

Negative Interest Rates and the Insurance Industry

A Survey of Risk-Management Capabilities and Practice





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Section 1: Introduction

Since 2008, we have lived in a world of unconventional monetary policy. Faced with limits to the effectiveness of their traditional tools of monetary policy, central banks around the world have extensively utilized nontraditional policy tools in the exercise of monetary policy. Foremost among these tools have been asset purchases (quantitative easing, or QE), forward guidance and negative interest rate policy (NIRP).

While those in North America are more familiar with QE and forward guidance, NIRP has been used extensively in Europe and Asia. Beginning in 2012, central bankers in the European Union, Japan, Switzerland, Sweden and Denmark¹ have imposed negative interest rates (NIR), effectively charging interest rather than paying interest on certain deposits at the central bank. NIRP has been long lived in these jurisdictions—every policy interest rate that has moved into negative territory remains negative today. These jurisdictions have experienced widespread reductions in interest rates—government and corporate bond yields, deposit rates and loan rates for individuals and businesses. It has recently been reported that a Danish bank is offering negative rates on residential mortgages (Collinson, 2019) and that UBS had imposed NIR on deposit accounts in its home country of Switzerland that exceed 500,000 euros (Winters, 2019). Countries with NIRP exhibit low interest rates across the yield curve, including NIR on long-term government bonds, and on corporate bonds.

Recognizing that NIRP could pose significant risks to the insurance industry, the Joint Risk Management Section of the Canadian Institute of Actuaries, the Casualty Actuarial Society and the Society of Actuaries (SOA) have undertaken this study of NIR and the insurance industry. This study has three primary objectives, addressed in the three main report sections:

Section 3 reviews the history of NIR, analyzing the evolution of policy interest rates, government bond yields and corporate bond yields in those jurisdictions that have employed NIRP compared with the US, which has not.

Section 4 provides an overview of existing literature related to NIR, including literature on the drivers of NIRP, the effectiveness and unintended consequences of NIRP, the effect of negative rates on the insurance industry, and insight into the likelihood of NIRP's future use.

Section 5 provides results of a study of practicing actuaries gathering information on their familiarity with NIR and NIRP, their opinions on the effectiveness and unintended consequences of NIRP, and their firms' modeling and risk-management practices related to NIR.

¹ This also includes central banks in Hungary, which was not considered in this report, due to a combination of the country's small gross domestic product and the modest level of its NIRP, -0.05% on a secondary policy rate.

Bringing together these three elements, we aim to assist the industry in developing appropriate plans and responses to address risks related to NIR.

To set context for the discussion to follow, we introduce several terms as used throughout the paper. “NIR” refers to a negative nominal interest rate, as contrasted with a real interest rate, which may be negative if a nominal rate is positive but is lower than the rate of inflation. NIR is an inclusive term and can refer to interest rates on loans or deposits, interest rates on bonds and other debt instruments issued by government or corporate issuers, or interest rates set by central banks for monetary policy. “NIRP” is a narrower term referring to monetary policy under which a central bank sets one or more of its policy interest rates below zero. A “negative rate jurisdiction” is a jurisdiction experiencing NIR since 2012 (we use the term “jurisdiction” rather than “country” in recognition that the Eurozone is supranational), and in some instances, we use the more specific term “negative policy rate jurisdiction” to highlight discussion that is specific to policy interest rates.

Section 2: Executive Summary

Since 2008, central banks around the world have extensively utilized nontraditional policy tools in the exercise of monetary policy. This report focuses on one of those tools—Negative Interest Rate Policy (NIRP) and has been undertaken by the Joint Risk Management Section of the Canadian Institute of Actuaries, the Casualty Actuarial Society and the Society of Actuaries in recognition that NIRP could pose significant risks to the insurance industry. This report includes three distinct threads of research—an analysis of historical interest rates under NIRP; a review of existing literature related to NIR and NIRP; and results of an actuarial practitioner survey of awareness of NIR, opinions regarding the effectiveness of and risks associated with NIRP, and insurance company modeling and risk management practice related to NIR. Considerations for the pension system are out of scope of the report, though many of the risks and implications of NIRs described for the insurance industry would be applicable to the pension system as well.

We summarize our findings and results by section, followed by a summary of our primary conclusions.

2.1 Negative Interest Rates in Recent History—Section 3

NIRP was first implemented in Denmark in 2012. The European Central Bank (ECB) did not follow until mid-2014, with Sweden and Switzerland then quickly following suit. The Bank of Japan then implemented NIRP in early 2016. Since then, all five jurisdictions have maintained NIRP, and as of May 2019, the rates ranged from a high of -0.05% in Japan to a low of -0.75% in Switzerland.

As NIRP has been implemented, government bond yields have fallen across the yield curve, and there has not been evidence of significant yield curve steepening in any jurisdiction. For three of the five jurisdictions, 10-year government bond yields have fallen below zero at some time during this period, and the five-year has fallen below zero for all of them. In most cases, the spread between the 10-year government bond yield and the policy rate has fallen in the time since NIRP was implemented, and no jurisdiction shows a significant increase in this spread. During most of the period of NIRP, the US yield curve has shown greater steepness than yield curves in the NIRP jurisdictions, with the US 10-year spreads becoming comparable only after the Federal Reserve (Fed) began implementing steady increases in 2017.

