns are going to stay for a long time. "Contrarian timing" investment strategies look promising in such a situation but are difficult in practice. Contrarian investors, aiming to avoid large losses from a bursting of the bubble, might for instance choose to switch into cash years too early, thus foregoing substantial return. Two further strategies to enhance yield are to attach a higher share to equities versus bonds, while staying in liquid instruments ("Norwegian Sovereign Wealth Fund approach") or into less liquid assets ("Yale approach"). These approaches have in common that their return is 90% correlated with equity performance, falling short of risk diversification potential. A good investment strategy should aim at harvesting diverse return sources, using many market and alternative risk premiums in a balanced way. In his view, tactical timing, illiquid investments and "star" managers are secondary to such core return sources. Using "alpha" strategies in the sense of selecting in a discretionary way specific investment is costly, faces volume con-

straints and ultimately is a zero sum game. By contrast, as shown by an increasing body of empirical academic literature, value investment strategies, i.e. long-run strategies which systematically scan the market for undervalued investments (buying last year's winners, high yielders, "boring" quality companies, low volatility titles) are more promising. While Ilmanen regards the "slow pain" scenario as more likely, he also showed some comparative historical case studies on how different portfolios performed in the event of sharply rising real yields. While bond portfolios of course suffered in all such episodes, in most episodes (except the Volcker recession) equity and commodity portfolios were doing well. Mixed 60/40 equity/bond portfolios did well most of the time as well. Long-short strategies did well in virtually all episodes because they are zero-duration investments. To conclude, Ilmanen emphasised that in low yield situations, investors pay more attention to costs, putting pressure on management fees and calling for efficient portfolio management techniques.

John Nugée, Laburnum Consulting Ltd., gave an overview of **current issues in central bank reserves management.** Central bank reserves management has elements of economic policy (foreign exchange management, maintaining a country's creditworthiness, managing of a country's foreign exchange debt), market liaison (collecting information on foreign exchange and bond markets, communicating policy intentions, etc.) and of financial management (balance sheet and risk management, income generation, wealth preservation). These three very different objectives require different skills, their relative weightings may differ across central banks, and as a result also individual central banks' investment objectives and style will differ. Any central bank must thus first of all position itself in this "reserve management triangle", on the basis of which it can then determine the relative importance of security, liquidity and return among its investment objectives. Particularly for large central banks, and for those investing in smaller less liquid markets, central banks may become important price makers or even dominant players. Then timing, sensitivity to the market situation, effective order management, a strategic choice of counterparties as well as confidentiality pre- and post-trade become central. Central banks feel the current ultra-low yields much the same as many other market participants, since they need the return on their reserves to fund themselves (or are expected to pay large dividends to the Finance Ministry). Similarly to other large investors, central banks might in principle diversify into higher-yielding bonds (e.g. corporate), into second-tier developed markets (e.g. CAD, AUD, NZD, NOK, SEK, DKK) and emerging markets (especially RMB), establish equity and alternative asset portfolios, increase the role of gold and outsource non-core portfolios to external managers. However, in practice central banks face many constraints such as size, liquidity, transparency, knowledge of markets, and available counterparties. Central banks must also do cost-benefit analyses, ask whether they can afford to hire and hold staff with the very specialized skills required, and question whether

the central bank's management would understand the new investment vehicles and could explain them to the public. Also, interference with other official investors and the potential recipient markets (and its authorities) needs to be considered. Finally, central banks' large scale involvement in markets – particularly through QE – is bound to influence the signalling properties from these markets, depriving central banks from important information and increasing policy uncertainty. Many central banks have turned from lenders of last resort to funders of last resort. Thus, some markets have turned from being a window of the outside world into a mirror of central banks' own operations. Also investors' response functions to central bank actions is changing, with investors paying less attention to inherent market value but increasingly on expectations of central bank actions. Thus, a change in policy can produce bigger market responses than hitherto. This is compounded by a fall in market maker capacity and reduced bond market liquidity, further restricting the number of markets considered investable by central banks.

The session concluded with a presentation by *Dario Focarelli, Director General of the Italian Insurance Association,* on **ALM with ultra-low interest rates from a (life) insurance perspective.** Almost three quarters of the European life insurance industry's individual premiums (EUR 667 billion in 2013) are related to traditional life insurance products, which offer capital and/or return guarantees. National markets differ vastly by size. However, life premiums as a share of GDP give a distorted picture since for asset and liability risk management, the duration of liabilities is also crucial. Therefore, e. g., while in Italy the share of life insurance premiums in GDP is much higher than in Germany, the required provisioning in percent of GDP is roughly the same in both countries, since the duration of insurers' liabilities is much shorter in Italy. According to EIOPA's (European Insurance and Occupational Pensions authority) assessment dated December 2014, the risk from low interest rates continues to be the major risk factor for insurers. Stress tests by EIOPA with insurance companies have shown that central and northern European insurers are more exposed to risks from gaps between financial guarantees and low yielding assets than firms in southern Europe and France. Guaranteed rates have already tended to decrease between 2009 and 2013, thus adapting new business to the low yield environment. A major challenge for insurers is how to cope with these risks without failing commitment to policy holders and maintaining competitiveness. A second important risk is liquidity risk, if insurers take illiquid assets into their books. For the future, Focarelli sketched three scenarios: 1) a gradual rise in interest rates – as the European economy recovers gradually thanks to reforms and QE, inflation and inflation expectations also gradually return to 2%; as a result, nominal and real interest rates will gradually increase. 2) a prolonged period of ultra-low interest rates – QE turns out to be ineffective because overly leveraged banks and consumers choose to deleverage rather than to lend and spend; bond yields would remain close to their current levels for the next ten years. 3) an infla-

tion-driven surge in interest rates, as the ECB reacts too slowly to prevent a rapid rise in inflation; increasing inflation expectations would lead to a sharp rise in nominal bond yields. He regarded Scenario 1 – the most favourable for insurers – the most likely. Scenario 3 is in his view very unlikely for the next 2 to 3 years. EIOPA seems to be mostly concerned with Scenario 2. This is what Japan experienced: there, the prolonged period of low interest rates led to a number of insolvencies among insurers. Japanese insurance firms responded by shifting their focus away from traditional endowment products towards protection products. As regards the European insurance industry, Focarelli concluded that, even if a Japan-type scenario 2 were not to materialize, insurers should vigorously shift their business strategy from savings towards protection products, including the restructuring of financial guarantees. In terms of their asset composition, insurers should reallocate assets towards corporate and structured bonds. In this way, they can make minimum financial guarantees sustainable in a prolonged low interest rate scenario.

The final session 4, chaired by *Vice Governor Andreas Ittner, OeNB,* was devoted to **policy perspectives.**

Isabel Schnabel, Chair of Financial Economics Gutenberg School of Management and *University of Economics Mainz and Member of the German Sachverständigenrat,* gave a presentation on **bubbles and central banks: historical perspectives.** She started from the controversy of whether central banks should be passive about bubbles and only "clean up the mess" once a bubble bursts (Greenspan view) or whether they should actively "lean against the wind" (BIS view); and in the latter case, whether they should use interest rates or macroprudential tools to deflate bubbles. While the recent crisis experience seems to have shifted the balance of views towards a more pro-active role by central banks, the question is still unresolved. To shed more light on this issue, Schnabel analysed 23 prominent asset price booms from the past four decades, classifying them by types of asset classes involved, asset holders, the economic environment during the build-up of the bubble, the severity of the crisis and the policy responses. A first finding is that bubbles occurred in a wide range of assets; in most instances, bubble assets were held widely, banks were often among the speculators; most bubbles were largely financed by debt, and importantly bank credit, thus increasing the likelihood of a banking crisis; bubbles were usually triggered by technological or financial innovations or by political events; they emerged when monetary policy was expansionary and were often accompanied by lending booms and sometimes capital inflows. While real estate bubbles often led to severe recessions, a narrow focus on them would be misleading, since also other markets are prone to bubbles. Crises were sometimes amplified by fire sales by banks of bubble assets, and weak bank balances sheets due to asset depreciation sometimes laid the ground for later crises. Regarding policy responses, pure "cleaning up the mess strategies" were found only in rela-

tively immature financial systems and were associated with severe disruptions of the financial sector and real economy. There were historical examples of successful "leaning against the wind" interest rate policies but in most instances they could not prevent severe recessions. Often, they were too weak and came too late. For lack of counterfactuals, Schnabel could not confirm the hypothesis that too strong "leaning against the wind" may be harmful. Also, the pricking of bubbles historically did not always lead to recessions. A policy of early leaning against the wind is preferable to a late pricking of bubbles. When prices have already risen to unsustainable levels, all policy options will likely be expensive. Macroprudential instruments were not used in the early parts of the sample but became more common in the 20th century. They were sometimes (but by no means always) successful. While macroprudential measures have the advantage of being more targeted than interest rate policies, since they can focus on specific sectors, they can at the same time be more easily circumvented. As with interest rates, timing and dosage are essential. All in all, there are therefore no simple prescriptions – no instrument worked in all circumstances. Currently, there is a build-up of risk in many markets due to search for yield, which is the consequence of "cleaning up the mess"-oriented highly expansionary monetary policy. However, there is no clear threat to financial stability as long as there is no sharp expansion of credit. The risks from "leaning against the wind" interest rate policy are particularly acute after financial crises; therefore, at the current juncture, macroprudential policies may be better suited to deal with current emerging asset price booms.

Korbinian Ibel, Director General at the Single Supervisory Mechanism, offered a **microprudential bank supervisor's perspective.** Low interest rates are as such nothing special; however, negative nominal rates are very rare both for banks and for supervisors. Banks need to look out for three areas in particular: A first area concerns business infrastructure. Most derivative models cannot handle negative nominal interest rates. Pricing assets or risk becomes difficult in such an environment. Also, the functioning of Value at Risk Models is unclear with zero or negative rates. But even if models can be made to work, it is open whether the associated IT systems can. Bankers thus need to make very careful plausibility checks of any model results and to generally check all their infrastructure. A second area concerns customer behaviour and deposit modelling. Models assume deposits are stable and safe assets. But this may no longer be the case with negative nominal interest rates. If customers were to dislike negative interest rates sufficiently, would they shift financial balances to alternative investments? This needs to be played through with scenarios. Also the competitive position may be affected. Even if customers were to accept negative deposit rates (also through higher fees), banks need to assure that national consumer protection legislation allows this. Third, a lengthening of duration implies huge interest rate risk. The 1990s US savings and loans crisis reminds us that in such a situation, a hike in interest rates can threaten many banks'

solvency. Interest rate risk is currently not adequately captured. Supervisors need to take four measures. First, they need to reinforce horizontal analysis. For instance, within the SSM, the fact that 120 large banks from 19 different countries are supervised by one institution allows extensive cross-checking and peer learning for best practices. Second, the intensity of supervision by the SSM's joint supervisory teams is determined on the basis of risk levels. Third, onsite inspection is central: the SSM's joint supervisory teams also check IT systems, operational aspects, interest rate management and risk management. Fourth, stress testing will remain important. While no AQR-type of stress test is planned for 2015, the SSM will challenge banks' business models to ensure a stable banking system also in an ultra-low interest rate environment.

Wolfgang Herold, Austrian Financial Market Authority, presented **a supervisor's perspective on asset liability management at insurance companies.** He started with explaining the recent 2014 EIOPA stress test (based on 2013 balance sheet and interest rate data), which comprised 167 insurance firms and groups from across the EU, Switzerland, Iceland and Norway. The stress test checked for the impact of applying Solvency II on the robustness of insurance firms' financial situation, under certain macro stress scenarios, including a low-yield "Japanese"-type scenario. The aim was to check the preparedness of both the industry and insurance supervisors, and to provide some input on the final calibration of the level 2 guidelines for Solvency II. With the benefit of hindsight, the interest rate assumptions of the EIOPA stress test, which were fixed in December 2013, were much more benign than the current actual interest rate level. Even the "low yield scenario", which was at the time heavily criticized for being too extreme, has been surpassed by far on the downside by actual interest rate developments. Comparing pre- and post-stress solvency capital requirement coverage ratios (i.e. the ratio of pre- and post-stress test own funds over the equity required according to Solvency II), the stress test showed that Austrian and German life insurers are strongly exposed to interest rate risk as compared to firms in other countries such as Italy. A decomposition of the pre-stress solvency capital requirement shows that market risk (the most important component of which is interest rate risk) dominates. For the European insurance industry as a whole, market risk even exceeds the aggregate net solvency capital requirement. A comparison of the duration of liabilities and assets shows that German and Austrian insurance firms have a very large duration mismatch of about 10 years. Given Austrian insurance firms' leverage, a 1 percentage point fall in interest rates wipes out 30% of their equity. He then showed simulation results in which the yield curve is not shocked equally across maturities but where a marked flattening is involved. Depending on the assumed asset composition, very different time profiles for cash flow mismatch result, with strongly diverging implications for equity over time. Comparing the internal rate of return on assets to the discount rate of liabilities showed a positive return margin of 1% for Austrian insurers, compared

to –0,5% for German firms. Finally, using the risk-free yield curve published by EIOPA in February 2015, taking the average maturity of Austrian insurers liabilities of 16 years as a basis, Herold showed that currently insurers need to earn around 2 percentage points of yield through taking credit risk over and above the risk-free rate, in order to earn the average guaranteed rate of close to 3% inherent in their liabilities. This is why Solvency II provides for very long transition periods for capital requirements to be fully met, in order to give insurance firms the time needed to adjust their product portfolios and contracts to the low yield environment in a sustainable way.

The session was concluded with a presentation by *Olivier Garnier, Group Chief Economist, Société Générale,* on **ultra-easy monetary policies: risks and benefits for the financial system.** Ultra-easy monetary policy implies lower risk-free short rates, a steeper yield curve ("bull steepening"), lower risk premiums and higher equity prices. For banks this may imply wider net interest margins, lower delinquency and default rates, a revaluation of legacy assets and stronger credit demand. On the other hand, easy monetary policy risks a zombification of the economy, excessive risk taking (including carry trades) and asset price bubbles. But the current situation is different. Central banks' bond purchases result in a zero or even negative term premium. Negative official interest rates imply a tax on banks' excess reserves. And top of this, financial re-regulation requires tougher capital/leverage ratios, tighter liquidity ratios, new resolution and bail-in rules have been introduced, and in a number of countries various levies on bank balance sheets have been introduced (systemic risk tax, contributions to resolution fund etc.). The term premium for 10-year US Treasuries has been depressed into negative territory, not only due to the Fed QE purchases, but also due to distortionary regulatory rules of Basel 3 and Solvency II as well as increased demand for government bonds as collateral (because of rules aiming to make wholesale markets safer). The negative term premium is a key risk to financial stability if sustained for a long time. The term premium is the price for maturity transformation. If distorted to zero or even into negative territory by state intervention, savers become even more reluctant to invest long-term, while borrowers will be eager to borrow long-term. Thus the maturity mismatch between the supply and demand of savings will be exacerbated, while discouraging bank maturity transformation, and maturity transformation risk will be shifted outside the banking system into more opaque areas. If maturity risk is priced negatively, investors will react by assuming increased liquidity risks, which results in increasing liquidity mismatch between assets and liabilities in investment funds (which guarantee daily liquidity to their customers) and other institutional investors, at a time when secondary market liquidity is already drying up as a result of investment banks reducing their market maker activities in response to regulation. The exit from this current negative term premium regime will be challenging. Once central banks start hiking official rates, the adjustment in the term premium could

be either too slow (as happened in the US in 2005 when risk neutral yields strongly surged while the term premium remained at zero) or too abrupt. To smooth the adjustment and "guide" the term premium, central banks might consider interventions in interest swap markets. Regarding negative interest rates, Garnier expects that we are just at the beginning, since the euro area banking system's excess reserves will be boosted over the next 18 months as a result of the ECB's Expanded Asset Purchase Program, and the EONIA will move towards the ECB's deposit rate. How will markets react to this? There might be a flight to paper currency. For instance, "cash reserve accounts" (that only hold currency) or "vault cash bonds or ETFs" might be created. As a result the money multiplier would fall and become more unstable. Retail banks' profitability will be depressed by the negative rates, since charging significant fees on retail deposits is unlikely due to legal, commercial and political obstacles. Finally, liquidity will be forced out of the banking system by discouraging banks to take wholesale deposits through multiple "taxation": Regulatory liquidity coverage ratios discourage banks to take on corporate deposits, and liability taking is discouraged by various levies. As a result, liquidity may be shifted into the shadow banking system. Summing up, the combination of reregulation and ultra-low/negative interest rates may encourage "bad" (rather than "good") disintermediation, which is driven by regulatory arbitrage and search for yield.

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With around 170 registered participants, the conference demonstrated impressively how useful and crucial an interdisciplinary dialogue between practitioners, policy makers and academics is, in particular when it comes to new, complex and multidimensional topics such as the one addressed in this conference. To fully grasp relevant scenarios, challenges and possible solutions to the topic at hand, the conference combined insights from economic history, macroeconomics, finance and business administration as well as legal and institutional expertise on relevant supervisory frameworks, including various operational aspects. Only such a holistic view allows financial firms and policy makers to make adequate assessment and decisions, and enables academics to tailor their analysis and research to the needs of practitioners and policy makers and society at large. SUERF thanks its co-organisers, its members as well as conference speakers and participants for supporting activities like this.

This volume contains policy oriented contributions by seven of the conference speakers. We thank all conference speakers as well as in particular the authors to this volume for their time, effort and willingness to share their expertise and experience with a wider community. The power point presentations of all conference presentations can be found at www.suerf.org/vienna_2015. In addition, we have published a synthetic overview of the topic in the OeNB's quarterly bulletin Monetary Policy and the Economy, Q2/15.

Interest rate cycles and implications for the financial sector: a long-term view

Richard S. Grossman[1]
Wesleyan University and
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1 Introduction

Writing at the time of the conference on "Asset-liability management with ultra-low interest rates", jointly organized by SUERF – Société Universitaire Euopéenne de Recherches Financières, Oesterreichische Nationalbank (OeNB) and Austrian Society for Bank Research (BWG), it is impossible to deny the conference's underlying premise, namely that the industrialized world is in the midst of a period of *ultra-low* interest rates. Central bank benchmark rates have been low for years. The US Federal Reserve's federal funds target rate range has been 0 to 0.25 percent for nearly 6-1/2 years, the Bank of England's bank rate has been 0.5 percent for almost exactly 5 years, and the Bank of Japan's overnight call rate has been 0.1 percent for 4-1/2 years. The above, of course, includes only central banks with positive benchmark rates: at the time of this writing, the Swedish Riksbank and the Schweizerische National Bank benchmarks are below zero.

Although the above-mentioned rates seem low, are they low by historical standards and in comparison with rates not directly set by the central bank? Charts 1 and 2 address this question, by presenting data on American, British, German, Japanese, and Swiss Treasury bill rates from 1960 to 2015. These figures illustrate that the recent declines in short term interest rates are both more profound and persistent than any experienced during the past half-century. Japan is an outlier in that ultra-low short-term rates have been a feature of its economy since the "lost decade" of the 1990s.

Nor has the phenomenon of ultra-low interest rates been limited to the short end of the market. Quantitative easing (QE) has also brought down longer-term yields. Charts 3 and 4 present data on US and Japanese 10-year treasury bonds, highlighting three rounds of American QE, two rounds of Japanese QE, and the Bank of

[1] The author is grateful to conference participants for helpful comments.

Japan's recent enhancement of its existing QE program. Just days before the conference, the European Central Bank commenced a EUR 60 billion monthly QE program, which is scheduled to extend through September 2016.