Corporate bond yields have also fallen steadily since the introduction of NIRP, as measured using Standard & Poor's corporate bond yield indices. Spreads on corporate bonds were more difficult for us to evaluate, because we did not have access to full yield curve data for either government or corporate bonds and because the average duration varies for the different countries' corporate bond yield indices. However, measured against either policy rates or 10-year government bond yields, corporate spreads do not indicate any significantly increasing patterns, and spreads in the Negative Rate Jurisdictions are generally lower than US spreads over this period.

2.2 Review of Existing Literature—Section 4

We have reviewed and summarized literature addressing several key elements related to NIRP—factors driving the introduction of NIRP, effectiveness and unintended consequences of NIRP, measures to improve the effectiveness of NIRP, and literature related to the insurance industry. This literature indicates that natural interest rates have fallen over the last few decades—primarily due to demographic factors and increased risk aversion—and that this trend is likely to persist, which reduces the effectiveness of conventional monetary policy measures.

Just as our empirical analysis suggests that NIRP has been effective at reducing interest rates across the spectrum of debt instruments, the literature—with some exceptions—finds that NIRP has been effective at

reducing interest rates and increasing both credit supply and investment activity. Some critics of NIRP argue that it may constrain, rather than expand, bank lending because of reduced interest margins. While some authors have found such behavior among a subset of banks, the literature indicates that, broadly, banks have responded to NIRP with increased lending as policymakers expect.

The literature generally finds that adverse consequences of NIRP have not arisen to any significant degree. Several authors have studied the impact of NIRP on bank profitability, finding that the banking sector as a whole has effectively offset reduced interest margins with a combination of increased lending volume and increased revenue from other sources. The literature does find that some banks, particularly those whose business model is heavily weighted toward retail depositors and whose capitalization is low, have suffered greater adverse effects but in most cases have been able to respond in ways that mitigate these effects. More broadly, some authors have studied the effect of NIRP on variables related to systemic financial stability risks, generally finding little adverse impact to date. While adverse consequences have not arisen, authors are consistent in cautioning that “have not” does not mean “will not.”

While monetary policymakers have found the effectiveness of NIRP to be acceptable under the modestly negative rates implemented to date, most authors still believe that a sub-zero lower bound exists beyond which deeper negative rates would be ineffective. A body of research has suggested mechanisms by which this lower bound could be eliminated. Such mechanisms include development of digital currency to replace or supplement physical currency, as well as means to impose fees or taxes on cash holdings. This research argues that more deeply negative rates may be desirable in some circumstances and that policymakers should not be constrained in their ability to implement them.

Research into the effect of NIRP on the insurance industry are limited, with most literature being general in nature and with little of the empirical analysis seen for the banking sector. Authors unaffiliated with the insurance industry have warned about the risk of NIRP to the financial stability of the insurance industry, as well as the financial stability of the pension system, but little industry literature studies this risk. There is a need for additional research—both empirical and projection-based—into the industry’s financial risks and potential responses. There is also a need for research into regulatory changes that may be needed to enable the industry to navigate the effects of negative rates. Such changes might include adjusting capital requirements to consider the risks of NIR as well as adjusting the floors on guaranteed interest rates to consider negative rates. In the US, several reserving or capital requirements rely on formulas or scenarios that do not accommodate NIR.

2.3 SOA Survey on Negative Interest Rates—Section 5

The practitioner survey on NIR found participants were only modestly aware of NIR and NIRP throughout the world. Participants perceived much greater risks than benefits arising from NIRP, both for their firms and for the economic system. Solvency and profitability risks to the financial sector were low on their list of adverse consequences, however, with such consequences as excessive risk-taking and increased inequality ranking considerably higher among the participants’ list of concerns.

Actuarial modeling capabilities related to negative rates were moderate, with 50% to 70% of participants responding capabilities in asset and liability software and in their scenario generation. Fewer than 30% of participants indicated that they do include negative rates in their modeling exercises, with a larger number using modeling methods or assumptions that prevent or suppress the impact of negative rates. A similarly small number responded that negative rates are considered in their enterprise risk management (ERM) program in any formal way, although about 40% indicated that their firms hedge against declining interest rates.

2.4 Conclusions—Section 6

We conclude that the results of NIRP to date have generally met policymakers' expectations, with minimal adverse consequences. Because of this and because the natural rate of interest is expected to remain low, one may expect that, in the next economic downturn, more central bankers—including the US Fed—are likely to implement NIRP and that rates are likely to move more deeply into negative territory. The risk of adverse consequences remains high, including risks to the insurance industry. Insurance industry research to date is inadequate to assess the magnitude of these risks, and additional research is needed in this area and in the area of potential regulatory actions to help ensure stability (see the Conclusion and Section 4.5 for discussion of potential research topics). As a whole, survey participants and their firms appear under-prepared for negative rates in terms of both modeling practice and ERM. Additional work is needed on both an industry-wide scale and at the firm level to evaluate and respond to the risks posed by NIR.