Are these interest rate declines steeper than those witnessed following financial crisis in earlier eras? Charts 5 and 6 suggest that they are not. Chart 5 presents data on the private discount rate (a short-term market interest rate) in England between 1840 and 1870, as well as the average for the entire 19th century, and highlights the three major banking crises of the period (1847, 1857, and the Overend, Gurney crisis of 1866). Chart 6 presents data on the US commercial paper rate between 1863 and 1910 and indicates the three major banking major crises of the period (1873, 1893, and 1907). The three horizontal lines in chart 6 represent the average commercial paper rate during the ten years prior to each crisis. The data presented in charts 5 and 6 confirm that it was not unusual for interest rates to remain below their pre-crisis levels for extended periods of time in the wake of 19th and early 20th century financial crises.

We can broaden these results by considering the experiences of more countries over a longer period of time. To do this, chart 7 looks at average pre- and post-crisis interest rates during a longer period and across a broader sample of countries. Based on data gathered by Michael Bordo, it presents average short- and long-term interest rates for years in which banking crises took place, the five years before crises erupted, and the five post-crisis years. Thus, the chart shows the course of interest rates averages before, during, and after crises. The data cover 20 countries (including western Europe, the USA, Canada, Japan, and Australia) between 1880 and 1997. The pattern in chart 7 is striking: following financial crises, long- and short-term rates fall by as much as 4–5 percentage points, typically bottoming out four years after the crisis, and remaining below pre-crisis levels for at least five years.

The potential consequences of ultra-low interest rates – both positive and negative – are many and varied. On the positive side, low interest rates should boost investment spending (e.g., spending on housing, plant, and equipment) because these purchases are frequently made with borrowed money, thereby leading to improved prospects for economic growth. Large-scale borrowers also benefit from low interest rates. According to a study by McKinsey, low interest rates led to a savings of about USD 1.6 trillion for governments in the USA, UK, and euro area countries between 2007 and 2012. The same study indicates that non-financial corporations saved about USD 710 billion.[2]

Exporters also benefit because low domestic interest rates encourage investors to send funds abroad in search of higher returns. Since the domestic currency cannot be used to purchase foreign assets, investors seeking a higher return overseas must sell domestic currency to purchase foreign currency (which can be used to purchase

[2] Dobbs, et al. (2013).

foreign assets), driving down the exchange value of the domestic currency and making domestic goods cheaper, and more attractive to foreign buyers.

Ultra-low interest rates can also have negative consequences. Lenders – including pension funds, insurance companies, and retirees living off their savings – suffer because their investments yield less income. Banks and other financial institutions that rely upon interest rate margins to earn a profit, find those margins squeezed. And importers suffer because the foreign goods they would like to sell in the domestic market become more expensive.

A potentially dangerous consequence of ultra-low interest rates, and the focus of the remainder of this paper, is that they may generate asset-price bubbles as low interest rates lead investors to seek higher returns via ever-riskier investments. Because credit is cheap and plentiful in a low interest rate environment, investors have the resources in the form of borrowed money to make large wagers on high-risk projects. Thus, low interest rates may contribute to a rise in the prices of assets (i.e., asset price bubbles), such as real estate or commodities. When these bubbles burst, those who have taken on debt to finance asset purchases and those who provided the loans to finance those purchases find themselves in serious financial difficulty.

The next section presents a description of the observed pattern of boom-bust financial crises. The subsequent section discusses the recent US subprime crisis in the context of the historical pattern. The final section concludes with a brief evaluation of the risks of ultra-low interest rates, particularly for Europe.

2 Boom-bust financial crises: a familiar pattern

Boom-bust financial crises have long been a feature of the world economy.[3] Writing in 1859, the journalist D. Morier Evans noted that the pattern was *already* 60 years old, saying such crises occurred "…immediately after a period of apparent prosperity, the hollowness of which it has exposed. So uniform is this sequence, that whenever we find ourselves under circumstances that enable the acquisition of rapid fortunes, otherwise than by the road of plodding industry, we may almost be justified in arguing that the time for panic is at hand" (Evans 1859 [1969]).

Among the earliest modern economists to construct an analytical model of financial crises was Irving Fisher (1932, 1933); more modern versions of his model were developed in the popular and influential works of Hyman Minsky (1982) and Charles Kindleberger (1978). In this model, financial crises begin with an exogenous shock – such as a bumper harvest, the beginning or end of a war, the widespread adoption of a game-changing technology – which provides new profit opportunities and sets the economy off on an economic boom. As the boom progresses, speculation develops in a particular asset. The object of speculation varies from crisis to

[3] See Grossman (2010, 2013) for more detailed descriptions of boom-bust financial crises.

crisis, and has included land/real estate, agricultural products, mines, railroads, foreign securities, and assets as diverse as limited liability companies.[4]

Boom-bust economic expansions are typically fed by ample credit, which reduces the cost of borrowing. Once the speculative mania catches hold, cheap credit allows speculators not only to risk their own funds, but to assume ever-greater debt which increases the potential reward, as well as potential risk, of speculation.

Because cheap credit is frequently an important contributor to boom-bust cycles, it is reasonable to ask – as many have[5] – if ultra-low rates will lead to a renewed boom-bust cycle. Historical evidence suggests that low interest rates alone are not sufficient to generate a boom-bust cycle.

Consider again chart 7. A notable feature of this diagram is that the years preceding financial crises are not characterized by below-normal interest rates. In fact, short- and long-term interest rates do not decline during the prelude to financial crises, only in their wake. Looking across a number of countries during the late 19th and early 20th century, Grossman (2010, chapter 3) finds that business cycle expansions that precede financial crises tend to have higher interest rates and stronger GDP growth than business cycle expansions that do not end in a financial crisis. This evidence supports the view implicit in the work of Fisher, Minsky, and Kindleberger that in the absence of an exogenous shock, low interest rates alone are not sufficient to cause a boom-bust cycle.

3 A recent example: the subprime crisis

The American subprime mortgage crisis provides a case in point in which stimuli other than low interest rates generate a boom-bust financial crisis. The exogenous shock and key culprit in generating the subprime crisis was the dramatically expansionary fiscal policy undertaken by the administration of President George W. Bush. Ideologically committed to lowering taxes, in accepting the Republican Party's nomination for president in 2000, candidate Bush said: "Today, our high taxes fund a surplus. Some say that growing federal surplus means Washington has more money to spend. But they've got it backwards. The surplus is not the government's money. The surplus is the people's money…. So we will reduce tax rates for everyone, in every bracket."

President Bush was true to his word. Under his predecessor Bill Clinton, the US government ran a budget surplus for the first time since the 1960s. During President

[4] See Grossman (2010, Appendix 3.1) for a detailed catalogue of banking crises and the target of speculation in each.

[5] See, for example, Koo (2014) and the warning by IMF chief economist Olivier Blanchard www.telegraph.co.uk/finance/economics/10989500/IMF-fears-ultra-low-rates-are-fuelling-asset-bubbles.html.

Bush's first administration, he engineered three tax cuts. In addition to cutting taxes, the United States embarked on costly wars in Iraq and Afghanistan. The combined effect of the tax cuts and increased war spending raised the US government's debt-to-GDP ratio from less than 58% in 2001, to 65% in 2005, to nearly 70% in 2009.

Fiscal policy was not the only culprit, of course. Monetary policy was exceptionally loose in the aftermath of the collapse of the dot-com bubble: by the end of 2001, the federal funds rate was lowered to 2%. Although not low by the standards set in December 2008, at the time it was the lowest federal funds rate in 40 years (it would subsequently drop to 1% or lower between 2003 and 2004), and well below what rule-of-thumb models of monetary policy recommended. In addition to easy fiscal and monetary policies, financial supervision was lax and a number of regulatory and legislative changes made it easier for firms and households to take on increased debt loads, and encouraged more subprime mortgage lending. The combined effect of fiscal, monetary, regulatory, and supervisory changes inflated a bubble in US real estate markets. The bursting of this bubble in 2008 led to a massive financial crisis which reverberated worldwide.

Although various observers blame different factors for generating the subprime crisis, fiscal policy must bear the lion's share of the blame. Tighter monetary policy would have reduced the appetite for risk-taking; more rigorous regulation and greater vigilance on the part of the ratings agencies might also have curbed some of the excesses that led to the crisis. Fundamentally, however, the incentives brought about by expansionary fiscal policy, both on the tax side and on the spending side, increased the incentives for risk taking to the point where a financial crisis was inevitable.

4 Conclusion: how risky are ultra-low interest rates?

Prolonged low interest rates can increase risk-seeking on the part of investors as they embark on a hunt for yield. And they certainly contributed to the subprime crisis, as they have in many other crises throughout the past 200 years. It is not inconceivable that current ultra-low interest rates may lead to bubbles in various assets, particularly commodities and real estate. Policy makers need to be wary of these asset bubbles.

For the most part, however, low interest rates have not generated financial crises in the absence of other factors. In virtually all historical instances of financial crises in which easy credit was a factor, there was some exogenous shock that generated the boom-bust cycle. In the United States prior to the subprime crisis, a massive fiscal stimulus provided the backdrop for the crisis. In Japan, by contrast, interest rates have remained low since the mid-1990s and no asset bubble has emerged, primarily because the Japanese economy has been so weak.

As of March 2015, US economic growth has rebounded from the recession. GDP growth is now nearly equal to pre-crisis levels, and is forecast to perform well in 2015–2016. Unemployment in February 2015 was 5.5 percent, its lowest level since May 2008, and the upper end of the range set by the Federal Reserve to trigger higher interest rates. In the current environment, it appears likely that US rates will rise in the coming months, as they should.

In Europe, where growth remains more sluggish, the European Central Bank has just embarked on monthly quantitative easing of EUR 60 billion through September 2016 and interest rates will remain low for some months yet. This policy is not without risks. With higher interest rates in the United States, low European interest rates may not lead to increases in investment, but may provide an incentive for European money to flow to the United States to take advantage of higher rates.

At the time of this writing, however, economic growth in Europe remains sluggish. In the current economic environment, and in the absence of some exogenous macroeconomic shock, the risk of low interest rates leading to a boom-bust are considerably lower than the risk that higher interest rates will strangle Europe's recovery. As Europe's economy recovers, this calculation will change.

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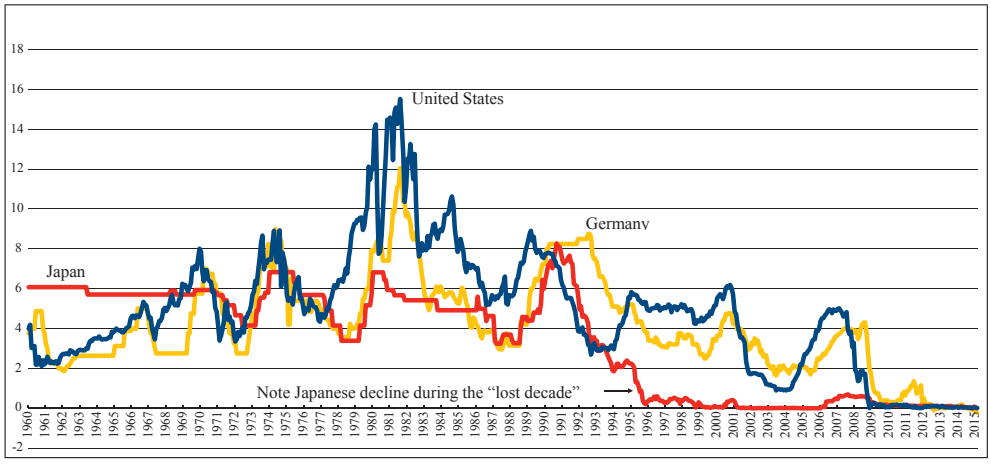
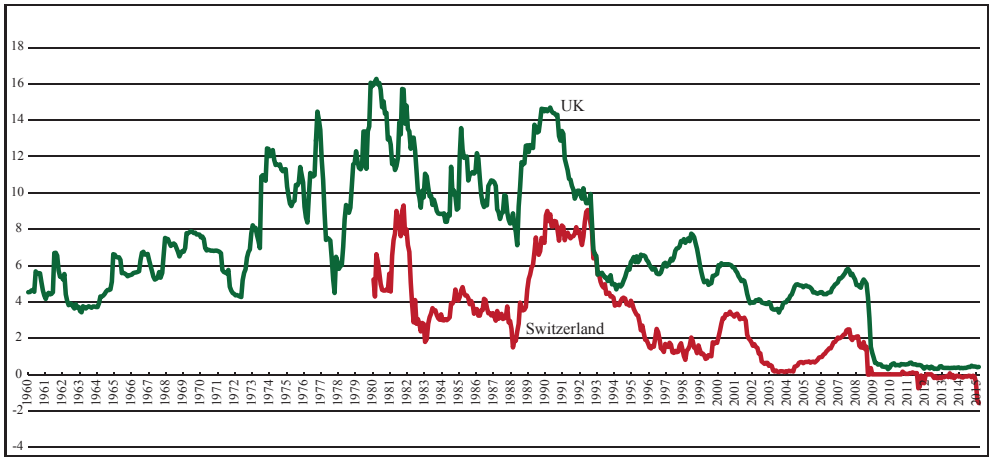
Chart 1: 3-month treasury bill rates, Germany, Japan, USA (Jan. 1960–Feb. 2015)



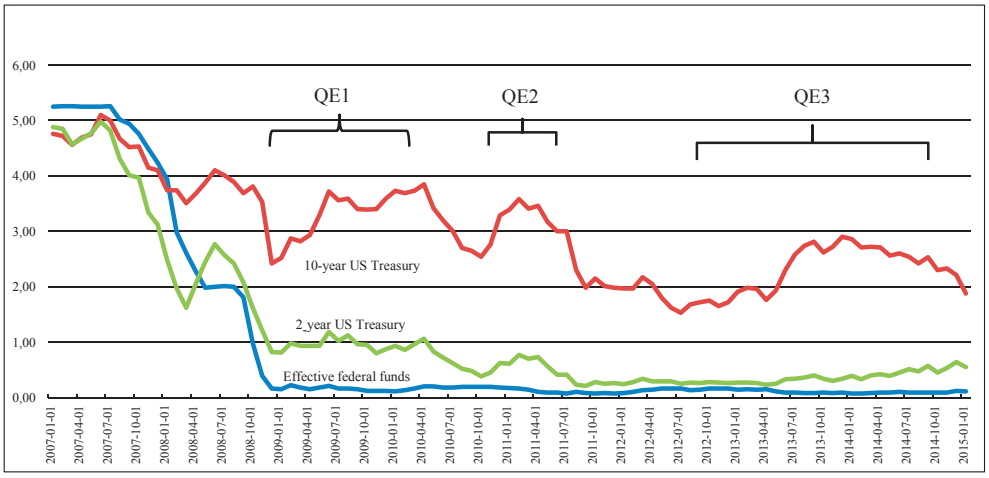
Source: Global Financial Data.

Chart 2: 3-month treasury bill rates, Switzerland and UK, (Jan. 1960–Feb. 2015)



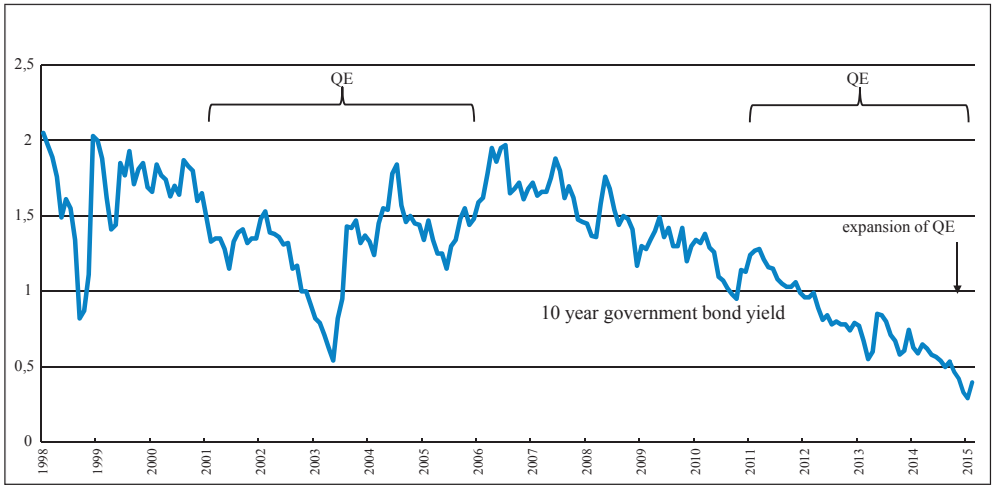
Source: Global Financial Data.

Chart 3: Quantitative easing and yield in the USA



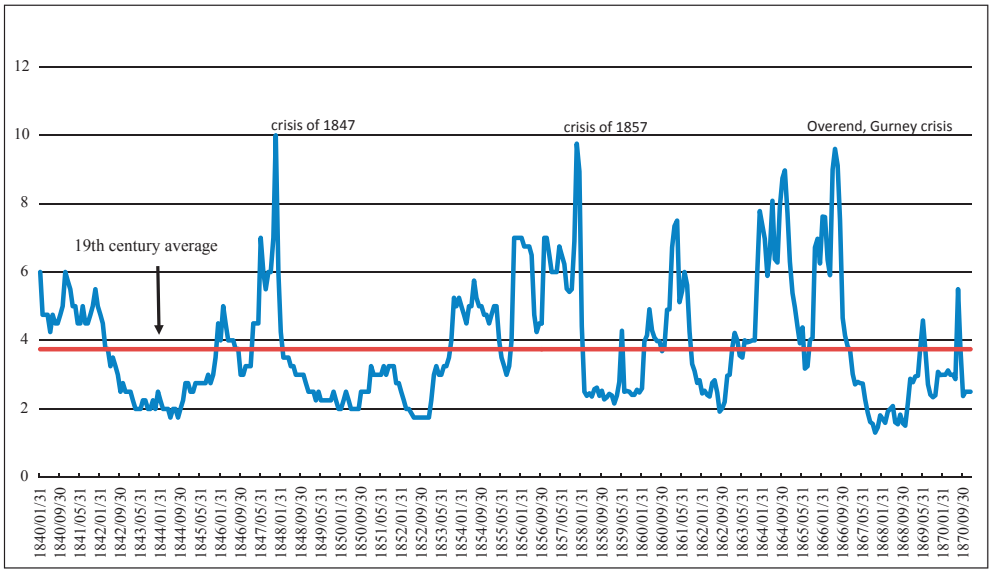
Source: Federal Reserve Bank of St. Louis.

Chart 4: Quantitave easing in Japan



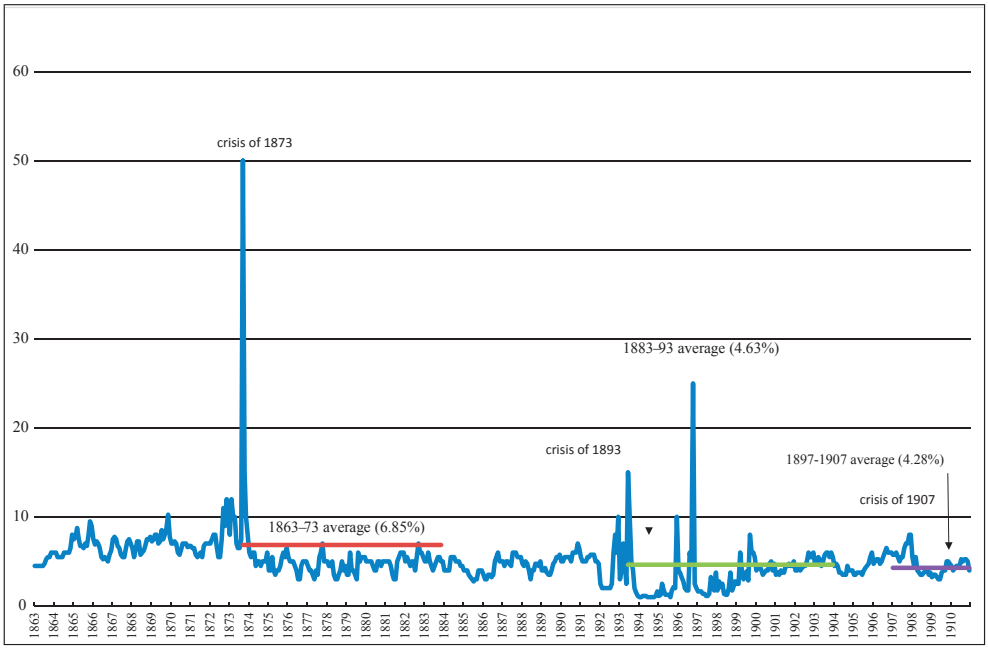
Source: Global Financial Data.