Section 3: Negative Interest Rates in Recent History

With limited exceptions discussed in Section 4.1, negative nominal interest rates have historically arisen only as a result of NIRP, that is, central bank decisions to set reference interest rates at negative levels in their management of monetary policy. Negative nominal market yields on other debt instruments have been recorded but only subsequent to NIRP. The history of NIRP began quite recently. Prior to 2012, we are aware of one instance where a central bank has utilized NIRP, when the Swedish Riksbank's deposit rate dropped as low as -0.25% over the period of July 2009 through Aug. 2010. Previously, in the 1970s, Switzerland imposed a surcharge on foreign deposits, which resulted in effectively negative rates on these deposits. These limited instances notwithstanding, there was thought to be a zero floor on interest rates until central banks began experimenting with NIRP in 2012. Our review of negative rate history begins in 2012.

3.1 Policy Interest Rates

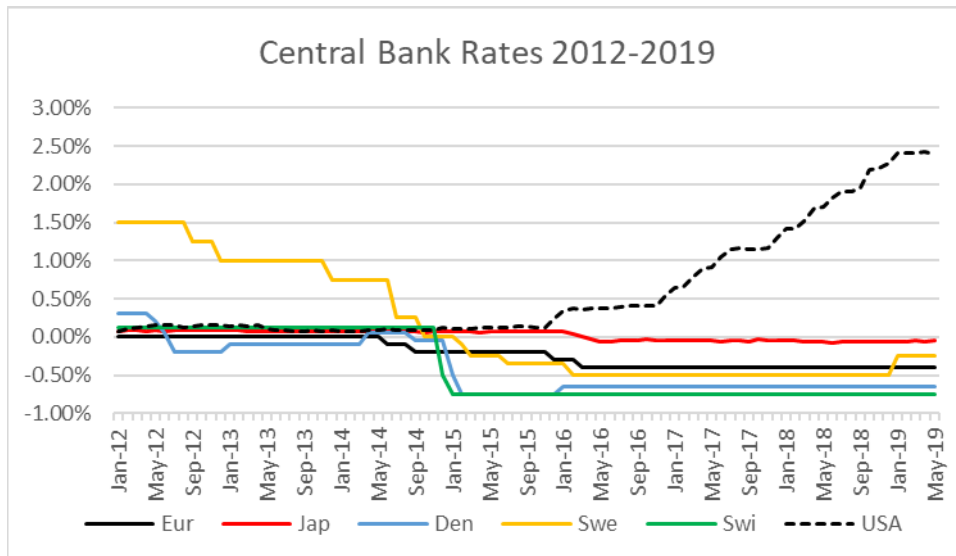
A central bank may manage multiple reference interest rates. For the purposes of this report, NIRP is defined by at least one policy interest rate set at a negative level, and a Negative Policy Rate Jurisdiction is a jurisdiction in which the central bank has implemented NIRP. As of this writing, central banks in five jurisdictions—Denmark, the Eurozone, Japan, Sweden and Switzerland—have utilized NIRP since 2012. Table 1 shows and defines the policy interest rates utilized for NIRP in each of these jurisdictions. Although in some cases a central bank may set other interest rates that are not negative, our research indicates that the rates below are these banks' primary policy rates.

Table 1
NEGATIVE POLICY INTEREST RATES BY JURISDICTION

Central Bank	Policy Interest Rate	Rate Description
ECB	Rate of the deposit facility	Rate that banks may use to make overnight deposits with the Eurosystem
Bank of Japan (BOJ)	Call rate, uncollateralized overnight—average	Average rate on money market transactions, targeted by the BOJ under a three-tier rate system
Danmarks NationalBank	Certificates of deposit rate	Rate on one week certificates of deposit offered to monetary-policy counterparties
Sveriges Riksbank	Repo Rate	Rate of interest at which banks can borrow or deposit funds at the Riksbank for a period of seven days; Riksbank's policy rate since 1994
Swiss National Bank (SNB)	Three-month LIBOR target range	Target range for secured short-term money market rates until June 13, 2019, when SNB announced the introduction of the SNB Policy Rate to replace LIBOR as the target basis

Figure 1 charts the history of these rates since 2012, along with the effective US Federal Funds Rate, for comparison. This figure shows that, apart from Sweden, policy rates in these jurisdictions were tightly clustered in the 0.00% – 0.30% range at the beginning of 2012. Denmark was the first jurisdiction to implement NIRP in July 2012. The ECB did not implement NIRP until two years later, in 2014, at approximately the same time Danmarks NationalBank increased its rates above zero for a short time. Central banks in Switzerland and Sweden followed fairly closely on the heels of the ECB decision, with Japan following in 2016. Rates have remained negative in all five jurisdictions and have moved within a narrow range since that time. As of May 2019, rates in these jurisdictions ranged from a low of -0.75% in Switzerland to a high of -0.05% in Japan. Over this same period, the US Fed maintained rates in positive territory, with rates comparable to most of the Negative Rate Jurisdictions in the 2012–2014 time period but with rates increasing steadily beginning in 2016.

Figure 1
Policy Interest Rate History by Jurisdiction



Data sources: Board of governors of the Federal Reserve System, retrieved from FRED, Federal Reserve Bank of St. Louis; ECB; BOJ; Danmarks NationalBank; Sveriges Riksbank; SNB. See references for links to specific data series.