Chart 5: Private discount rate in England, 1840–1870



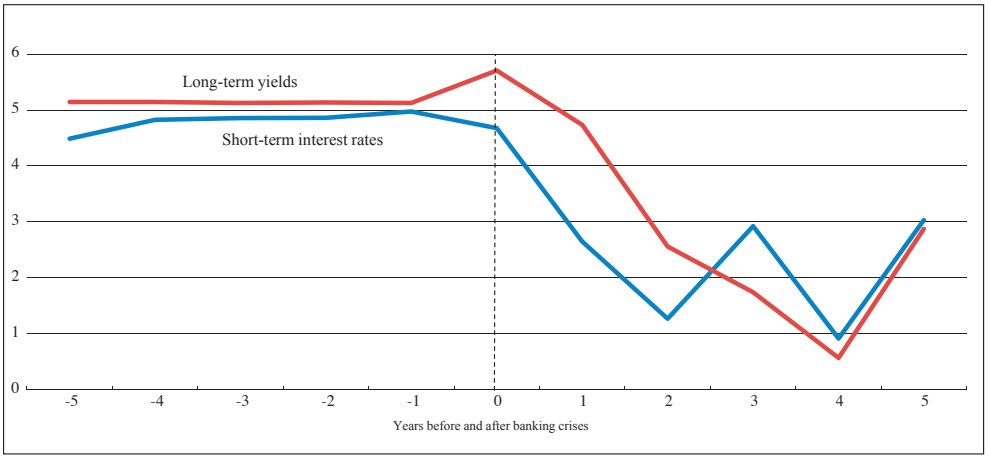
Source: Global Financial Data.

Chart 6: US commercial paper rate, 1863–1910



Source: Global Financial Data.

Chart 7: Short-long-term interest rates before and after banking crises



Source: Bordo.

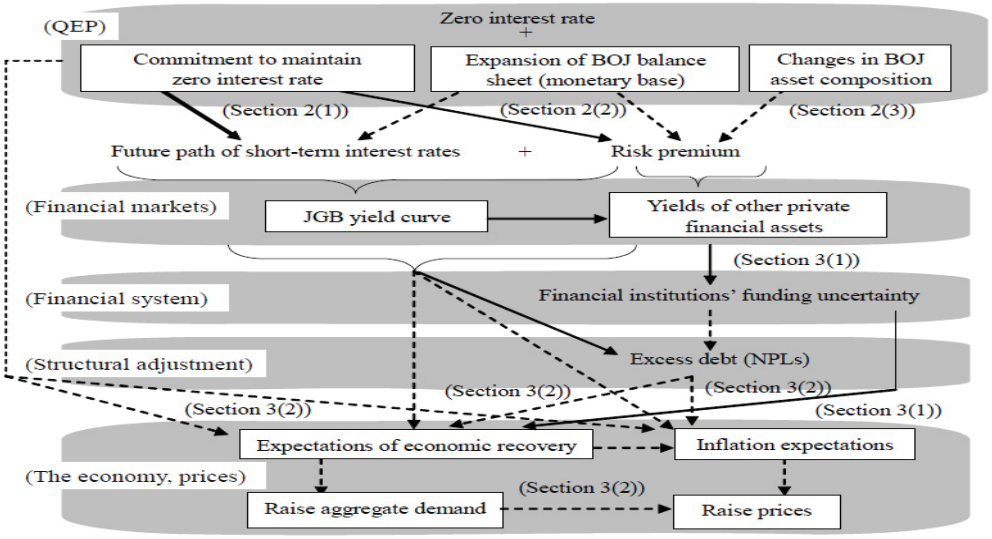
Banking with ultra-low interest rates – conceptual and related issues

Philip Molyneux
Bangor University

1 Introduction

This presentation examined the theory and practice of the impact of ultra-low interest rates on bank behaviour. First, the conceptual issues, and here the experience of Japan's low interest rate environment in the early to-mid 2000s provides useful insights that tend remarkably to be repeated in the more recent low interest rate environments in the USA, UK and euro area. Chart 1 provides lessons from Japan on the main channels through which an ultra-low interest rate channel impacts banks and the overall financial system. It can be seen that such policy is character-

Chart 1: Conceptual issues – insights from Japan's 2001–2006 QE



Source: Ugai (2006).

Note: ——▶ *strong effects* ——▶ *some effects* ·····▶ *uncertain/small effects*

ised by 1) a commitment to maintain very low or zero rates into the future; 2) expansion of the central bank balance sheet / monetary base; and 3) changes in the asset composition of the central bank. The strongest impact on the financial sector is found to be via the commitment to low rates which influences the future path of short-term rates and ultimately the government bond yield curve. It also impacts risk premia influencing yields on private financial assets that reduced bank and other financial firms funding risks/uncertainty which boosts expectations of economic growth. A variety of possible influences with the strength of effects are shown in the aforementioned chart, ultimately the impact on the macroeconomy overall is found to be uncertain or small at best.

2 Empirical evidence

There is a growing recent empirical literature on the influence of Quantitative Easing (QE) and related low/zero interest policy. One strand of these studies examines the influence of central bank asset purchases on financial markets. Studies on the USA (Gagnon et al., 2011; D'Amico and King, 2013 and Hancock and Passmore, 2014) and the UK (Joyce et al., 2011; Breedon, Chadha and Waters, 2012; D'Amico et al., 2012) find that the impact varies depending on the type of asset the central bank acquires. Typically, purchases of mortgage-backed securities seem to have the largest influence on broader financial markets. Other studies look at the influence of asset purchases on the broader macroeconomy – in the USA (Chung et al., 2012 and Chen, Curdia and Ferrero, 2012); UK (Kapetanios et al., 2012; Bridges and Thomas, 2012 and Pesaran and Smith, 2012); and in Japan (Berkmen, 2012). All these have the common finding that QE has a modest impact on broad economic indicators such as output/growth and inflation.

One area where low or zero interest rate monetary policies have had an impact, however, is on yield curves. The general consensus being that such policies have lowered long-term yields and financial market volatility (see Vissing-Jorgensen and Krishnamurthy, 2011; Gagnon et al., 2011; Swanson et al., 2011; Damico et al., 2012; Wright, 2012; Aksoy and Basso 2014; Wu 2014; Neely 2015 and Steeley and Matyushkin 2015).

There have been very little analyses of the effects of QE/asset purchases on banks. A couple of notable exceptions are by Bowman et al. (2011) who finds that Japan's QE between 2001 and 2009 had a modest positive influence on bank lending, and Joyce and Spaltro (2014) who look at the UK and find a modest impact on bank lending.

Overall, the empirical literature appears to focus more on the influence of financial markets and (via) yield curve effects, as it looks like, this is what policy-makers view as the main channel of QE/alternative monetary policy. So there is

need for more work on the impact of QE on banks, particularly as there is casual evidence that alternative monetary policy can have specific industry effects.

3 Industry views

In addition to formal academic study, industry analysts have also been studying prior low-interest rate environments in Japan, the USA and UK to try and gauge the impact of the ECBs EUR 1 trillion QE that was announced in January 2015. Chart 2 illustrates Goldman Sachs (2015) assessment of prior US QE impact on banks and shows that their stock prices were bolstered by three main QE periods in the USA, although bank stickis still lagged broad market indices (S&P 500). Chart 2 also notes that QE tended to squeeze margins because although funding costs declined, yields on interest bearing assets fell more, thus reducing net interest margins and squeezing profits. QE also helped reduce US market volatility which is bad for investment banking securities trading revenues. There were some initial asset revaluation gains, however, due to the lower of rates.

Chart 2: Impact of QE on US banks

Banks: US QE announcement risk-positive – longer-term P&L effects negative

In the 1 month following the 6 QE announcements, banks outperformed in 4 cases. Medium term, however, profitability suffered, owing to margin pressure. QE introduced the following moving parts:

- **Margin pressure**: funding cost decline was more than offset by the fall in securities yields. Banks' NIMs were pressured, and profitability impacted, as a consequence.
- **Lower volatility**: By reducing volatility, QE impacted investment banks' securities trading operations.
- **QE-related deposits:** institutional investors placed some of the excess liquidity as deposits. Deposit volumes grew, and bank liquidity positions improved.
- **(Some) book value accretion:** ALM portfolios showed an uplift, owing to unrealised gains.

We note that banks underperformed in the years following QE extension, despite an initial positive reaction on the announcement date. This underperformance is reflective of factors other than QE (litigation, regulation, volume pressures).

Exhibit 2: Banks outperformed after the extension of QE1, but have consistently lagged the broader market in subsequent years
S&P 500 and S&P 500 Banks sub-index (1st Oct 2008 = 100)

Source: Federal Reserve Board.

Chart 3: Impact of QE on euro area banks (1)

Banks: Initial gain, longer-term NIM challenge …

QE will compress NIM across the Eurozone. In the core, we expect this process to be particularly acute (Sell Commerzbank). On the periphery, the initial impact of asset yield compression could be offset, owing to a fall in liability spreads. Longer term, however, we expect the margin compression (especially through ALM revenue reduction) to offset this benefit.

We see Intesa (CL-Buy) as a relative beneficiary in a Euro banks context, while we see Commerzbank (Sell) as exposed to NIM pressure from the onset.

QE should result in: (1) compression in sovereign yields across the Eurozone, thus (2) reducing funding costs for the peripheral banks, (3) and (further) lowering re-investment yields. We expect the medium-term effect of margin compression to be most visible in the core, where the liability cost reduction does not act as an offset. Peripheral banks, therefore, should find the medium-term impacts more manageable, in our view.

Exhibit 3: As interest rate expectations have continued to fall…
EUR 5y swap rate and EUR 3m swap rate, %

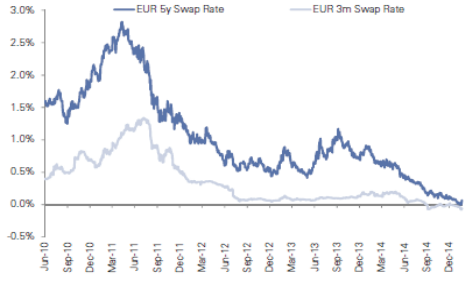
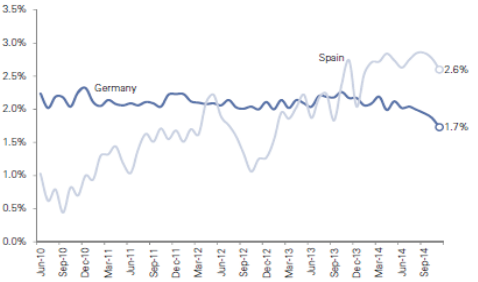


Exhibit 4: …margins in the core have compressed, with margins in the periphery still somewhat above that level
Margins on corporate lending (new business funded by corporate deposits)



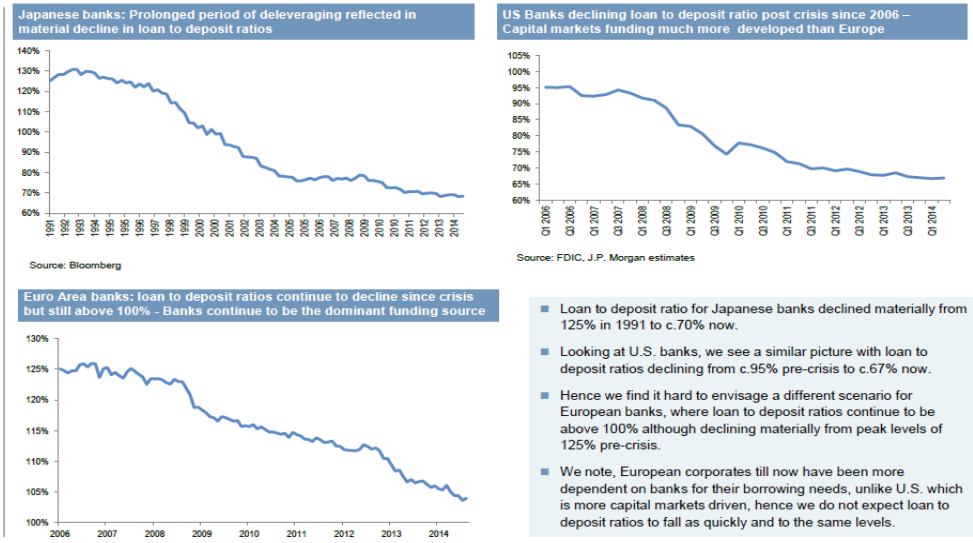
Source: Datastream, ECB, Goldman Sachs Global Investment Research.

Similar experiences are forecast for euro area banks, particularly a compression of margins and this is expected to be particularly acute in Germany and France.

As well as tightening margins there will also be pressure on other revenues. Banks with substantial euro area sovereign debt (and particularly those in the higher risk peripheral countries like Greece and Portugal) will experience a one-off asset revaluation benefit as QE leads to a fall in yields. This gain can be counted as Tier 1 capital under the EU's CRD IV regulation so it should strengthen thinly capitalised banks. Also, as QE tends to boost stock prices in general this could increase revenues of banks with significant asset management, private banking and related businesses. Also, there could be improvement in growth across the euro area that feeds through into improved banking sector performance. However, on the downside JP Morgan Cazenove (2015) have cautioned that if Japanese and US experiences are to be repeated, we are likely to witness a substantial deleveraging in euro area banking loan-to-deposit ratios are still much higher here at 110% compared with around 70% in the USA and Japan. Although JP Morgan Cazenove (2015) do not expect loan-to-deposit ratios to fall to the same levels they still expect a fall and this, they argue, will put further pressure on bank margins as illustrated in charts 3 and 4.

Chart 4: Impact of QE on euro area banks (2)

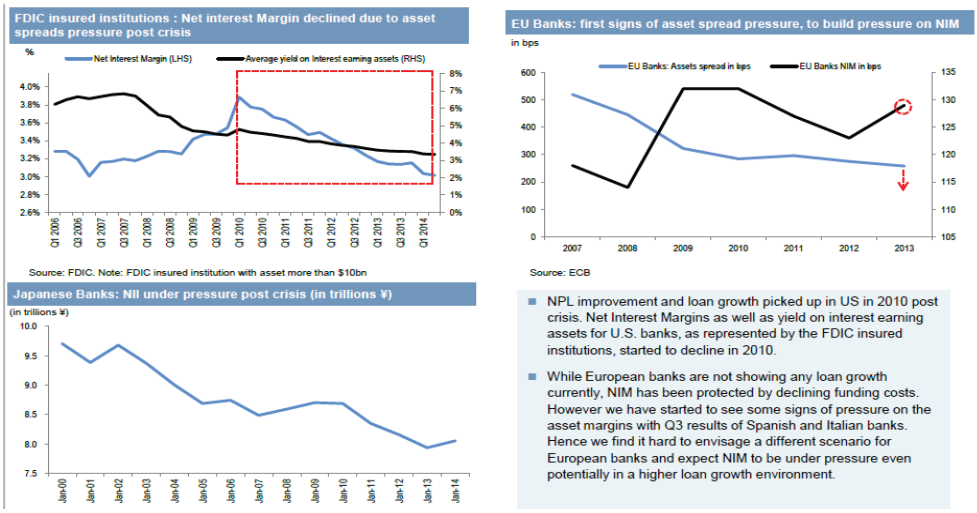
…and B/S deleveraging driving L/D ratio moving to excess funding position as in Japan leading to NIM pressure…



Source: Bloomberg, FDIC, J. P. Morgan estimates.

Chart 5: Impact of QE on euro area banks (3)

…in addition, NIM remain under pressure with asset margins feeling the pain - U.S. banks tell similar story…



Source: FDIC, ECB, Japanese Bankers Association, Bank of Japan.

Conclusions

There is increasing academic interest in the impact of QE and alternative monetary policy on the broad macroeconomy and financial markets but little work to date on banks. Academic studies typically focusing on country specific issues whereas analysts are more interested in international comparisons, looking at experiences from Japan, UK and the US and extrapolating for euro area banks.

In short, alternative monetary policy appears to have a substantial impact on yield curves and financial markets, less impact on macroeconomic indicators and a modest influence on bank lending (although evidence here is somewhat limited). Recent analyst work focuses on margin pressures. There is some evidence that bank profits were positively impacted by early US Fed asset purchases but this has not yet been rigorously analysed.

Overall, it is somewhat worrying that previous analysis of the influence of ultra-low interest rates and related QE policy in Japan, the USA, and UK have had such a limited observable impact on broad macroeconomic indicators. This does not augur well for the recent QE measures by the ECB.

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Are unconventional monetary policies bad for banks?

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The potential side-effects of unconventional monetary policies have received more and more attention as short-term interest rates in many advanced economies have been kept close to zero for growing periods of time. During the acute phase of the crisis, central banks' actions helped banks to withstand the financial turmoil. In the short term, they may have increased intermediation spreads by lowering short-term rates. Over time however, too easy monetary policies may reduce banks' profitability as the yield curve flattens and risk premia are reduced, and encourage more risk-taking. As former Federal Open Market Committee member Jeremy Stein put it in February 2013, "a prolonged period of low interest rates, of the sort we are experiencing today, can create incentives for agents to take on greater duration or credit risks, or to employ additional financial leverage, in an effort to *reach for yield*." Also, with low interest rates, banks may prefer to roll over loans to non-viable firms rather than declaring them non-performing and registering a loss in their income statement, a behavior often referred to as "evergreening." The overall effect of unconventional monetary policies on banks' profitability and risk is therefore theoretically unclear.

This paper discusses the results of various empirical analyses trying to shed light on this question. It is based on a chapter of the IMF's April 2013 *Global Financial Stability Report* analyzing the risks to financial stability of very easy monetary policies, and on a working paper co-written with Kenichi Ueda that focuses on the effects of unconventional monetary policies on banks.

Let us first define what we mean by unconventional monetary policies (UMP). Those indeed include very different measures that carry different potential risks (table 1).

The first policy is the prolonged period of low interest rates. While policy rate cuts are typically conventional policy measures, the prolonged period of zero-interest rate and the forward guidance often associated with it are something of a less conventional nature. Low interest rates for a long period of time can weigh on banks'

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net interest margin, encourage them to search for yield by taking more risk, or reduce incentives to clean their balance sheets by for instance provisioning or writing-off non-performing loans.

The second type of policy, quantitative easing, consists of direct purchases by central banks of government bonds to reduce term spreads when the policy rate is at or close to the zero lower bound. The risk here is that banks may become dependent on the liquidity provided in this way by central banks with possible ensuing delays again in balance sheet repair.