3.2 NIRP Objectives

Like any monetary policy action, NIRP seeks to influence borrowing/lending and investment behavior to achieve some more fundamental economic objective. Different central banks state different objectives for their monetary policy, and their NIRP objectives vary accordingly. Here we discuss the stated and inferred objectives of NIRP in the various NIRP jurisdictions.

Denmark and Switzerland have been considered safe-haven currencies, and the objective of their NIRP has been to counter currency appreciation.

Denmark, the first jurisdiction to implement NIRP, maintains a fixed exchange rate policy versus the euro, and the sole objective of its interest rate policy is to maintain this exchange rate within a narrow target range. Under most conditions, this entails making interest rate changes in parallel with the ECB. Denmark’s central bank manages four policy interest rates—the current-account rate, the certificates of deposit rate, the lending rate and the discount rate—and the rate on certificates of deposit was initially decreased to -0.20% in 2012 as part of a 0.25% reduction in all of its policy rates coincident with the ECB’s reduction in rates. Therefore, the objective of Denmark’s NIRP was, and continues to be, to fight inflation of its currency against the euro due to economic weakness in the Eurozone. Reuters reported at the time that “there was nothing fundamentally new in a negative interest rate,” according to the central bank governor (Acher and Mikkelsen, 2012). The certificate of deposit rate has remained negative since 2012 and has become the de facto primary policy rate, because the other rates have been floored at zero. The current certificate of deposit rate is -0.65%.

In Switzerland, the SNB introduced a cap on the Franc to euro exchange rate in 2011, maintained in the currency exchange market through the purchase of foreign currency reserves. In January 2015, the SNB abandoned its exchange rate cap. As reported by *The Economist*, reasons included concerns with the size of the foreign reserves; concerns that the ECB would implement quantitative easing, requiring accelerated currency reserve purchases to maintain the cap; and recognition that weakening in the euro with respect

to other world currencies had reduced the need for the policy (C.W., 2015). At the same time, the SNB reduced its policy rate to -0.75%, where it has remained since then.

Price stability is the primary monetary policy objective for EuroZone’s ECB, Japan’s BOJ and Sweden’s Riksbank, and all three banks have established an inflation target of 2% (European Central Bank, 2019; Sveriges Riksbank, 2018, 2016). NIRP in these three jurisdictions can then be seen as focused on stimulating price inflation or fighting deflation. In Sweden, secondary monetary policy objectives are stated to include “sustainable growth and high employment” (Sveriges Riksbank, 2018). The Riksbank, in a July 2016 article, cited several factors leading to its decision to implement and maintain a negative repo rate. These include a declining trend in real interest rates, pushing down the level at which the repo rate can be stimulative; a need to maintain parity with other jurisdictions, to prevent currency appreciation; and deflationary pressure on prices (Sveriges Riksbank, 2016).

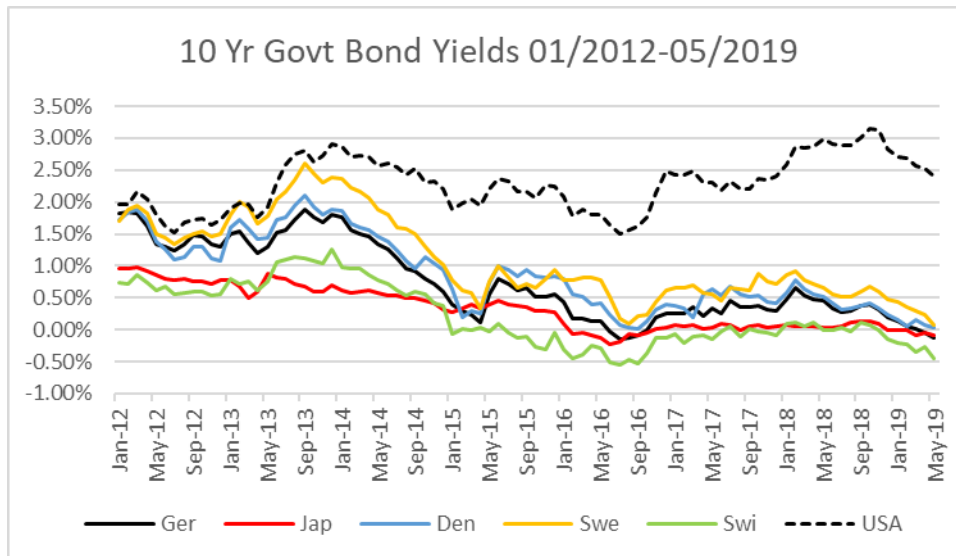
In addition to NIRP, the ECB and BOJ have implemented quantitative easing (QE) asset purchase programs as part of their monetary policy programs. While not the topic of this paper, QE interacts with NIRP, and they have complementary objectives. BOJ implemented its QE program in April 2013, while its NIRP was implemented later in April 2016. The level of the BOJ call rate has been the most modest of the negative policy rates, having not dropped below -0.10%, while the BOJ’s QE program has been the largest in the world, with the BOJ balance sheet exceeding Japan’s gross domestic product (GDP) as of late 2018, at more than \$4.8 trillion (Sano and Uetake, 2018). Thus, it appears that Japan’s NIRP was intended to complement its existing QE program. The ECB, by comparison, implemented its NIRP first, in June 2014, followed by its QE program in March 2015; and its negative rates have been more significant than Japan’s, ratcheted from -0.10% in June 2014 to -0.40%. At the same time, its QE program has been relatively more modest than Japan’s, peaking at approximately 41% of GDP (This Time It Is Different, 2019). As noted above, the SNB also conducted a previous asset purchase program whereby it purchased foreign current reserves to maintain its capped exchange rate, but the capped exchange rate program was terminated at the same time it began its NIRP.