Table 1: Risks from unconventional monetary policies

Type of policy	Examples	Associated potential risks for banks
Prolonged period of low interest rates	US Federal Reserve Bank Bank of Japan European Central Bank (forward guidance)	Pressure on the profitability and solvency of financial institutions Excessive risk taking ("search for yield") Evergreening, delay in balance sheet repair
Quantitative easing	US Federal Reserve Bank Bank of Japan Bank of England	Dependence on central bank financing
Indirect credit easing	Bank of England (FLS) ECB (LTRO) Bank of Japan	Dependence on central bank financing Delay in balance sheet repair Distortion in credit allocation, possibly weakening underwriting standards
Direct credit easing	US Federal Reserve Bank (MBS) ECB (CBPP) Bank of Japan (ETF, REIT)	Distortion to price and market functioning

Source: Adapted from Table 3.5 of the Global Financial Stability Report, April 2013.

Note: CBPP = Covered Bonds Purchase Program; ETF = Exchange Traded Funds; FLS = Funding for Lending Scheme; LTRO = Long-Term Refinancing Operation; MBS = Mortgage-Backed Securities; REIT = Real Estate Investment Trusts.

Finally, credit easing is about central banks either providing liquidity to banks to promote bank lending (indirect credit easing) or directly intervening in credit markets through purchases of corporate bonds or mortgage-backed securities (direct credit easing). In both cases, there is a risk of distortions in the allocation of credit, possibly weakening underwriting standards (if borrowers are able to get loans for which they would otherwise not qualify), with potential adverse effects on the performance of loans and on future bank health.

We use three complementary approaches to assess the effects of those policies on banks. The first approach is an event study, which is based on the idea that any effect of unconventional monetary policies on bank soundness (including bank default risk and performance) should be immediately be reflected in changes in bank stock prices and bond risk premia at the time of the announcement of new measures. The second approach furthers the understanding of the channels of impact of UMP on banks, by relating indicators of monetary policy to balance sheet measures of bank's health, including profitability, risk taking and the status of balance sheet repair. The third approach considers the possible rise in interest rate risk in banks, which is a potential consequence of the prolonged period of low interest rates.

The event study analyzes the effect of UMP announcements on bank stock prices and bond spreads. To accurately gauge those effects, we use the surprise component of policy announcements. This is because the expected element should not affect market prices at the time of announcement as it should be already priced in. In particular, we use the change in the one-year-ahead three-month futures rates as the surprise measure, so as to capture both the contemporaneous part of a monetary policy announcement (reflected in the target policy rate change) and any expected developments for near-term future rates (focus of the forward guidance and quantitative easing). However, this measure may also reflect expectations of economic conditions a year later, which are affected by current monetary policy (an endogeneity issue). Besides, downward changes in the one-year ahead futures rate are potentially limited once the policy rate hits the zero lower bound (a measurement problem). We therefore also propose a new way to measure the surprise component of monetary policy announcements by comparing the number of news articles on monetary policy three days before and after each policy announcement.

For (almost) all monetary policy announcement dates between January 2000 and October 2012, we regress daily bank stock returns and daily changes in the spread between bank bond yields and government bond yields on our measure of monetary policy surprises. We find that bank stock prices are not affected by a surprise easing of monetary policy in the United States, but that they are in the euro area and in the United Kingdom. The absence of significant result for the United States is consistent with previous studies. For example, English, Van den Heuvel, and Zakrajšek (2012) find a positive effect on bank stock prices of interest rate cuts,

but a negative effect of a steepening of the yield curve. The negative relationship in the euro area and the United Kingdom may seem more surprising. A possible explanation is that an unexpected announcement of a large monetary easing operation may be seen as a signal that the central bank has a pessimistic view of the economic conditions, thereby triggering a drop in stock prices.

We do however find a significant negative effect of monetary policy surprise on bank credit risk in the medium term. The economic magnitude of that effect is not negligible. Between 2007 and 2013, the policy rate in the United States came down by about 5 percentage points. Assuming that the cumulative easing from interest rate cuts, quantitative easing and forward guidance is "equivalent" to 6% in interest rate terms, the impact on credit spreads would correspond to a 60 basis points increase. According to Ueda and Weder di Mauro (2013), this 60 basis points funding cost increase is equivalent to a downgrade of almost 3 notches in the credit rating scale used by most credit rating agencies. We find no evidence of different effects of UMP compared to those of conventional interest rate cuts.

The second approach to investigating the effects of UMP on banks uses bank balance sheet data to measure financial health. Whereas the event study looked at *market perceptions* of bank soundness and risk, this approach relies on panel regressions to directly relate various measures of bank profitability, risk and efforts toward balance sheet repair, to monetary policy variables. We consider three policy variables: (i) the difference between the policy rate and the rate computed from a Taylor rule (a measure of the stance of monetary policy in terms of the interest rate); (ii) the number of periods during which this difference is negative over a 5-year period, to capture the effect of the prolonged period of low rates; and (iii) the ratio of central banks' assets/GDP to capture the effects of quantitative easing and credit easing. The regressions are estimated on quarterly data for 614 US banks over the period 2007–2012. The results need to be interpreted with caution for at least two reasons. First, some central banks' actions since 2007 have been partly in response to problems in banks, so they may not be truly independent. The estimation method we use (system GMM estimator by Arellano-Blundell-Bond-Bover) partially alleviates the issue. Second, besides the influence of UMP, banks balance sheets have been affected by other factors, like fiscal policies and financial reforms, which cannot be fully controlled for, raising a risk of omitted variable.

As mentioned in the introduction, the expected effects of UMP on bank profitability are theoretically ambiguous. On the positive side, low interest rates reduce bank funding costs whereas policies supporting asset prices have positive valuation effects. On the negative side, however, prolonged periods of low rates and the ensuing flattening of the yield curve compress bank interest margins. The empirical results reflect these ambiguous effects. We do not find any statistically or economically significant effect of the monetary policy variables on the net interest margin.

In the short term, low interest rates are associated with higher return on assets, but the effect of a prolonged period of low rates is negative.

Theoretically, the effect of UMP on bank risk-taking is less ambiguous than the effect on profitability. On the asset side, low interest rates increase the demand for riskier assets, yielding higher returns, while on the liability side, they decrease the cost of debt, thereby encouraging leverage. Unfortunately the results of the empirical analysis are not as clear-cut. We find that low interest rates are associated with a decrease in the risk-weighted assets ratio in the short term but that a prolonged period of low rates seems to increase risk. At the same time, longer periods of low interest rate are also associated with a higher equity ratio (so a lower leverage).

Finally, we look at the effects of UMP on balance sheet repair by banks. On the asset side, balance sheet repair implies removing toxic assets and writing off bad loans. When interest are very low, banks can however rollover existing loans or even extend new loans to nonviable firms at nearly zero cost. On the liability side, banks can take advantage of lower term premia to extend the maturity of their debt and reduce the risk of maturity mismatches. The empirical analysis finds evidence of these two effects. We proxy banks' efforts towards balance sheet repair by two measures: the first one is the ratio of provisions for possible losses on loans to total loans. The second one is the share of short-term debt in banks' total borrowing. Banks' loan loss provisions decline with the expansion of central banks' balance sheet and this can suggest a risk of evergreening. Yet an alternative view is that with UMP supporting economic activity, existing loans become more viable and hence need fewer provisions. On the liability side, we find a decrease in the short-term debt ratio when central banks' assets increase. So banks do seem to take advantage of lower term premia to extend the maturity of their debt.

The last part of the analysis looks at changes in interest-rate risks in banks. There are two main channels through which banks are affected by increases in interest rates: the spread between lending and borrowing rates, and the value of fixed-income securities on their balance sheet.

There may also be indirect effects on loan performance. These effects can work in opposite directions, and the sign of the overall effect depends on things such the maturity structure of banks' balance sheets and other factors.

The "repricing gap" is the cumulative amount of interest-sensitive assets repricing within one year less the amount of interest-sensitive liabilities scheduled to reprice within one year. It is negative if interest-sensitive liabilities exceed interest-sensitive assets. According to this measure interest-rate risk looks contained, at least for the largest US banks. The average gap for US banks is slightly positive, so banks could actually gain from a rise in interest rates.

Yet banks still hold very large volumes of government securities whose value would drop if interest rates rise. Bank holdings of government debt have generally increased since the beginning of the crisis, making them potentially more vulnera-

ble to valuation changes. In 2012, the Bank of Italy thus reported that a 200 basis points increase in interest rates would cost Italian banks 7.7% of their capital through a combination of increases in net interest earnings and a fall in the value of their government bond holdings.

In conclusion, we do not find evidence of an immediate deterioration of bank health. Unconventional monetary policies have generally improved bank soundness, by for instance buying time for banks to recapitalize (i.e. increase their equity ratio). The results of the panel regressions on bank risk and efforts toward balance sheet repair are indeed rather benign. But risks are likely to rise the longer very accommodative policies remain in place. The event study indeed showed some evidence of increased credit risk and reduced profitability, as did the panel regressions. Finally, the holdings of government bonds by banks in some countries could raise challenges for the exit.

In 2013, the Global Financial Stability Report (GFSR) was recommending to be alert to possible emerging risks in banks. The analysis was based on data up to 2012. We now have two more years of data and things may have changed. Policy makers should in particular make sure that risks do not increase outside the traditional banking sector. This requires vigorous risk-based supervision and robust data provision. There may also be scope for targeted micro- and macroprudential policies. The GFSR again identified specific measures that could prove helpful to contain credit risk and funding challenges for banks, such as robust capital requirements, improved liquidity requirements, and well-designed dynamic forward-looking provisioning. Bank supervisors should ensure that banks repair their balance sheets and strengthen their capital and liquidity buffers while unconventional monetary policies are still in place. And when exit time comes, the changes in policy should as much as possible be gradual and predictable to avoid market disruptions.

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Asset and liability management with ultra-low/negative interest rates The perspective of a Swiss bank – an illustrative example[1]

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Market environment

In 2014 fixed income markets saw a huge curve-flattening globally on disinflation concerns and a "hunt for yield". This could be well observed in forward curves showing incredibly low outright yields, e.g., the 5-year, 5-year CHF forward rate fell from 2.60% in January 2014 to a new low of 0.42% in January 2015, and is now standing at 0.75%. The 5-year, 5-year EUR forward curve dropped from 3.20% to 1.20% in 2014.

[1] This paper and the information contained herein, including the illustrative examples, are provided solely for information purposes, address the topic of Asset and Liability Management with ultra-low/negative interest rates in general and not with respect to UBS Group AG, UBS AG, the UBS group or their position, and are not to be construed as a solicitation of an offer to buy or sell any securities or other financial instruments in Switzerland, the United States or any other jurisdiction. No investment decision relating to securities of or relating to UBS Group AG or UBS AG or its affiliates should be made on the basis of this document. UBS specifically prohibits the redistribution of this material in whole or in part without the written permission of UBS and UBS accepts no liability whatsoever for the actions of third parties in this respect. The views expressed in this presentation and the accompanying remarks are the views of Claude Moser and do not necessarily reflect the views of UBS or its management.

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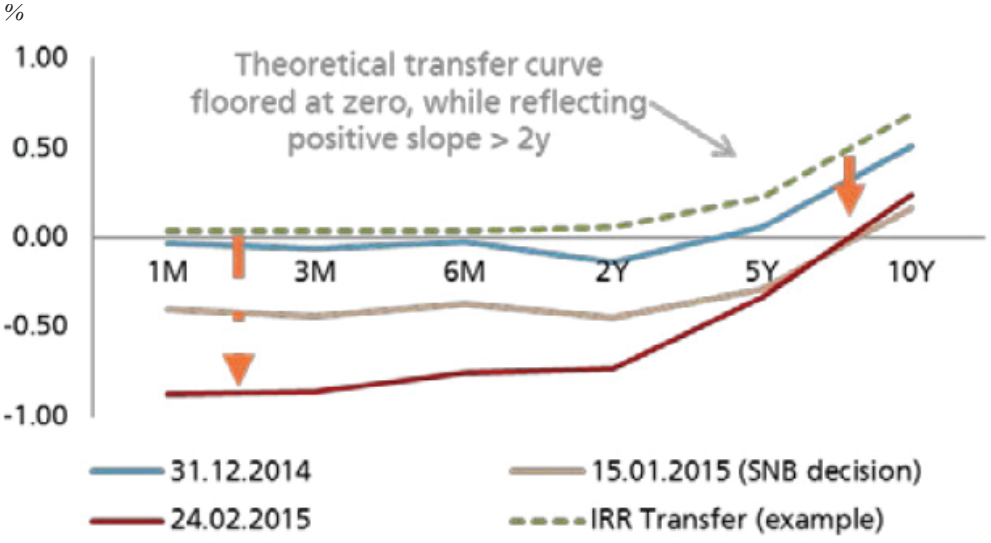
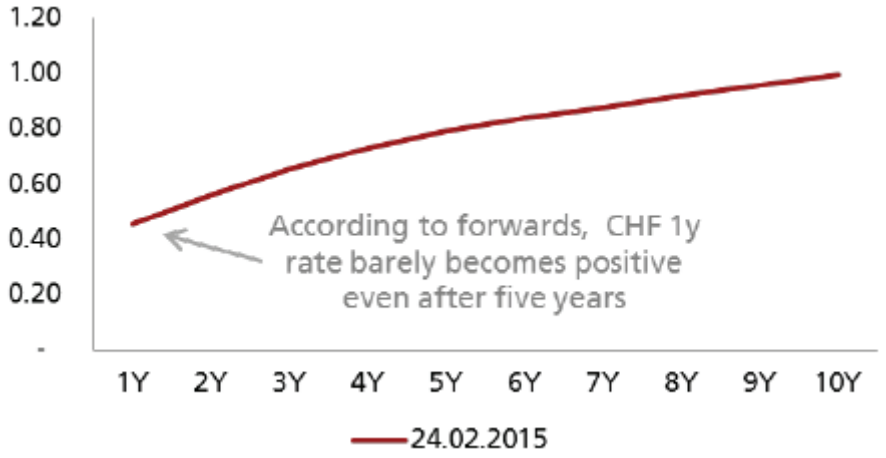
Chart 1: CHF rates development



Source: Bloomberg, UBS.

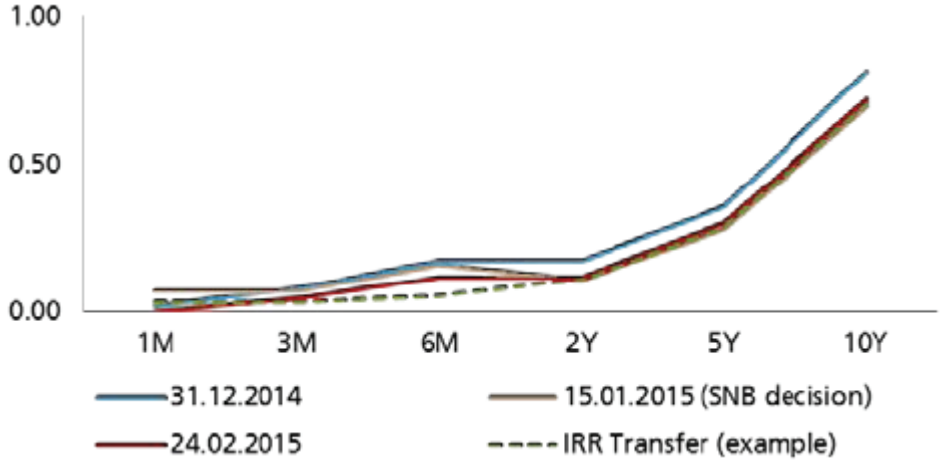
Chart 2: CHF yield curve in 5 years according to current forward rates



Source: Bloomberg.

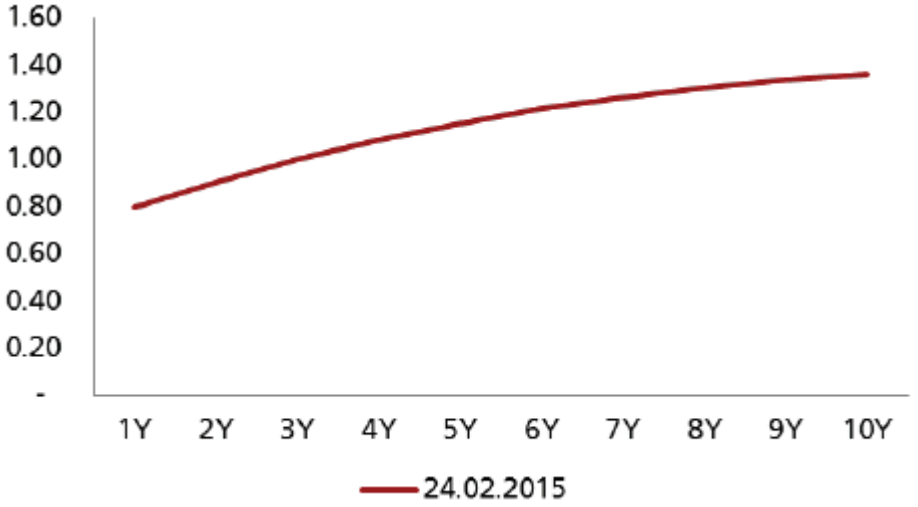
With the SNB's decision on January 15, 2015 to remove the EUR/CHF exchange-rate floor, CHF rates have steepened in 2015 with the SNB taking the short end to significantly negative levels. The euro curve flattening of 2014 has largely remained.

Chart 3: Euro rates development
%



Source: Bloomberg, UBS.

Chart 4: Euro yield curve in 5 years according to current forward rates
%



Source: Bloomberg.

One could conclude that CHF and EUR rates curves seem to be pricing in a Japan-like outcome in Europe, but it is more the case that markets are characterized by global lowflation. Consensus has made a systematic error with inflation fore-

casts as the sources of inflation have reverted to being global. The systematic error is shown by the fact that the US and other economies' employment numbers continued to improve, but inflation has not increased. It seems that the recovery from balance sheet recession led to a slower growth (lower inflation) environment than expected, whereas employment has recovered. Another influential factor was the oil price keeping inflation rates low. In particular the euro area is characterized by competitive deflation with inflation turning negative year on year. This is driven by the decision to encounter the financial crisis with austerity resulting in a deflation of wages and increased competitiveness. Also, China's economic growth is slowing down with concerns remaining around the credit boom driven by housing and other investments. Last but not least, the global commodity demand is decreasing, with the Baltic Dry Index reaching historic lows in mid-February 2015.

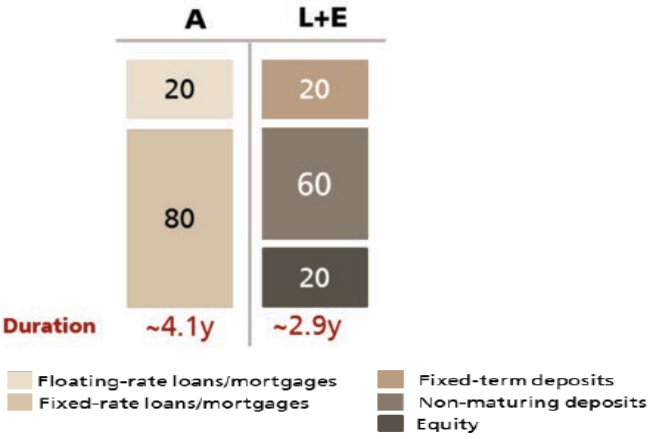
Within this context, unprecedented central bank easing has continued. Since January 2015, over 20 independent central banks have eased their policy with Egypt, Turkey, Botswana, Israel, China, India, Australia, Singapore, Pakistan, Indonesia, Canada and Peru being amongst them. The European, Swiss, Danish and Swedish central banks have even imposed negative rates. However, with central banks having significantly expanded their balance sheets, the scope for potential policy mistakes has increased greatly.

Illustrative balance sheet structure of a Swiss bank

Below an illustrative example is shown of how a typical bank's balance sheet might have looked like before the advent of the persistently low rates environment a few years ago.