3.3 Long-term Government Bond Yields

As discussed in Section 5, some survey participants, particularly those not located in Negative Rate Jurisdictions, reported an expectation that financial markets would compensate for negative policy rates through an increase in liquidity premiums for long-term bonds and in credit premiums for corporate and other nongovernment debt. This is perhaps an intuitive expectation—that in light of NIRP, market participants would price in additional risk for assets with embedded liquidity or credit risk—albeit a naïve one, as we will see. We were interested to understand how market yields on long-term corporate bonds and investment-grade corporate bonds have, in fact, behaved in Negative Rate Jurisdictions.

Figure 2 provides simple time series of 10-year government bond yields in the same jurisdictions. Note that while the Eurozone shares a central bank, European countries issue their own government debt. For this analysis, we have selected Germany to represent European long-term bond yields. At the beginning of 2012, 10-year rates in Japan and Switzerland were below 1%, but all other jurisdictions, including the US, were clustered in the 1.5–2.0% range. These rates remained clustered until the middle of 2013, at which time yields in Germany, Denmark and Sweden began to fall relative to the US, driven by lower economic growth rates in Europe. By the beginning of 2015, 10-year government bond yields had fallen below 1% in all of the Negative Rate Jurisdictions and have remained so since then. All of the Negative Rate Jurisdictions have experienced negative yields on 10-year government bonds except for Denmark and Sweden, where yields have dropped very close to—but not below—zero.

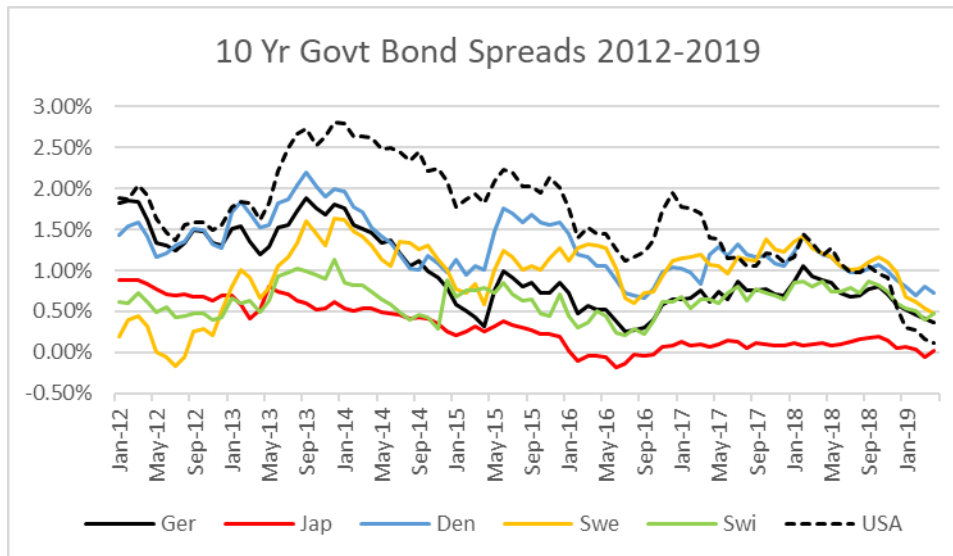
Figure 2
10-Year Government Bond Yields by Jurisdiction



Data source: Organization for Economic Co-operation and Development, retrieved from FRED, Federal Reserve Bank of St. Louis. See references for links to specific data series.

For a more direct view of term spreads, Figure 3 combines the data from Figures 1 and 2 to show time series of the spreads between 10-year government bond yields and policy interest rates in each of these jurisdictions. While there has been variation over time, the trend has been flat or downward in all of the Negative Rate Jurisdictions since the introduction of NIRP. In Sweden, we see significant increase in the term spread in the period up until early 2014, prior to the implementation of NIRP but thereafter see flat to declining term spreads like the other Negative Rate Jurisdictions. In the US, we also see a decline in the term spread, indicating yield curve flattening as the Fed has increased the Federal Funds Rate.

Figure 3
10-Year Government Bond Spreads to Central Bank Policy Rates by Jurisdiction



Data sources: Board of governors of the Federal Reserve System, retrieved from FRED, Federal Reserve Bank of St. Louis; ECB; BOJ; Danmarks NationalBank; Sveriges Riksbank; SNB; Organization for Economic Co-operation and Development, retrieved from FRED, Federal Reserve Bank of St. Louis. See references for links to specific data series.