Chart 5: Higher percentage of fixed-term deposits and short-/mid-term mortgages

CHF billion



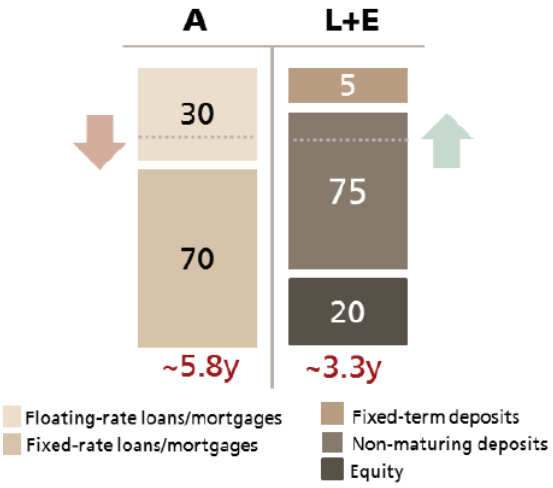
Source: Illustrative example prepared by UBS.

On the asset side, a mixture of floating-rate/short-term and fixed-rate loans/mortgages is assumed, CHF 20 billion and CHF 80 billion, respectively. On the liability side, a fair amount of fixed-term deposits (clients were still receiving a decent level of rates back then) and probably a larger amount of non-maturing deposits (current, transaction, savings accounts, etc.) is assumed, CHF 20 billion of term deposits and CHF 60 billion of non-maturing deposits. In addition, we assume CHF 20 billion of equity.

Since the low interest environment started in 2009, an increasing number of clients have been incentivized to move from fixed-term into non-maturing deposits and from mid-term into longer-term mortgage products. Recent central bank decisions have further intensified this development. Consequently, the interest rate risk structure of the balance sheet will have significantly changed.

Chart 6: Higher percentage of non-maturing deposits and longer-term mortgages

CHF billion



Source: Illustrative example prepared by UBS.

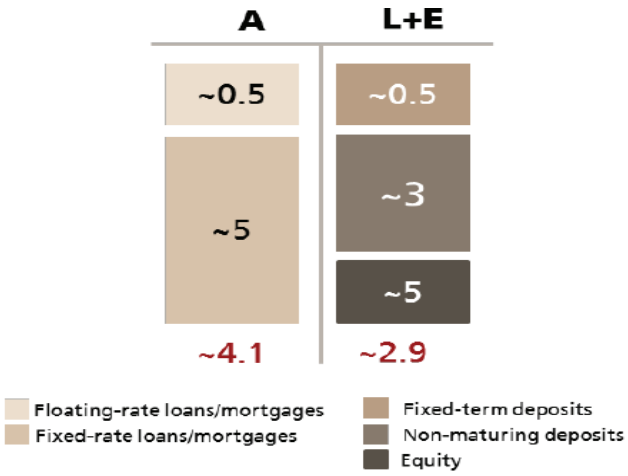
Along with the structural changes on the balance sheet, there will be a bar-belling on the asset side, with an increased demand for floating-rate mortgages. Within the portfolio of fixed-rate mortgages, clients are assumed to have an increased preference to lock in longer tenors once longer-term rates have fallen far enough. On the deposit side, less and less clients are willing to invest in term deposits at low rates and would begin to "park" their excess cash in non-maturing accounts to "sit out" the period of low rates. Therefore, without appropriate steering, negative or low

interest rates can significantly influence the long-term structure of the balance sheet.

Chart 7 shows a likely duration structure of the example-bank's balance sheet before the extended period of low and further falling rates sets in. The duration of the fixed-rate mortgages would be, say, around five years on average. Further, it is assumed that the floating-rate/short-term loans or mortgages have an average interest rate duration of around six months and that is about the same average duration for the fixed-term deposits.

Chart 7: Higher percentage of fixed-term deposits and short-/mid-term mortgages

years



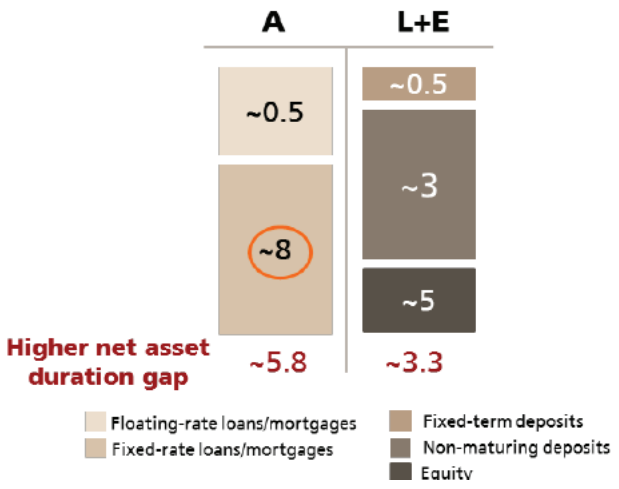
Source: Illustrative example prepared by UBS.

Ideally, the balance sheet will exhibit a very high degree of natural duration netting capacity with any imbalance economically hedged with the external market via fixed versus floating interest rate swaps. The higher the imbalance between asset and liability duration, the higher the reliance on the external market to enable hedging of inherent interest rate risk.

The next chart shows the implications for interest rate risk management after the extended period of persistently low interest rates. By this time the duration of the fixed-rate mortgages would have increased to, say, 8 years from 5 years on the initial balance sheet.

Chart 8: Higher percentage of non-maturing deposits and longer-term mortgages

years



Source: Illustrative example prepared by UBS.

Although the volume of fixed-rate mortgages has dropped due to shifts into floating-rate mortgages, the average duration of the asset side will have increased to nearly 6 years compared to around 4 years initially. While the volume of the non-maturing deposits will have increased in the low-rates environment, it is assumed that their effective interest rate duration will have remained the same, at around 3 years.

However, the average duration of the liability side will have increased from the higher proportion of non-maturing deposits versus (shorter-duration) term deposits. To complete the picture, a target duration of the bank's equity to be 5 years is assumed, while any interest rate hedges the bank may have put on to reach this target duration are ignored.

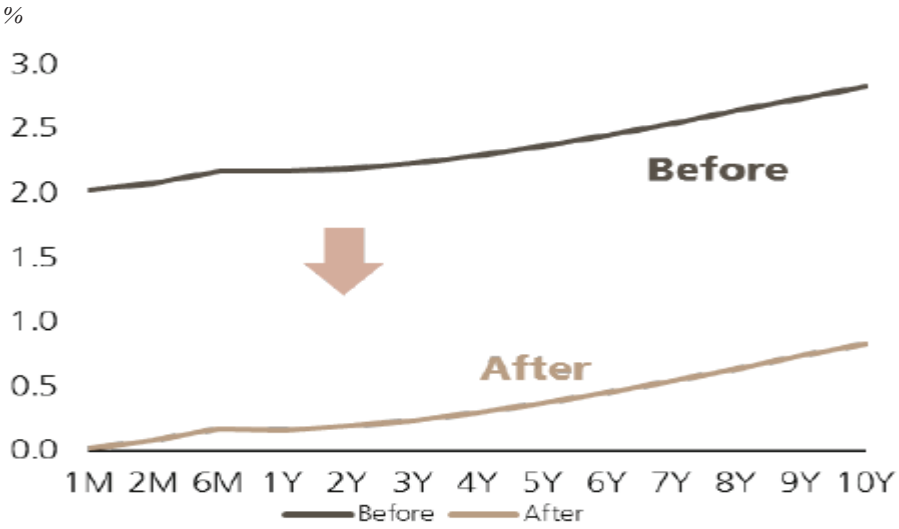
Initially, the example bank was running an additional gap of approximately 1.2 years over its target duration (4.1 years assets versus 2.9 years liabilities). The result from the downward shift in rates is an extended asset duration gap, to 2.5 years (5.8 years versus 3.3 years) – despite a lengthening of average deposit duration, since the asset duration has increased by even more. In other words, low rates will have induced a higher interest rate duration imbalance and therefore an increased reliance on the external market to hedge the inherent interest rate risk in the balance sheet. The next section describes the scenario analysis which was

performed to assess the consequences of this induced structural shift on the bank's earnings profile.

Scenario analysis

We assume a starting yield curve at 2% and higher, which corresponds with the initial balance sheet we showed before.

Chart 9: Market rates

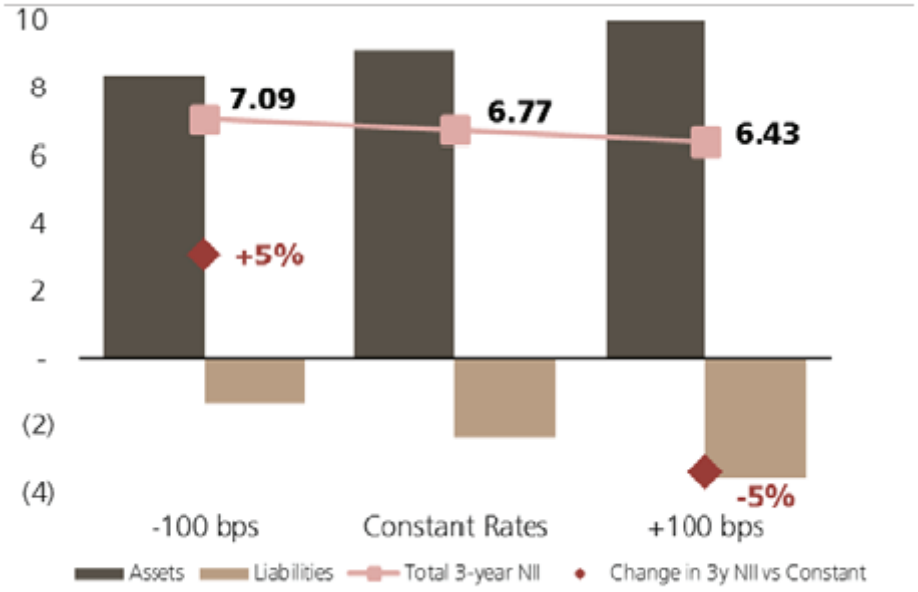


Source: Illustrative example prepared by UBS.

Then, after rates have continually fallen over an extended period of time, we arrive at a lower yield curve, where the short-end is barely above zero. The whole curve has effectively fallen by 200 basis points in parallel compared with the initial situation ("Before").

Then the Net Interest Income (NII) profiles of both balance sheets were calculated, i.e., how the (cumulative) 3-year NII would look like assuming a static balance sheet for 3 years. The scenarios assumed are: Constant rates (the center column), and then under an immediate parallel rates shock of –100 basis points (left-hand column) and +100 basis points (right-hand column).

Chart 10: 3-year net interest income profile: Before
CHF billion

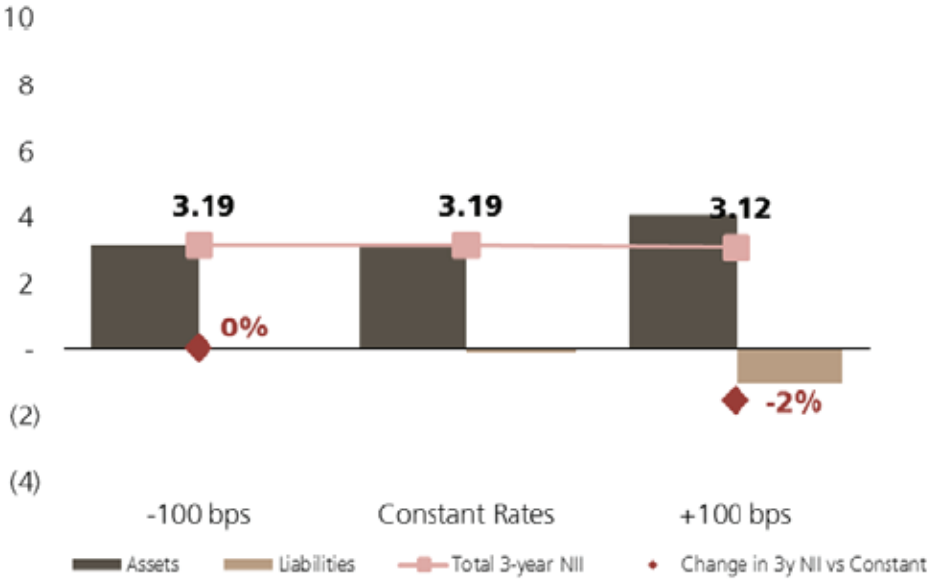


Source: Illustrative example prepared by UBS.

The 3-year NII under constant rates is CHF 6.8 billion, implying a 2.3% net interest margin (NIM). This improves under a –100 basis points shock by +5% to CHF 7.1 billion (left column), as the deposits re-price (downwards) quicker than the mortgages. The reverse holds under the up-shock of +100 basis points: the 3-year NII drops by 5%.

In the "After" interest rate environment, following the extended period of falling/low rates, the "base-case" 3-year NII under constant rates has practically been halved, to CHF 3.2 billion. This implies only a NIM of 1.1% per annum (NIM 1.1% p.a. = 3.2bn/3y/100bn).

Chart 11: 3-year net interest income profile: After
CHF billion



Source: Illustrative example prepared by UBS.

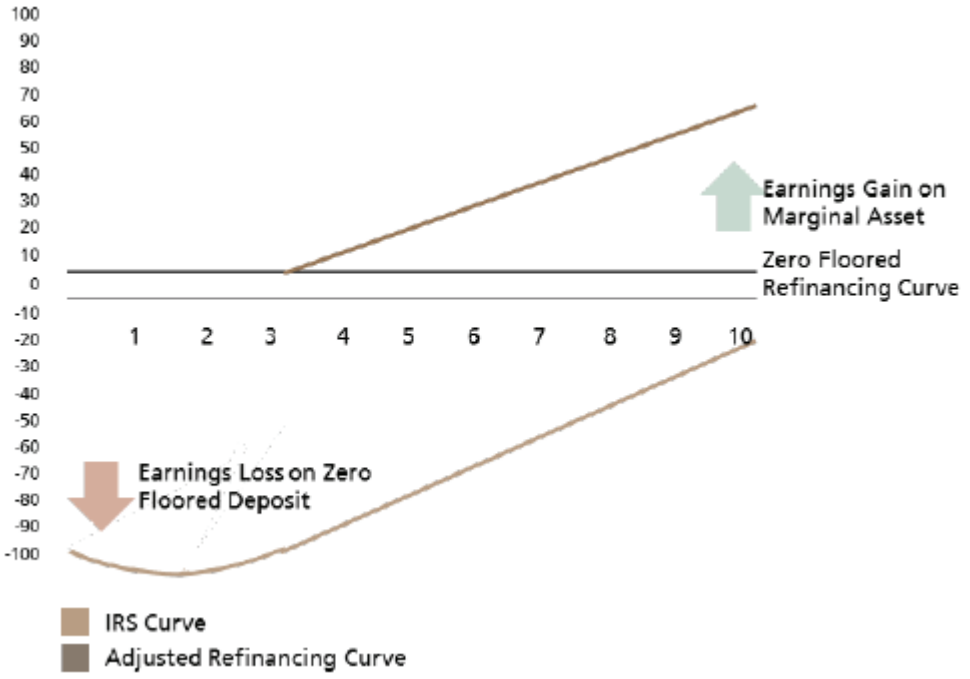
In effect, the example bank's overall margin has become compressed. While it can still earn the same margin on its mortgages versus market rates, it can no longer earn the same margin on its deposits since the client deposit rates are being pushed against the zero floor.

Also, there is no more NII upside if rates fall further (downside NII sensitivity ~0%). In fact, the NII still drops under an immediate rates rise, but only by 2% under the +100 basis points scenario. The reason for this is that the balance sheet duration profile has lengthened. Interestingly, the "Before" situation appeared to benefit from falling rates (NII +5%) in the –100 basis points scenario, but in the "After" situation, where rates have in fact dropped, the NII result is worse than the "Before" situation. This is because the +5% NII benefit versus "Before" assumes the same balance sheet with no structural change and the "After" situation is such that all of the existing long-term loans have already re-priced at new (low) level of rates.

Mitigation measures

As a retail bank cannot, at least initially, charge customers negative rates for short-term or non-maturing deposits, it is forced to disconnect economically from the external market. The larger this disconnect, the less utility the external market provides in managing its balance sheet mismatch between the asset and liability duration inherent in its product offering. The bank has little choice but to manage the client's demand for duration to the extent that it is willing to invest its zero floored deposit base at a particular return. This can only be done by the bank reflecting the minimum term premium it is willing to accept for investing its non-maturing deposits and equity in its asset offering. Even if a zero or negative expected economic return was acceptable to a bank, the effects on its earnings in the short term would be severe. The potential asset duration overhang that required hedging externally would accrue highly negative initially (potentially for three years) completely eroding the margin on its asset offering.

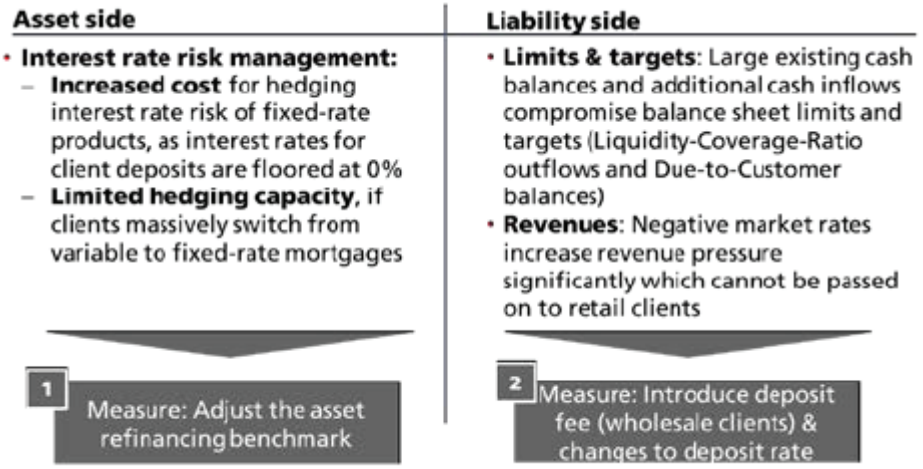
Chart 12: Minimum term premium for offering maturity transformation
basis points



Source: Illustrative example prepared by UBS.

A further and far more important consequence of not reacting in such a fashion is that client preference would naturally be to extend the duration of their borrowings to the furthest available tenor as they have the security of not paying negative rates on their savings. In such an environment, dynamic margin management becomes a key measure to steer the structure of the balance sheet and to avoid large duration gaps in the balance sheet.

Chart 13: Margin management becomes a key driver



Source: UBS.

If clients are not willing to pay the minimum term premium, the average duration of the asset side would be expected to fall and potentially de-lever to the extent that competitors have a lower minimum. Essentially, given the lack of the market's capacity to re-price, the more banks will wish to move to a more short-term product offering to ensure non-economic or negative outcomes. Potential measures for the asset side could be to re-benchmark the asset refinancing curve to reflect the breakeven of offering maturity transformation, potential adding of limitations to offerings of longer tenors and the insurance that documentation risk is well reviewed, controlled and updated where necessary.

To protect from unwanted excess deposit inflows, interest rates for client deposits are generally floored at zero. Further measures for the liabilities side could be the introduction of deposit fees for wholesale clients, reduction of client rates across the retail offering, creation of alternative product offerings geared towards increasing the utility of the deposit base in order to improve the liability structure and to reduce unwanted balances. The latter could be further supported through a sound "Due to Customers Framework", which sets Liquidity Coverage Ratio outflow targets and

off-balance sheet product alternatives. Competitor monitoring is key with regards to all measures.

Further challenges

Margin pressure could be further intensified by a number of regulatory initiatives, e. g., the BCBS (Basel Committee on Banking Supervision) task force on Interest Rate Risk in the Banking Book (IRRBB) and Basel 3 regulation on the Leverage Ratio Denominator (LRD), Liquidity Coverage Ratio (LCR) and "too big to fail"/ subsidiarization requirements.

A BCBS task force on IRRBB was mandated to update the existing guidance on interest rate risk regulation, which dates back to 2004. The current regulatory guidance advocates a Pillar 2 capital treatment of IRRBB by requesting from banks to have enough regulatory capital to support it. No direct capital charges specifically for IRRBB are required. The task force is now exploring options for direct CET1 capital underpinning of IRRBB. The main motivation appears to be: (i) Prevention of potential regulatory arbitrage between Banking Book & Trading Book; and (ii) concerns regarding the impact of rising rates on banks' balance sheets. The industry (IIF & EBF working groups) sent a detailed response expressing concerns to the BCBS Task Force in August and then on proposed draft QIS templates in December 2014. Recent updates show that the industry response was duly acknowledged by the BCBS.

In addition to this, new LRD rules translate into additional capital requirements at banks. LRD rules have been established long before central banks flooded markets with cash. However, regulators have so far shown little to no understanding for banks' request to at least exempt cash at central banks held for LCR purposes from LRD. Basel III client deposit modelling rules lead to additional consumption of LRD due to the obligatory build-up of high-quality liquid assets (HQLA).

Last but not least, subsidiarization is further increasing cost driven by unfavorable LRD rules. The requirement for legal entity specific LCR and Net Stable Funding Ratio (NSFR), whilst not immediately binding, would reduce flexibility for a consolidated bank to run a more efficient liquidity position and buffers at a local level required to manage volatility. Further consequences are increased trapped liquidity and complexity through intercompany relationships and rulings.

The overall market and regulatory environment keeps the job of Treasurers continuously challenging.

The effects of a low interest rate environment on life insurers[1]

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Helmut Gründl
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The current loose monetary policy pursued by many central banks around the world is resulting in extraordinarily low interest rates that are becoming a threat to the stability of the life insurance industry. This is especially the case in countries such as Germany, where products sold in the past with relatively high guaranteed returns still represent a significant share of the total portfolio.

Life insurers typically invest a large part of their portfolios in sovereign bonds. Therefore, the present low interest rates directly affect the rate of return of their portfolios. Moreover, typical life insurance products offered in Europe are sold with a long-term minimum return guarantee, which is set at the inception of the contract and remains unchanged until the contract ends. Life and annuity contracts usually have maturities of 20 to 30 years, meaning that life insurers still hold contracts in their underwriting portfolios that were sold in times when investment guarantees were significantly higher owing to higher bond yields. In addition, the duration of a life insurer's liabilities is typically higher than the duration of its assets. Therefore, under a market consistent valuation of assets and liabilities, i.e. under the forthcoming Solvency II regulation, the current low interest rates increase current liability values more than asset values. This, in turn, reduces the market value of equity capital, thus having a detrimental effect on insurance companies' solvency situation.

[1] The complete document is available at: The Geneva Papers on Risk and Insurance (retrieved on June 12, 2015).
http://www.palgrave-journals.com/gpp/journal/vaop/ncurrent/full/gpp201438a.html.

The case of the German life insurance industry

In our paper, we aim to assess the solvency situation of a typical German life insurer under the incoming Solvency II regulation, i. e. a mark-to-market regulatory regime. Our work also allows us to assess the impact of the newly introduced reform of German life insurance regulation (i.e. the "Lebensversicherungsreformgesetz") on insurers' default probabilities. To do so, we generate a stochastic term structure of interest rates and stock market returns to simulate the investment returns of a stylized life insurance business portfolio in a multi-period setting. Based on empirically calibrated parameters, we can observe the evolution of life insurers' balance sheets over time, in particular their solvency situation. To account for different scenarios and to check the robustness of our findings, we calibrate different capital market settings and different initial situations of capital endowment. Our results suggest that a prolonged period of low interest rates would markedly affect the solvency situation of life insurers, leading to relatively high cumulative probabilities of default for less capitalized companies.

Simulation of different capital market developments

We project the insurers' balance sheets 10 years into the future under different (stochastic) capital market settings and with different initial capital endowments. For this, we consider three calibrations for the simulation of capital market developments: under calibration 1, interest rates with a maturity of 10 years gradually converge towards 2%; under calibration 2, towards 1%; and finally, under calibration 3, towards 3%. We assume five different initial capital endowments, each representing a quintile of the observed capital endowments among German life insurers at the end of 2012. Both the asset and the liability side are modeled by taking into account the time to maturity structure that is typical for the life insurance business: based on publicly available German data, we are able to reproduce a duration mismatch between assets and liabilities of 3.75 years, which is very close to what is being observed in the German life insurance industry. Moreover, we distinguish between the book value balance sheet subject to German GAAP and the market value balance sheet subject to Solvency II rules. The former is used as a basis for the profit participation mechanism typical for life insurance contracts, whereas the latter is used to determine the solvency position of the life insurer.

Implications for the solvency situation of German life insurers

The results of our study suggest that: (i) should interest rates remain at the current level and gradually converge towards 1%, the solvency ratio of a large number of German life insurers would be considerably reduced, with a consequent increase in

the probability of default starting as early as 2016; and (ii) a moderate rise in the interest rate level would considerably increase the solvency margin, and thereby reduce the probability of default.

The newly introduced reform of German life insurance regulation substantially improves the situation, especially for less capitalized companies, which would otherwise not be able to bear the losses stemming from their liabilities. Yet, this improvement comes at the expense of lower benefit payments to policyholders, who experience a reduction of the minimum profit participation and therefore a haircut on their claims.

In conclusion, our model is of special interest for three reasons: (i) it allows a realistic calibration of different market conditions and different regulatory features; (ii) it provides insights into the effects of monetary policies on financial institutions which give long-term financial promises, such as life insurers and pension funds; and (iii) it can serve as a tool in the newly introduced Forward Looking Assessment of Own Risks (FLAOR), which insurance companies will have to perform under the Solvency II regulation.

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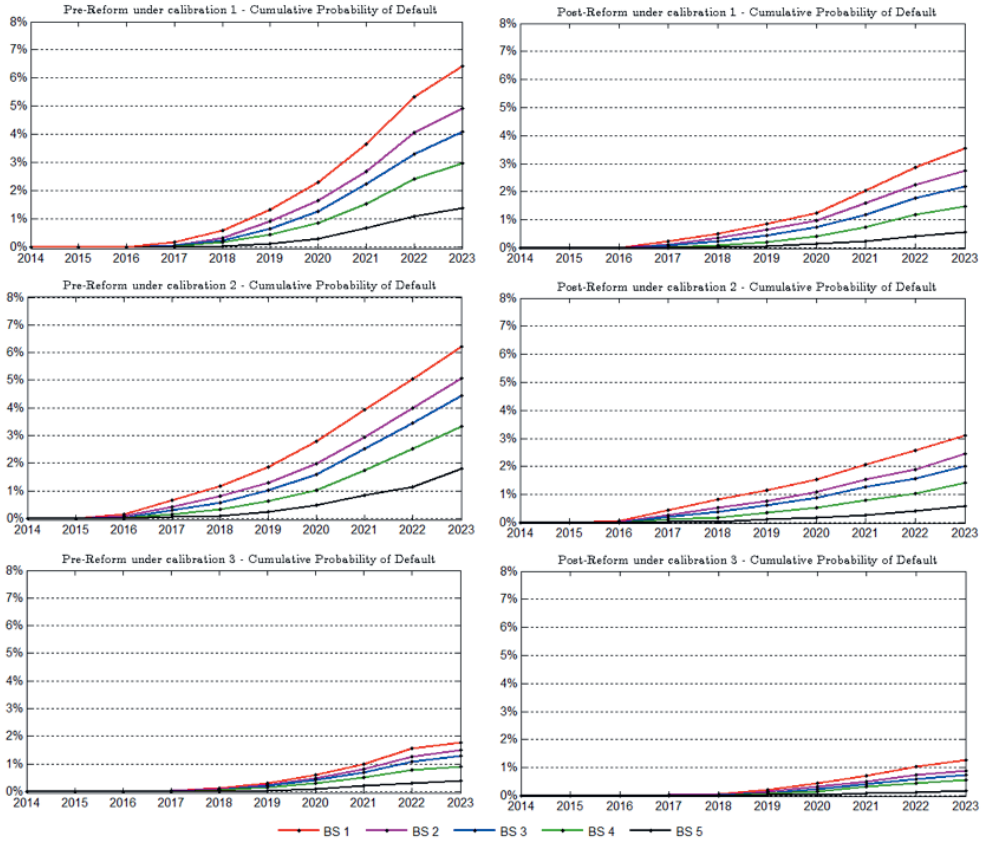
Schmeiser, H., Wagner, J. (2014) A Proposal on How the Regulator Should Set Minimum Interest Rate Guarantees in Participating Life Insurance Contracts, Journal of Risk and Insurance.

Antolin, P., Schich, S., Yermo, J. (2011) The Economic Impact of Protracted Low Interest Rates on Pension Funds and Insurance Companies, OECD Journal: Financial Market Trends, Issue 1, pp. 237–256.

Chart 1: Cumulative probability of default before and after the 2014 reform of German life insurance regulation



Source: Authors' calculations.

Note: Balance Sheet 1 (BS1) represents the bottom quintile (less capitalized companies), whereas Balance Sheet 5 (BS 5) represents the top quintile (most capitalized companies).

Current issues in central bank reserves management

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Abstract

With around EUR 15 trillion of investable reserves, central banks have become significant investors in capital markets, especially the fixed income and debt markets where the majority of official reserves are still invested. They face exactly the same current very low level of interest rates as other investors, and their response is therefore of interest both to other investors and to regulators and overseers of market stability. However, their objectives and strategies for the investment of their reserves and the constraints they face on their freedoms of action are not always the same as those of other investors, with many central banks facing the challenge of managing very large asset holdings and placing a lower emphasis on overall return than more typical investors, and this requires that their activities be considered separately from those of other market participants. The paper considers firstly the structure of central bank reserves management and the strategic environment that central banks operate in, with its implications for their objectives and asset management style. It then looks at current issues and in particular the central banks' response to current markets and the various constraints on their asset management activities, and finally it considers some of the issues that concern central bank reserves managers looking forward.

1 The structure of central bank reserves management

Central banks have managed their nation's foreign exchange reserves for well over 100 years; for most central banks it is a core part of their duties and since at least the 1920s they have been regular participants in the international markets for gold, bank deposits and foreign government bonds. As a result, their activities have always been of interest to those who follow markets, whether other investors and market

participants, or the authorities regulating markets and overseeing their financial stability.

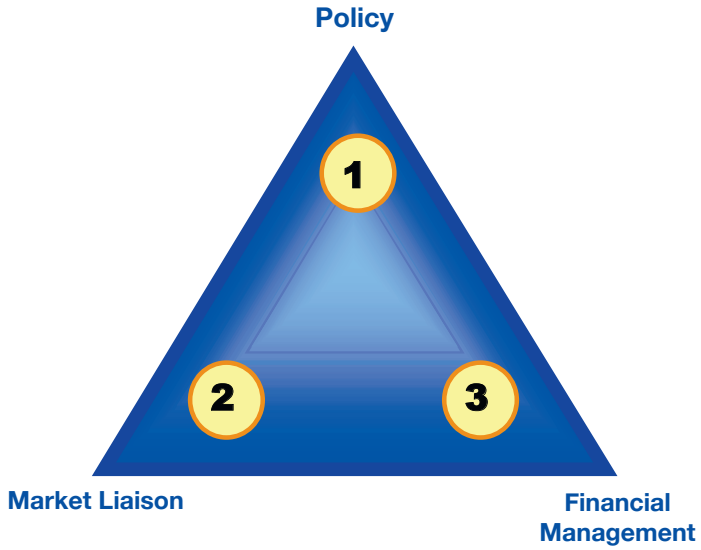
Until comparatively recently, however, central banks have been both relatively small investors compared to markets overall (total central bank reserves in the year 2000 were well under USD 2 trillion), and more importantly they were relatively passive investors, limiting themselves to core markets and not seeking to manage their portfolios that aggressively. In the last 15 years, however, total central bank reserves have grown rapidly, standing now at around USD 15 trillion, and in parallel with this (indeed partly because of the greater assets that need to be invested), central bank reserves managers have become active in a wider range of instruments and markets. Today, central banks invest in corporate bonds, equities, alternatives and the like; in short, they are present in almost all capital markets, and in many of them they are, due to their absolute size, significant players.

However, the fundamental rationale for reserves and so nature of reserves management has not been removed. Reserves Management remains a multi-faceted and multi-dimensional operation, with elements of *Policy* (for example the maintenance and defence of a fixed exchange rate, the maintenance of national creditworthiness, the management of national foreign currency denominated debt servicing) and *Market Liaison* (for example the oversight of and gathering of information on FX and bond markets, the communication of the central bank's intentions) alongside the more typical investor's objectives of *Financial Management* (for example balance sheet and risk management, income generation, wealth preservation). Any analysis of a central bank's actions as an investor, and in particular any consideration of their response to the current market environment, must therefore take into account this multi-faceted and multi-objective nature of their investment task.

The objectives outlined above – *Policy, Market Liaison* and *Financial Management* – are very different, and require different skills at both operational and managerial level. For any given central bank, the respective weights of each of the three will differ, and the impact on the central bank, its operations and its reputation will also differ. As a result, their investment style will also differ, both from other central banks and from other investors. The observer of central bank reserves management activities must first therefore consider, for any given central bank, what the respective importance of the three elements of reserves management is, and which will dominate the central bank's decision-making.

This can best be shown graphically, as in the following diagram:

Chart 1: The "Strategy Triangle" for central bank reserves management operations



Source: Author's compilation.

Different central banks will find themselves in different positions within this "strategy triangle", depending on what the prime motive for their reserves management is. Here (1) would represent the position of a central bank for whom Policy considerations dominate, for example a country with a FX peg or currency board to maintain; (2) would represent the position of a central bank for whom Market Liaison considerations dominate, for example the Federal Reserve; while (3) would represent the position of a central bank for whom Financial Management considerations dominate, for example a central bank with very large reserves and a clear investment-orientated mandate (whether wealth preservation or even wealth maximisation).

This in turn translates into different emphases on the elements of reserves management. To a very large extent, all central banks adhere to the "classical trilogy" of reserves management of Security, Liquidity and Return, but the strength of emphasis any individual central bank places on any one of the three will differ. For example, a central bank for whom policy issues dominate (i.e. (1) in the diagram above) will tend to emphasise the importance of liquidity – the reserves have to be usable in a crisis; a central bank for whom market liaison issues dominate ((2) in the diagram) will tend to emphasise security – the avoidance of loss; and only those

central banks for whom financial management issues dominate ((3) in the diagram) will tend to emphasise return.

This has direct relevance to how central banks are reacting to the current very low interest rate environment – broadly speaking, the more important financial management is in the central bank's policy hierarchy (i.e., the closer the central bank is to the point marked (3) on the diagram), the more it is legitimate to assume it will react in a similar manner to other wealth-maximising investors. But the corollary is also true: for central banks whose policy stance is closer to the points marked (1) or (2), their response to current markets may not be similar to the majority of investors.

2 The style of central bank reserves management

In the early periods of central bank reserves management, the operation was almost entirely administrative, with accounting and maintenance duties dominating. Until at least the end of the Bretton Woods fixed exchange rate system in 1971, most central banks did not attempt to manage their reserves actively, and the minimisation of operational costs far outweighed any thought of maximising investment returns.

This changed with the very much more volatile bond and FX markets of the 1970s: much higher inflation in developed markets and more significant exchange rate movements between major currencies firstly introduced the concepts of significant *risk* and *loss* to the world of central bank reserves management, and very quickly thereafter encouraged some central banks to explore the other side of the coin of *opportunity* and *profit*. Ever since then, there have always been questions as to the appropriate style of reserves management – what activities are acceptable and legitimate, and what activities should be avoided.

For example, in the 1980s a major question was whether reserves could be managed actively for profit or not – was it legitimate for central banks, with their privileged position in markets and with their policy responsibilities, also to seek to manage their reserves for profit? Many felt that central banks should not run both a policy operation (management of an exchange rate, for example) and a profit-driven operation through the same dealing desk, with the risk that counterparties might be confused as to the intentions of any given trade, and there were also concerns about the use of privileged and time-sensitive information such as interest rate changes. This led to a much clearer separation between the two "operating modes" of the reserves managers, and "Chinese walls" within every central bank isolating the reserves managers from market-sensitive information.

By the 1990s the dominant question was the central bank community's stance on gold – did central banks have the right to trade gold solely with their own interests in mind, or did they also have some responsibility towards the functioning and

health of the gold market? The resolution of this debate led to the 1st Central Bank Gold Agreement (CBGA1) in 1999, an agreement that has subsequently been renewed three times, the last occasion being in 2014 with CBGA4.

Latterly, central banks have debated the appropriateness of holding equities in reserves portfolios, and whether, if they are a legitimate diversification, they should be held passively or traded actively. This debate has probably been concluded (around 25 central banks now hold some equities in their reserves), but it has spawned the subsidiary question of whether and if so how central banks should use their share holdings to exercise ownership and governance oversight. For many, the only legitimate stance is passive ownership – i.e. abstaining from votes – as this avoids the authorities becoming active in the direction of private sector companies, but others are concerned that this helps weak management and preserves weak governance.

As this short section has shown, central bank reserves management is continually evolving; the current markets are not unique in generating points for discussion in the central banking community or forcing change in their reserves management operations.

3 Current issues facing central bank reserves managers

In the current market environment there are two main types of issue currently facing central bank reserves managers: internal issues, such as the changing rationale for holding reserves as they grow, the size of reserves portfolios or the interaction with any Sovereign Wealth Fund (SWF) the country may have; and external issues, most obviously the state of markets and the level of yields. It would be wrong to take these in isolation of each other – of course central banks, like any other investors, are challenged by current markets and low yields are encouraging them to re-examine and perhaps change their investment style, just as they are forcing others to adapt too. But their responses are conditioned by their institutional framework and in many cases by their size.

In general, investors fall into one of two categories. There are those who are managing net assets in excess of or without any offsetting liabilities – one might call these Wealth Managers – and there are also those who are managing assets against roughly commensurate liabilities or obligations – one might call these Balance Sheet Managers. Central banks can fall into either category, but in addition have a third category – managing assets against unquantifiable obligations (for example the duty to intervene to support a currency). As a result the assessment of the size of a central bank's reserves is always more qualitative than quantitative (the question of "how much reserves is adequate?" is notoriously difficult to answer), and any table describing the size of reserves against their uses will tend to be more descriptive than numerical.

However, this does not negate the value of considering the size of a country's reserves, and the tables below map reserve size against management style. Table 1 considers the size of the reserves relative to the central bank's own circumstances and need for reserves (e. g. its obligations):

Table 1: Different sizes of reserves relative to the central bank's own circumstances

Relative size of reserves	Implications for Reserves Management style
Inadequate	Liquidity management, rationing of access to foreign exchange (e. g. via exchange controls), prioritisation of servicing of foreign currency debt, establishment of credit lines, dialogue with official sector finance (IMF etc.)
Sufficient	Liquidity management, hedging of foreign currency debt, maintenance of creditworthiness and access to market finance
Comfortable	Liquidity management, hedging of foreign currency debt, interest rate risk management, increased transparency to stakeholders?
Surplus	Interest rate risk management, market selection, asset allocation and diversification, much increased communication with stakeholders
Significant Wealth	Wealth management, market selection, strategic asset allocation, role as shareholder/owner, implications for public profile of the central bank, issue of whether or not to split off assets to a SWF

Source: Author's compilation.