In our last view of the impact of NIRP on the term structure of interest rates, Figure 4 combines all the data from Figure 3 in a single scatterplot to which we have fit a third-order polynomial trend line.² This view indicates that when policy rates have been below 2.5%, lower policy rates have correlated with a flatter yield curve and that there has not been a discontinuous change in this pattern when policy rates turn negative. As indicated by the trendline, when policy rates have risen above 2.5%, this pattern has begun to reverse, with higher policy rates corresponding to a flatter yield curve. While not a statistical analysis and not controlled for other factors, this view does indicate that, historically, NIRP has not driven a steepening of the yield curve in Negative Rate Jurisdictions. This is one indicator that NIRP, often in conjunction with quantitative easing, has been effective at reducing interest rates across the yield curve.

² The trendline is intended to be indicative, and the choice of a third-order polynomial fit could be considered arbitrary. We reviewed trendlines ranging from linear to sixth-order polynomials, and higher order trendlines showed in steeper declines in the term spread for policy rates above 2.5%, as well as a flattening of the term spread for policy rates below -0.25%.

Figure 4
10-Year Government Bond Spreads to Central Bank Policy Rates Scatterplot



Data sources: Board of governors of the Federal Reserve System, retrieved from FRED, Federal Reserve Bank of St. Louis; ECB; BOJ; Danmarks NationalBank; Sveriges Riksbank; SNB; Organization for Economic Co-operation and Development, retrieved from FRED, Federal Reserve Bank of St. Louis. See references for links to specific data series.

3.4 Corporate Bond Yields and Spreads

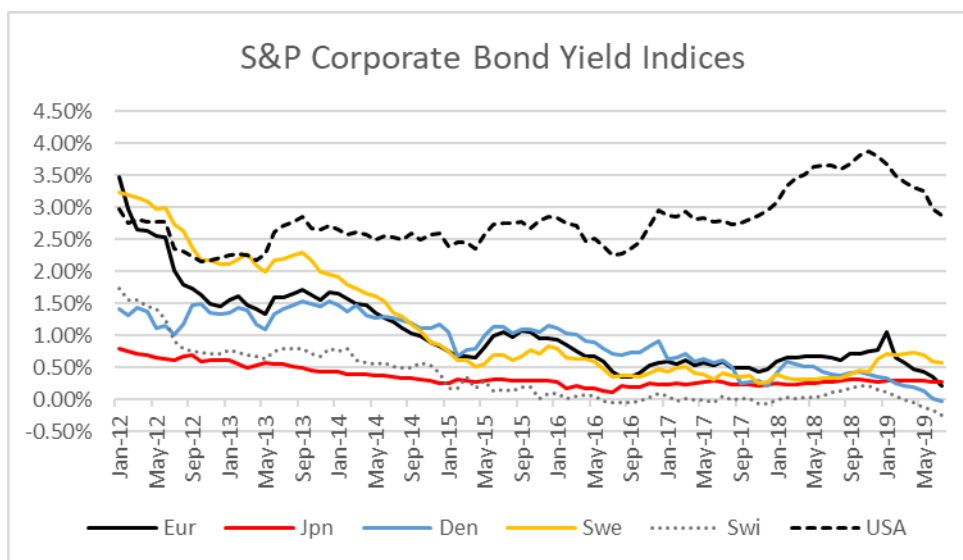
The data available to us for analyzing the relationship between NIRP and yields (or spreads) on corporate bonds and other investment-grade debt securities was more limited. We sought information on corporate rates that was comparable across jurisdictions—ideally targeting indices of A-rated corporate bonds with durations comparable to a 10-year bond—but such information was limited. Ultimately, we selected a set of Standard and Poor’s investment-grade bond yield indices that, while not perfect, provided a reasonable basis to investigate whether NIRP has significantly affected credit spreads on corporate bonds. Table 2 shows the names of the indices we selected, along with their effective durations as of May 2019. As shown in the table, the effective durations of the indices are widely variable, and for Denmark, the best available index was an aggregate investment-grade bond index, not an A-rated corporate bond index. Note that, unlike 10-year government bonds, where we used Germany to represent the Eurozone, we have used a corporate bond index for the entire Eurozone for this analysis.

Table 2
STANDARD & POOR’S CORPORATE BOND INDICES USED FOR ANALYSIS

Index	Bond Class	Effective Duration May 2019
S&P Eurozone A Investment Grade Corporate Bond Index	A-rated corporate	4.8
S&P Japan A Investment Grade Corporate Bond Index	A-rated corporate	3.8
S&P Denmark Aggregate Bond Index	Investment-grade, aggregate issuers	6.6
S&P Sweden A Investment Grade Corporate Bond Index	A-rated corporate	2.7
S&P Switzerland A Investment Grade Corporate Bond Index	A-rated corporate	4.4
S&P 500 A Investment Grade Corporate Bond Index	A-rated corporate	7.2

Figure 5 presents simple time series of these corporate bond yield indices, analogous to the series of policy rates and 10-year government bond yields in Figures 1 and 2, respectively. While the differences in duration and, in the case of Denmark, bond characteristics make direct comparison difficult, it is notable that, while there was a considerable dispersion in these indices at the beginning of 2012, the indices for the Negative Rate Jurisdictions have converged at a level below 1%, with Switzerland and Denmark even experience negative yields on corporate bonds recently.