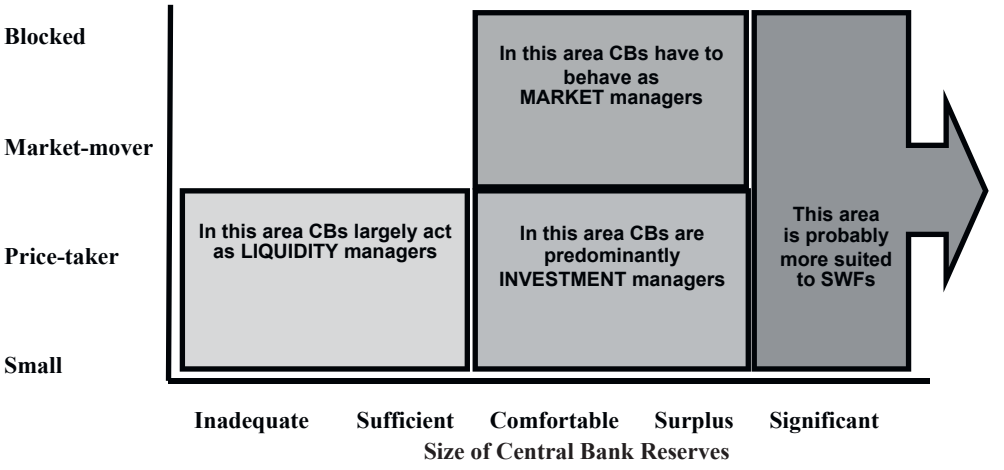
Secondly, we can consider the size of a central bank's reserves relative to the markets it is investing in:

Table 2: Different sizes of reserves relative to the markets

Size relative to market	Relationship of CB operations with market	Consequence for investment style	Implications for management
Very small	No significant effect	None	None – no need to consider market consequences of activity
Small or Medium	Price taker	Able to trade at almost all times	Choice of counter-parties important – need a selection but can include second tier players
Large	Price maker, potential market mover	Timing becomes important, need sensitivity to market	Choice of counter-parties crucial – should be drawn from the premier houses
Very large	Dominant market player if not largely blocked	Timing and order management crucial	Confidentiality pre-trade and trans-parency implications post-trade rise in importance

We can combine these two analyses on a single chart:

Chart 2: Different management styles for different sized reserves



Turning then to the central bank response to low yields, we can see that how any given central bank will respond will largely be determined by whether it is positioned mainly as a liquidity manager, an investment manager or a market manager. For example, those central banks facing a shortage of reserves and acting mainly as liquidity managers (and even more those forced to act as liquidity rationers) will find that their reserves management task is little changed by the very low yields on their investments: their assets are not predominantly held for their return potential and while a higher return is always welcome, they do not have the liberty to seek better returns if doing so jeopardises their liquidity position.

Similarly, those central banks whose reserves are so large that they are mainly acting as market managers will be forced to hold the bulk of their assets in the larger markets like government bonds; they may seek out other options at the margin but few spread markets will be large enough to absorb more than a small fraction of their assets.

The main category of central banks that is able to react to the very low yields and do something material in response is those in the box labelled investment managers. This is not entirely surprising; these are the central banks that have both asset sufficiency and the freedom to act most like other investors in markets. And the solutions such central banks are considering are similar to those that others have adopted, viz:

– Diversification into other fixed income asset classes (e. g. corporate bonds)
– Diversification into second tier developed markets (e. g. CAD, AUD, NZD, CHF, NOK, SEK, DKK)
– Consideration of emerging markets (especially RMB)
– Introduction of equity portfolios and portfolios of alternative assets
– A renewed consideration of the role of gold
– Outsourcing non-core portfolios to external managers including hedge funds

Many of these markets pose challenges to all investors, whether central banks or not. These include issues of market and deal size, market liquidity, market and trade transparency, incomplete or unusual market structure, and the availability and familiarity of satisfactory counterparties. Such challenges are common to all investors seeking to diversify away from traditional first tier markets.

But in addition central banks face a range of extra challenges and issues before adding complexity, for example:

– Is it worth it? Does it move the dial? There is no point in adding extra complexity (and, probably, risk) for limited or no extra return taken over the portfolio as a whole.
– Do we have the staff to understand it? And can we survive their departure? Central banks are often very vulnerable to key staff risk and should not build portfolios which cannot be maintained if key staff leave.
– Does management understand it? Can they explain it to the public? Governance issues are increasingly important for central banks as reserves sizes grow, and all central banks are now much more aware of the risk of reputational loss from poorly executed operations.
– How does this interact with any other official investor of the state? For countries with SWFs or national pension funds, what is optimal for the central bank in isolation may not be optimal for the authorities taken as a whole, and the central bank may have to step back from diversification if to do so would result in unwanted overlap with another part of the authorities' overall asset management structure.
– How will the recipient market (and its authorities) respond? Not all markets welcome large official sector investors, and a central bank always has to remember that what for it is a foreign market is for a fellow central bank their home market.

4 Outlook and concerns

Collectively, central bank reserves managers do not expect yield levels to return rapidly to normal, and if any phrase sums up expectations, it is "Lower for Longer". This seems to be much in keeping with general investor sentiment, though it is notably (and perhaps strangely) in contrast to the Federal Reserve's own interest rate expectations as shown in the Federal Open Market Comittee's "Dot charts".

Having said that, central bank reserves managers do have some particular concerns, largely arising out of their interaction with their colleagues on the domestic money market and regulatory sides of the bank, as part of the central bank's internal analysis of how markets are working under Quantitative Easing (QE) and very low or even negative yield environments. Two that repeatedly arise in discussions with central bankers are the market's function as a source of signalling and information, and the changing attitudes of other market participants.

The first of these concerns stems directly from the use that central banks make of markets to provide information on the underlying real economy and on the actions and intentions of other market participants. As central banks increase the scale and scope of their market operations the ability of markets, particularly money markets, to operate independently of the central bank is reduced – indeed, in a number of markets the central bank is now the dominant player, and acts not so much as the market clearer and LOLR (Lender of Last Resort) but market maker and FOFR (Funder of First Resort). And even where financial institutions are not actually dependent on the central bank for funds, the central bank's operations (e. g. QE) can heavily influence markets.

As a result, some markets are increasingly moving from being a window for the central bank, showing it the outside world, to a mirror, merely reflecting back the consequences of its own operations. These risks reducing the information flow available to the central bank, and increases the risk of policy uncertainty if not error.

Secondly, investors' response functions to central bank actions is also changing. Market positions have inevitably become more sensitive to the stance of the central bank, as market participants hold positions not only on their assessment of inherent value but increasingly on their expectations of official actions. As a consequence they may be less tightly held, and a change in policy can produce a bigger response from markets than has hitherto been considered the norm – two recent examples being reactions from the US Treasury market and emerging markets to the indications in late 2013 that QE would be reduced (the "taper tantrum"), and the response to the Schweizerische Nationalbank's removal of the cap on the Swiss Franc in January of this year.

This is compounded by the observed reduction in market-maker capacity and hence liquidity in many bond markets, a phenomenon that is well documented and largely the result of regulatory changes. The consequence is that increasingly, markets are subject to the risk of periods of elevated volatility, and even the largest markets may suffer volatility spikes and liquidity deserts at times of major policy change.

For central bank reserves managers, with their traditional focus on security and liquidity, this further restricts the number of markets that are considered appropriate and investable, and means that their response to the current market environment of ultra-low yields is even more closely constrained.

Asset liability management and interest rate risk in Solvency II – an empirical study

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1 Introduction

The variation in the net value that arises due to changes in the term structure of the interest rates, used for the calculation of the present values of both sides of the balance sheet of insurance companies, is one of the most important risks that they have to allocate capital (eligible own funds) for. Under the new supervisory rules for insurances in the European Union – usually referred to as Solvency II – the relevant capital requirements for this risk are defined within the market risk module, in the interest rate risk sub-module.

In general, Solvency II allows for two different approaches to determine the relevant capital requirements to compensate for a reduction in the company's net value. Firstly, the determination is based on the worse outcome of two predefined scenarios, one reflecting an upshift of the risk free interest curve and one defined as a downshift, usually referred to as the standard approach. Secondly, the determination can be based on an internal model for the relevant risk. If an insurance company chooses to use an internal model, the model has to be calibrated in such a way that it measures the value-at-risk for a confidence level of 99.5%, based on a one year horizon. Both approaches have to be applied on the total balance sheet, thus capturing interest rate sensitivity of assets and liabilities. Given the typically long term oriented liability profile of e.g. life insurers, proper management of (long term) interest rate risk is the most demanding part of asset liability management in the insurance sector.

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The following sections present an empirical study to the task of measuring interest rate risk. Based on the historic development of German government bonds with various maturities, the changes in the term structure within one year seen historically are calculated and applied to four different cash flows. This allows for the calculation of the changes in the *Net Asset Values (NAV)* and subsequently the construction of an empirical cumulative distribution function of these changes. From these empirical cumulative distribution functions, the regulatory relevant value-at-risk 99.5% can be derived.

These results are of special interest when compared to the capital needs stemming from the use of the standard approach, which uses more or less parallel shift scenarios. The question is, whether this type of stress calibration is suitable for various types of cash flow profiles (balance sheets) when compared to actual changes in the own funds of these balance sheets.

2 The cash flows

This study elaborates on the risks due to changes in the interest rate term structure for four different cash flow profiles ("stylized" balance sheets). These cash flows are named *Demo, Balanced, Unbalanced* and *Matched* and shall be described in this section. It is worth mentioning that the four cash flows have identical liabilities and identical amount of own funds (defined as the difference in present value of assets minus liabilities) and only differ on the maturity profile of the asset side of the balance sheets.

Chart 1 further down this section shows the asset and the liability side of the four cash flows. It can easily be seen that the maximum maturity of all cash flows is 61 years, as it was defined in the latest quantitative impact study conducted by EIOPA and national supervisors (Financial Market Authority, FMA in the case of Austria) in 2014, based on 2013 year end company data.[2]

2.1 The "Demo" cash flow

The first cash flow *Demo* represents the cumulative term structure of Austrian insurance companies and therefore can be seen as a representative example of the structure of the balance sheet for an average insurance company as of year-end 2013. The present values of assets and liabilities are used to calibrate the other three cash flows to ensure that the results are easily comparable. The cash flow represents an

[2] The FMA's official homepage contains detailed information on conditions and results of the QIS6 assessment: www.fma.gv.at/de/sonderthemen/solvency-ii/informationen-fuer-versicherungsunternehmen/qis-6eiopa-stresstest.html.

insurance company with equity EUR 100,000[3], the sum of assets equals EUR 2,915,838 and the sum of liabilities equals EUR 4,168,163. Applying the term structure of the risk free rate r_{base} on this cash flow results in a present value of assets equal to EUR 2,448,004 and a present value of liabilities of EUR 1,800,290. Subsequently the NAV for this cash flow under the risk free term structure equals EUR 647,714.

For the same term structure of the risk free rate the duration of the asset and liability cash flows can be calculated as well. For the Demo cash flow we get 7.2 for the Macaulay duration of the assets and 21.1 for the Macaulay duration of the liabilities. As the euro duration[4] we get EUR 170,606 for the assets and EUR 368,302 for the liabilities.

This is already a first indication on the inherent interest rate risk of insurance balance sheets, as the difference in euro duration for assets and liabilities is a rough approximation for the net change in company value for a one percent change in the risk free interest rate level. Such a change would wipe out almost EUR 200,000 in value which was only determined at around EUR 650,000.

2.2 The "Balanced" cash flow

The second cash flow named *Balanced* represents the balance sheet of an insurance company which has exactly the same liabilities, but a different structure of assets. The asset side of the cash flow has been calibrated in such a way that the euro duration of the assets equals the euro duration of the liabilities. Therefore, this cash flow represents an insurance company who has tried to immunize its balance sheet against the risk associated with parallel changes in the interest rate term structure via duration matching. Obviously, such a profile would be exposed to non-parallel shifts, such as twists, which are not modelled under the standard approach.

The cash flow represents an insurance company again with equity amounting to EUR 647,714, the sum of assets equals EUR 3,981,784. With the term structure of the risk free rate r_{base} we get a present value of assets equal to EUR 2,448,004, a Macaulay duration of 15.3 and EUR 363,717 for the euro duration. Note that the present value of assets is exactly the same as for the *Demo* cash flow. This was one of the conditions for calibrating the cash flows and holds as well for the *Unbalanced* and the *Matched* cash flow.

[3] For this and the following sections the term equity is used to denote the assets of the company with maturity 0 years.

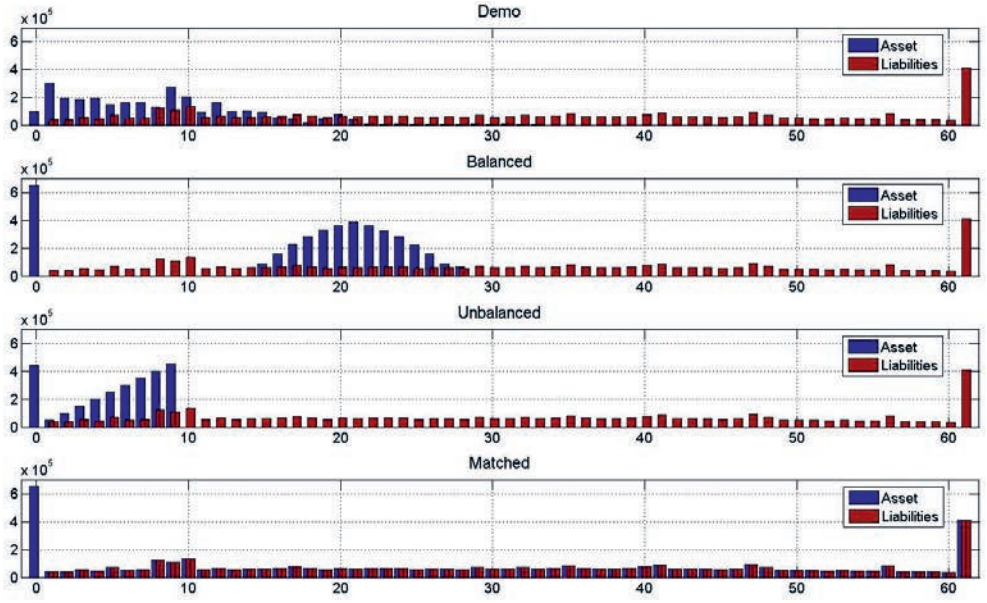
[4] For the calculation of the euro-duration the following formula has been used: D€=PV * modified Duration / 100.

The sum of liabilities, the present value of liabilities and the corresponding durations of liabilities clearly equal the values of the *Demo* cash flow as the liabilities are identical.

2.3 The "Unbalanced" cash flow

The third cash flow *Unbalanced* represents the balance sheet of an insurance company who has taken no effort to immunize its balance sheet in respect to changes in the risk free rate term structure. While the liability side of the cash flows is the very long term, which is typical for insurance companies due to their contract portfolio especially of life insurance products, the asset side is rather short term with maximum maturity of 9 years. This reflects the asset allocation of a company that is waiting for interest rates to rise again before taking longer fixed rate securities.

Chart 1: Modelled cash flow profiles of assets and liabilities



Source: FMA, authors' calculations.

The cash flow represents an insurance company with equity EUR 437,047, the sum of assets equals EUR 2,687,047. Applying the term structure of the risk free rate r_{base} results in the same present value of assets equal to EUR 2,448,004, but a drastically lower Macaulay duration of 5.1 and a corresponding EUR duration of EUR 121,113.

The sum of liabilities, the present value of liabilities and the durations of liabilities once again equal the values of the *Demo* cash flow.

2.4 The "Matched" cash flow

The forth cash flow represents the balance sheet of an insurance company which has fully immunized its balance sheet in respect to changes in the term structure of the risk free rates. Its assets equal the liabilities for all maturities taken into consideration. Therefore, any change in the interest rate does not affect the NAV of the company as the changes in the interest rate affect the assets exactly the same way as the liabilities; both effects abrogate the subsequent effect to the NAV.

The calibration of this cash flow has resulted in an equity of EUR 647,174, which is equal to the equity of the *Balanced* cash flow. The sum of assets equals to EUR 4,815,877. With the term structure of the risk free rate r_{base} we get the same present value of EUR 2,448,004, a Macaulay duration of 15.5 and a euro duration of EUR 368,302. Note that the euro duration of the asset side of this cash flow by design equals the euro duration of the liability sides of all four cash flows.

3 Interest rates

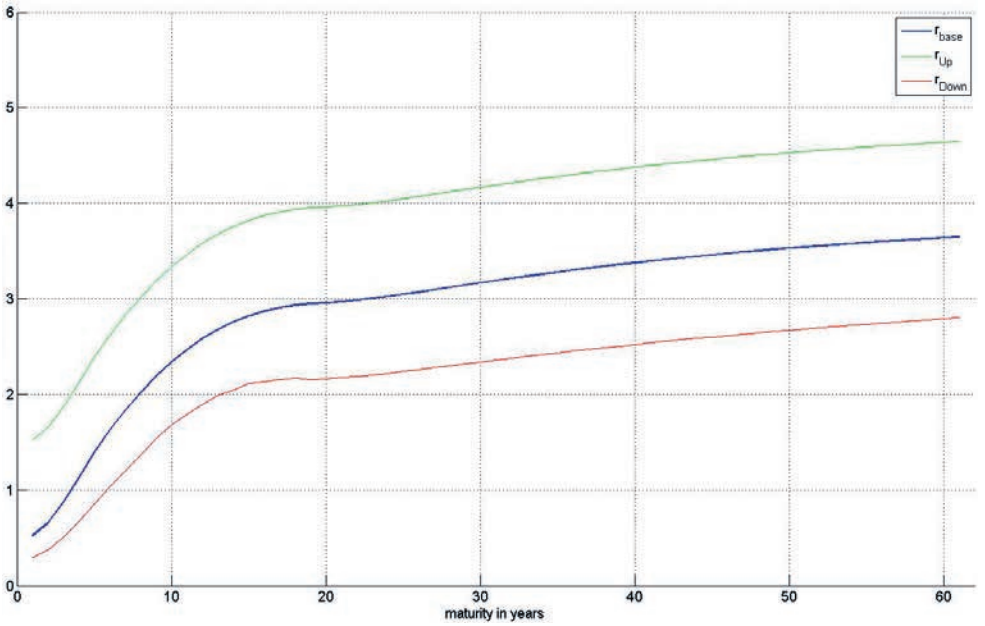
In general this study uses similar inputs for interest rates as used in the Quantitative Impact Study 6 (QIS6). QIS6 refers to a voluntary study conducted by many European insurance companies in order to elaborate on the effects of the new regulatory framework denoted as Solvency II. Within this study several parameters have been set as a default, foremost it proposed a term structure for the risk free rate which has to be used as standard for the present value calculations.

3.1 Risk free rate r_{base}

In this study, the predefined term structure of the risk free rate is usually referred to as r_{base}. It has been used to calibrate the three cash flows *Balanced, Unbalanced* and *Matched* and represents the basis scenario. For QIS6 the interest rate term structure has been given for maturities up to 150 years, while for this study only the first 61 years have been taken into account as 61 years represent the maximum maturity of the cash flows taken into consideration.

Chart 2: EIOPA's risk-free interest rate structure and shocked levels by end of 2013

interest rates in %



Source: EIOPA.

In chart 2 the term structure of the risk free interest rate r_{base} is shown as bold solid blue line.

3.2 Interest rate shock in the standard approach of Solvency II

One aim of this study is to compare the results of an empirical analysis of historical interest rate changes and their effects on balance sheets of companies to the corresponding measurement of interest rate risk as defined in the standard approach of Solvency II.