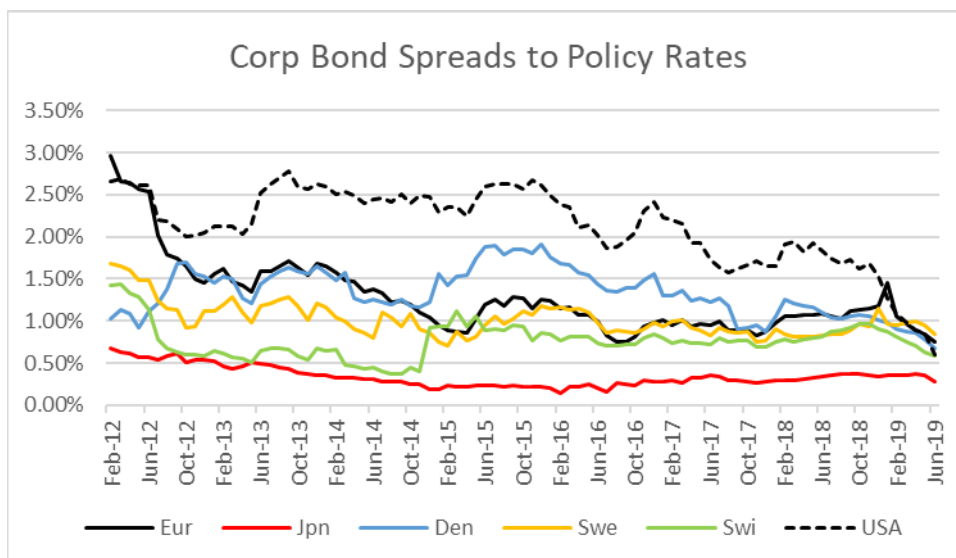
Figure 5
S&P Corporate Bond Indices, Yield to Maturity by Jurisdiction



Data source: Standard & Poor's. See references for links to specific data series.

Figures 6 and 7 chart the spreads of these bond yield indices compared with policy rates and 10-year government bond yields, respectively. Figure 6 indicates that, in general, the corporate spreads to policy interest rates, which reflect both the term structure of interest rates and credit spreads, have not increased and in some cases have decreased in the Negative Rate Jurisdictions since the introduction of NIRP. While the changes vary by jurisdiction, the reductions in this spread have generally been greater in the Negative Rate Jurisdictions than in the US, at least until the Fed began raising the Federal Funds Rate in 2016. This analysis does not provide insight into whether credit spreads have increased relative to a government bond yield of comparable duration, but any such increases have been offset by yield curve flattening.

Figure 6
S&P Corporate Bond Indices, Yield to Maturity Spread vs. Policy Rates by Jurisdiction

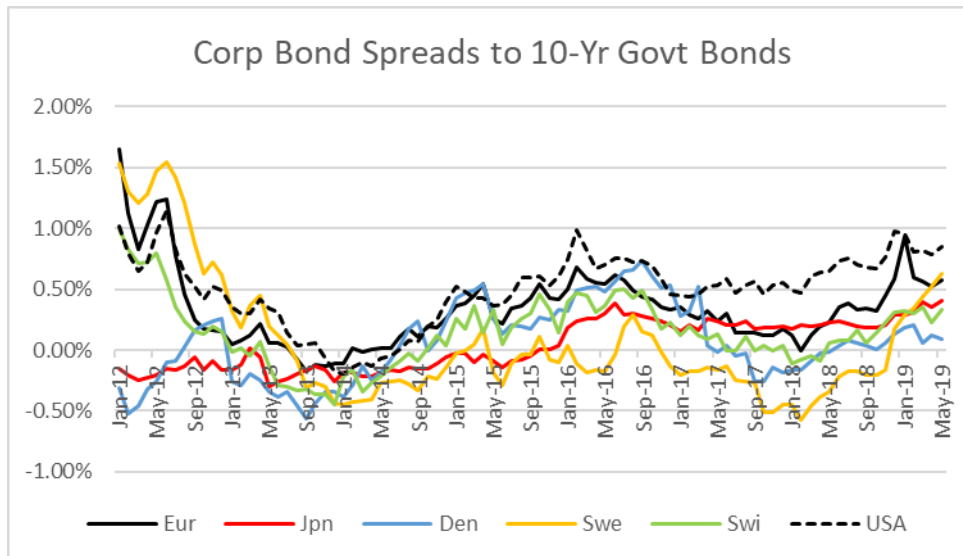


Data sources: Board of governors of the Federal Reserve System, retrieved from FRED, Federal Reserve Bank of St. Louis; ECB; BOJ; Danmarks NationalBank; Sveriges Riksbank; SNB; Standard & Poor's. See references for links to specific data series.

Figure 7 provides some additional insight into changes in credit spreads during the NIRP regimes. If the average duration of the corporate bond indices were equal to that of a 10-year bond over the time period, these spreads would accurately represent credit spreads. As illustrated in Table 2, the average duration of most of these indices as of May 2019 is considerably shorter than that of a 10-year bond, meaning that the spreads presented below consist of a credit spread and a negative term spread. This has a couple of implications for interpreting these series: 1) Under a normally shaped yield curve, these spreads would understate the true credit spread at a point in time; 2) over time, a flattening yield curve would tend to increase these spreads relative to the true credit spread. Duration data for these indices was not available before 2016, so we also have no insight into the impact of changes in the average duration of the indices over time.