In order to do so, the standard scenarios for an interest rate shock as defined in articles 146 and 147 of the Draft Delegated Acts to Solvency II have to be specified. In general within Solvency II shocks are always defined as shocks in both directions, the capital requirement for this risk module is then derived from the worse effect on the company's change in NAV.

For this study the shocks as defined for the QIS6 study have been taken into consideration. In difference to the legal definition of *Up* and *Down* shocks for the interest rates which is only given as a relative increase and decrease of the risk free

rate term structure (e.g. the increase for the 10 year maturity is defined as 42%), the predefined scenarios used for QIS6 are given in absolute values. This results in two additional term structures for the stress scenarios which can also be seen in chart 2. The shock of a sudden increase in interest rates is shown as green line, while the shock of a sudden decrease is shown in red.

3.3 Historic interest rates of German government bonds

The aim of this study is to conduct an empirical analysis of the effects of changes in the term structures of interest rates on the NAV of insurance companies. The idea is to use observed historical shifts in the interest rate term structure to analyze the effects these changes have on the cash flows defined in section 2.

German government bonds are nowadays somewhat the standard yield curve for the whole euro area. Furthermore, German bonds represent financial instruments traded in "deep, liquid and transparent financial markets". This requirement for the choice of the relevant risk free interest rate term structure is part of the Solvency II regulation.

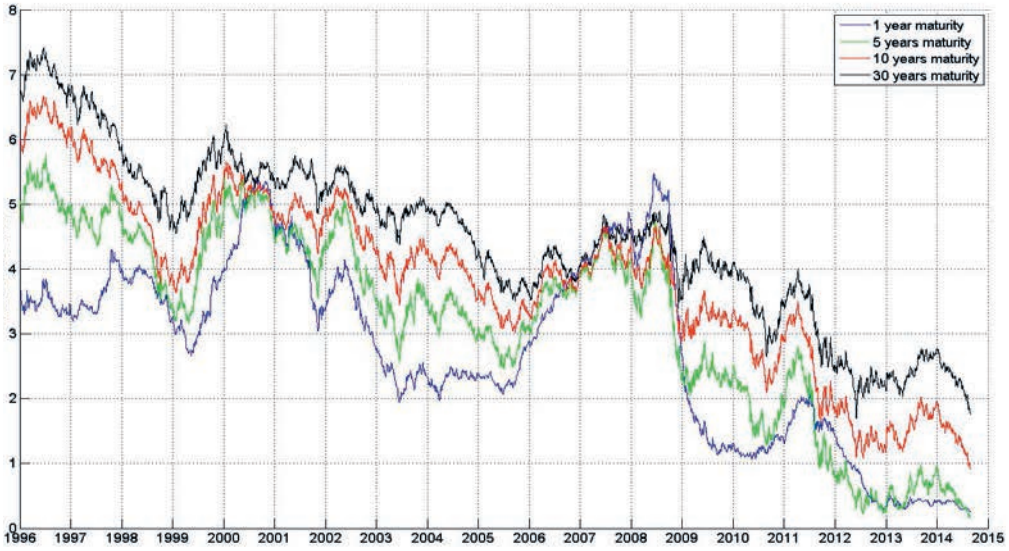
The historical German bond yields[5] are given for the maturities 1, 2, 3, 5, 7, 10, 20 and 30 years. The data starts January 1st, 1996 and ends August 28th, 2014. The overall data set therefore consists of 8 interest rates, given for 4,868 trading days.

Chart 3 shows the development of the interest rates for 1, 5, 10 and 30 years. It can easily be seen that the historic development of the interest rates does not follow the generalized idea that interest rate term structures should change similar to parallel shifts. Such a parallel shift of the interest rates can be seen in the base scenario of *Up* and *Down* shocks as defined in QIS6, but history indicates that other forms of interest rate changes are possible as well. They are not even rare, but rather the most common development. Phases where the interest rate term structure flattens – or even inverts as seen in 2008 – exist besides phases where the interest rate term structure steepens. This empirical study includes such effects, which can lead to very different assessments of interest rate risk, as discussed in section 5.

[5] Source: Thomson Reuters, German Bond redemption yields.

Chart 3: Yield of German sovereign bonds by maturity

interest rates in %



Source: Thomson Reuters.

4 Interpolation of interest rates

In order to use the yields of German government bonds, given for different maturities, the term structure has to be completed in order to obtain interest rates for maturities which are not given by the historical data. For this study, two methods of interpolation have been used, a simple linear interpolation and the Smith-Wilson method.

4.1 Linear interpolation

To calculate the missing interest rates with linear interpolation, one has to simply connect the given yields, e.g. for maturities A and B, with a straight line. The yields for all maturities in between the given ones, e.g. all maturities C with A<C<B, are then given by the function value of the straight line for this maturity.

This method allows for two different choices of parameters. Firstly, an *Ultimate Forward Rate (UFR)* has to be specified. The UFR represents the interest rate, which can be expected in the very long run. For this study an UFR of 4.2%, in line with the EIOPA specifications, has been chosen.

Secondly, the maturity at which the UFR is reached has to be fixed. In geometric form this equals the fixing of the endmost point on the very right side which can then be used to determine all the interpolated interest rates between the last historically given interest rate (in our case the rate for 30 years maturity) and the maximum maturity of the cash flows. For this study the UFR is reached after 61 years, in other words at the last maturity of the given cash flows.

4.2 Smith-Wilson method

The Smith-Wilson method is a sophisticated mathematical method for fitting yield curves to given spot rates. It was developed by Andrew Smith and Tim Wilson, further information can be found in the original paper Fitting Yield Curves with Long Term Constraints (2001), Research Notes, Bacon and Woodrow. The Financial Supervisory Authority of Norway published a more application orientated paper titled A Technical Note on the Smith-Wilson Method, which is publicly available on their homepage.

Some of the main advantages of this method include that it is a purely mechanized approach to yield curve fitting which can be easily implemented. It provides a perfect fit of the estimated term structure, while the UFR is reached asymptotically. Furthermore, it is a uniform approach including both interpolation between given spot rates and extrapolation beyond the last given spot rate. In contrast to the linear interpolation, the resulting yield curves have no kinks at maturities for which yields are given.

In order to conduct the yield curve fitting for given data, two parameters have to be chosen. Firstly an *Ultimate Forward Rate (UFR)* has to be fixed; for this study the UFR is 4.2%. Secondly the value for the parameter α has to be set. The parameter determines the weight of the ultimate forward rate within the model. Larger values give greater weight to the ultimate forward rate, while smaller values give more weight to the input data. For this study α equal to 0.1 has been chosen.

5 Change in net asset values

Both interpolation methods described in the previous section can be used to construct a full yield curve out of the given yields of German government bonds. The resulting interpolations can then be used as indication for possible changes in the yield curve within one year. For this empirical study the historic changes in the yields of German government bonds within one year are used as scenarios to model the effects of changes in the risk free term structure.

5.1 Calculation of the change in the interest rate term structure

The basis of risk assessment within Solvency II the value-at-risk 99.5% for a horizon of one year is used. For the submodule interest rate risk this means that the regulatory relevant risk is the change in the Net Asset Value (NAV)[6] of the insurance due to changes in the risk free rate term structure.

The standard approach defines an upside shock and a downside shock on the interest rates out of which the more adverse effect on the NAV is relevant for the capital requirements. This can be problematic as other changes in the term structure, such as flattening or steepening of the risk free rate term structure, can have more sever effects on the NAV but are not covered by the standard approach.

For the empirical study, we do not try to identify adverse scenarios on the basis of the yield curve but rather conduct simulations based on *all* observed changes in the risk free rate term structure. In order to be in line with the regulatory framework, changes for the horizon of exactly one year have been taken into account. In order to simplify calculations, observed interest rate term structures for February 29th have been excluded from the data.

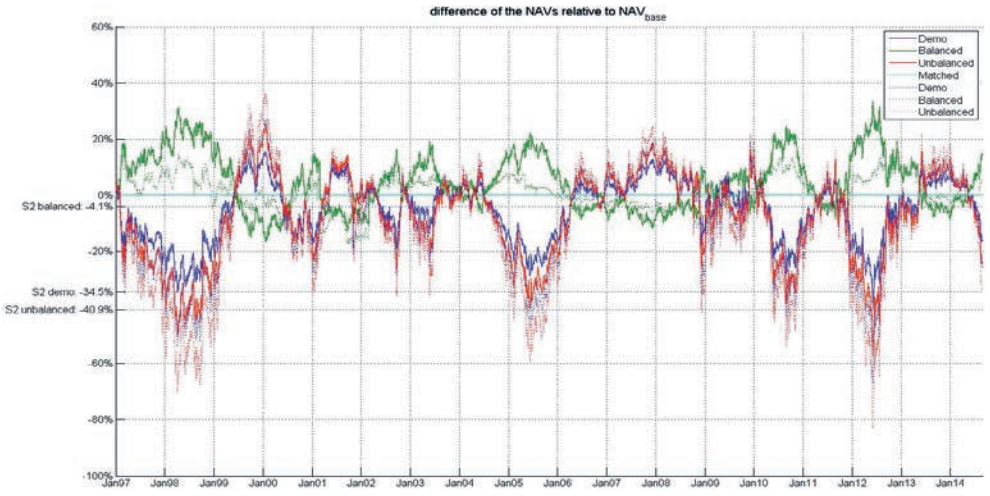
This allows for the calculation of movements in interest rates for different maturities for each day, if the interpolated interest rate term structure of the previous year is known. As our data starts January 1st, 1996 the first change in the interest rate term structure we can observe is the change from January 1st, 1996 to January 1st, 1997. Equivalently, the last change in the interest rate term structure our data contains is the change between August 28th, 2013 and August 28th, 2014.

For this paper the change in interest rates for a given maturity is defined as the absolute change. Other definitions of changes, such as relative changes as given in the legal definition of the standard approach to interest rate risk or absolute/relative changes in the discount factors are possible as well. Further research to study the effects of the various definitions of "change" seems promising.

Overall the empirical method derives a set of two times 6,444 changes in the risk free rate term structure which then can be applied to the four defined cash flows.

[6] For this study net asset value (NAV) refers to the difference of the present value of assets and the present value of the liabilities.

Chart 4: Relative change of NAV over a rolling 12 month period
%



Source: Authors' calculations.

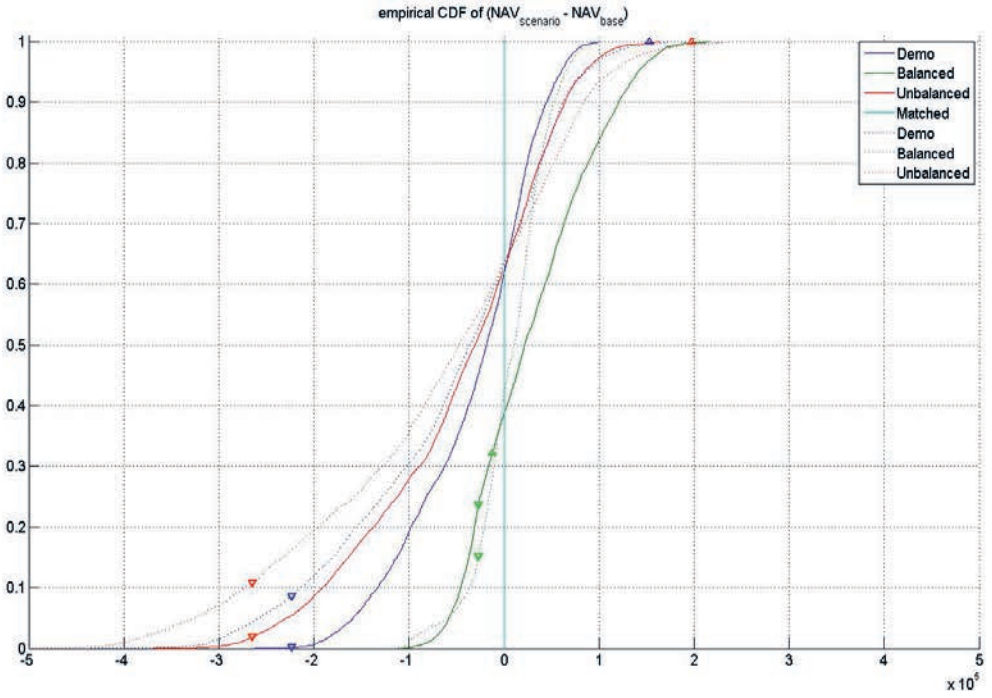
Chart 4 shows the relative difference of the NAV of a certain cash flow calculated with the term structure of the risk free rate (usually denoted as NAV_{base}) and the NAV calculated with the term structure of the risk free rate plus the movement of the interpolated German government bond yields (denoted as $NAV_{scenario}$) in % of NAV_{base}. The results calculated with linear interpolation are shown as solid lines while the results obtained via Smith-Wilson interpolation are shown as dashed lines. Additionally, the results of the standard approach to interest rate risk as defined in Solvency II are shown in the grid of the graph. It can be easily seen that the NAV of the *Balanced* Cash Flow is reduced by 4.1% under the standardized interest rate shock. Similarly the NAV of the *Demo* Cash Flow is reduced by 34.5% and the NAV of the *Unbalanced* Cash Flow is reduced by 40.9%.

5.2 Empirical cumulative distribution functions (empirical CDF) of Delta NAVs

After the historically observed changes in the term structure of interest rates have been calculated, these changes can be used to calculate the effect they have on the NAV of the cash flows defined in section 2.

Depending on the movement of the interest rate term structure and the structure of the cash flows, the effects on the NAV can vary widely. For some cash flows a flattening is much worse than for other cash flows, while for the cash flow Matched all changes in the interest rate term structure do not result in a change of the NAV as both sides of the cash flow are perfectly matched.

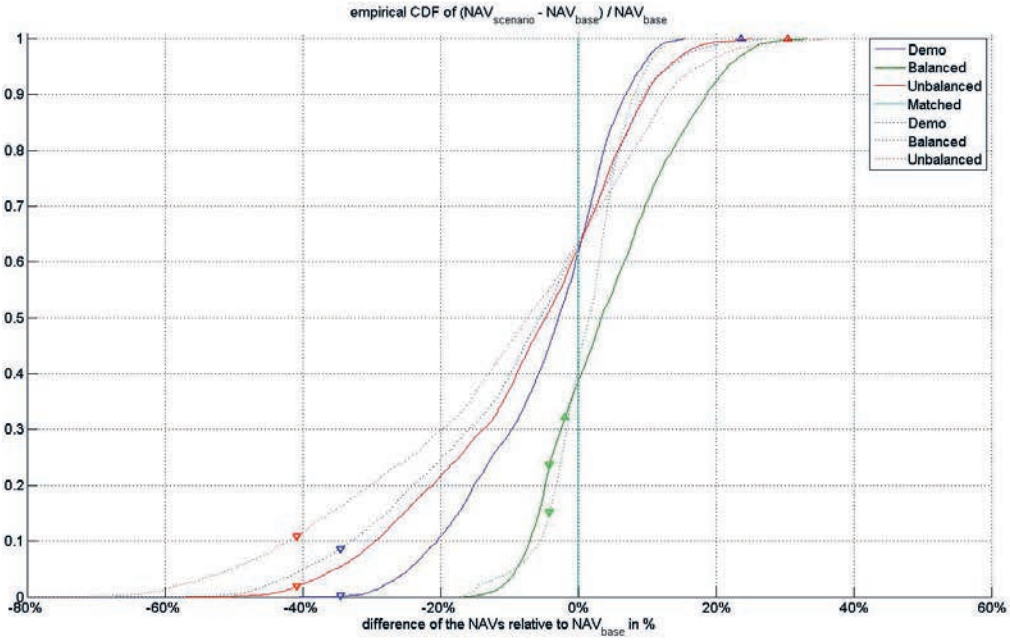
Chart 5: Distribution of absolute changes in NAV over a rolling 12 month period



Source: Authors' calculations.

In order to analyze the effects of the changes in the interest rate term structure, an empirical cumulative distribution function of the changes in the NAV can be constructed. Formally an empirical cumulative distribution function is constructed for the values of $NAV_{scenario} - NAV_{base}$. Chart 5 shows the empirical cumulative distribution function for absolute values of the change in the NAV. The results for the scenarios where the term structure of the interest rate are obtained with linear interpolation are shown as solid lines, the results for the interpolation with the Smith-Wilson method are shown as dashed lines.

Chart 6: Distribution of relative changes in NAV over a rolling 12 month period



Source: Authors' calculations.

Chart 6 shows a similar empirical cumulative distribution function, but for relative values of the change in the NAV, formally the empirical distribution function of the values of $(NAV_{scenario} - NAV_{base}) / NAV_{base}$. The results for the scenarios where the term structure of the interest rate are obtained with linear interpolation are shown as solid lines, the results for the interpolation with the Smith-Wilson method are shown as dashed lines.

In both pictures, the absolute and relative change in the net asset value for the interest rate shock in the standard approach are included as triangles. The triangle pointing upside represents the outcome of the shock of interest rates moving up; the triangle pointing downside represents the outcome of the downside shock.

The construction of the empirical cumulative distribution function allows for the empirical calculation of the regulatory relevant value-at-risk 99.5%. Table 1 shows the empirically calculated value-at-risks 99.5% in EUR, both for the linear interpolation of the interest yield curve and the Smith-Wilson interpolation method. The last column shows the corresponding results for the standard approach as given by the down shocks defined for QIS6.

Table 1: Absolute value-at-risk comparison for various methods of calculation

	VaR 99.5% in EUR linear interpolation	VaR 99.5% in EUR Smith-Wilson	VaR 99.5% in EUR standard approach
Demo	–203.040	–324.881	–223.187
Balanced	–88.588	–104.271	–26.728
Unbalanced	–291.730	–414.443	–264.608
Matched	0	0	0

Source: Authors' calculations.

It can easily be seen that the linear interpolation method roughly results in the same value-at-risk values as the standard approach especially for the *Demo* and *Unbalanced* cash flow. The value-at-risk 99.5% for the cash flow *Balanced* differs much more, but from a much lower level. In contrast to that the empirical results, obtained with Smith-Wilson interpolation, indicate a much higher level of risk. Table 2 shows the same results for relative values.

Table 2: Relative value-at-risk comparison for various methods of calculation

	VaR 99.5% in % of NAV linear interpolation	VaR 99.5% in % of NAV Smith-Wilson	VaR 99.5% in % of NAV standard approach
Demo	–31,3%	–50,2%	–34,5%
Balanced	–13,7%	–16,1%	–4,1%
Unbalanced	–45,0%	–64,0%	–40,9%
Matched	0,0%	0,0%	0,0%

Source: Authors' calculations.

6 Conclusion

The results outlined above give rise to three main conclusions.

Firstly, it indicates that the overall calibration of the standard approach seems to be underestimating the potential effect of interest rate changes, mainly due to its design as a shock relative to the current level of rates. Opposite to this, especially in recent years the movement of rates has been very strong already on an absolute level.

Secondly, it can be concluded that a lot of influence comes from technical aspects such as the interpolation method. Especially for poorly balanced cash flows

the effect of linear versus other interpolation methods can be of the magnitude of 20% of NAV.

Thirdly, and as the main result, we find that not only parallel shifts have to be considered when assessing the risk arising from changes in interest rates. Paradox, the relative risk estimation error between parallel (standard) approach and historic variation is higher for assumedly hedged balance sheets, in our analysis represented by the balanced cash flow profile. Whereas an alleged insensitivity towards rate movement as measured by the duration sensitivity measure would impose very little capital requirements on a company, the variation in NAV and thus own funds can be significantly higher in reality.

These findings suggest that further studies and more detailed data on the cash flow profiles of insurance companies and their sensitivities to interest rates as well as an impact study on technical specifications would be needed in order to properly assess the risk arising from adverse movements of the risk free interest rate curve.

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