With these limitations in mind, several observations are notable regarding Figure 7. With the exceptions of Japan and Denmark, these spreads have fallen since 2012. The spreads for all indices hit a low point at the end of 2013 and have generally increased since then. In all jurisdictions, yield curves have generally flattened over this time period, so these data may overstate the increase in true credit spreads. The increase in these spreads for the Negative Rate Jurisdictions has generally been lower than the corresponding increase in the US. Overall, these data do not suggest that markets have compensated for NIR through higher credit spreads.

Figure 7
S&P Corporate Bond Indices, Yield to Maturity vs. 10-year Government Bond Yield by Jurisdiction



Data sources: Organization for Economic Co-operation and Development, retrieved from FRED, Federal Reserve Bank of St. Louis; Standard & Poor's. See references for links to specific data series.

3.5 Summary of Negative Interest Rate History

The history of NIRP thus far has been one-directional. No central bank that has implemented NIRP has subsequently ended it. Denmark's NIRP has now lasted more than seven years, and most other jurisdictions are beyond four years. If one views these policies as designed to address an acute issue, the persistence of these policies may suggest that they have failed in their primary objectives. Alternatively, one may view NIRP as part of a new normal that will remain a regular tool of monetary policy. Section 4 discusses literature related to these questions.

NIRP aims to reduce borrowing costs across financial markets to achieve a more fundamental economic objective. To the extent that increases in spreads limit the transmission of NIRP through the debt markets, the effectiveness of the policy is limited, as is the impact of the policies on long-term debt investors like insurance companies. Table 3 provides one additional view of the transmission of negative rates to the long-term government bond and corporate bond markets, based on changes in spreads from the month immediately preceding the implementation of NIRP. Consistent with the discussion above, this table does not indicate that NIRP is associated with increasing term or credit spreads. This may be contrary to one's intuition that markets would compensate for NIRP through higher spreads.

Table 3
Changes in Spreads from NIRP Implementation to May 2019, By Jurisdiction

Juris	1st NIRP Mo	10-yr Spread to Policy Rate			Corp Spread to Policy Rate			Corp Spread to 10-yr		
		Pre-NIRP*	May 2019	Chg	Pre-NIRP*	May 2019	Chg	Pre-NIRP*	May 2019	Chg
Eur	June 2014	1.33%	0.27%	-1.06%	1.35%	0.85%	-0.50%	0.02%	0.58%	0.56%
Jap	April 2016	-0.05%	-0.05%	0.00%	0.21%	0.36%	0.15%	0.26%	0.40%	0.14%
Den	July 2012	1.21%	0.69%	-0.52%	2.94%	1.35%	-1.59%	1.54%	0.63%	-0.91%
Swe	February 2015	0.78%	0.32%	-0.46%	0.19%	0.13%	-0.06%	0.26%	0.33%	0.07%
Swi	December 2014	0.29%	0.30%	0.02%	0.99%	0.88%	-0.10%	0.08%	0.09%	0.01%

* Pre-NIRP spreads were measured the month prior to NIRP implementation

Data sources: Board of governors of the Federal Reserve System, retrieved from FRED, Federal Reserve Bank of St. Louis; ECB; BOJ; Danmarks Nationalbank; Sveriges Riksbank; SNB; Organization for Economic Co-operation and Development, retrieved from FRED, Federal Reserve Bank of St. Louis; Standard & Poor's. See references for links to specific data series.

It is important to note that NIRP is only one element of central banks' unconventional monetary policy, along with quantitative easing and other open-market operations, and that monetary policy itself is only one of many factors impacting the development of interest rates. It is beyond our scope to isolate the effect of NIRP from other factors, either to establish causality or to assert statistical significance for any correlations observed in the historical data. Instead, it was our objective to seek evidence in the historical record, suggesting that NIRP has been accompanied by an increase in term or credit spreads. Recognizing the limits in our data sources and, as a result, the rigor of the analysis, we did not observe evidence of such increases. In our opinion, this experience increases the likelihood of central bankers' future use of NIRP and increases the impact of NIRP on investment yields achieved in the insurance industry.

Section 4: Review of Existing Literature

Since NIRP is a relatively novel development, there is a limited (but rapidly growing) body of literature on the topic, primarily in the sphere of economics. Existing literature also reflects a wide range of views on NIRP, its effectiveness, risks and consequences (intended or unintended), many of which are speculative due to the limited historical record. The objective of this section is not an exhaustive review or critique of the existing literature. Instead, we intend to provide an overview of literature, which includes extensive but not complete references, on several topics that will be of interest to practicing actuaries and will provide context for the survey results to follow. Specifically, this section touches on literature related to the following topics: causes of NIRP, effectiveness of NIRP, measures to improve NIRP effectiveness, risks and unintended consequences of NIRP, impact of NIRP on insurance companies, and the likelihood of future NIRP use.

4.1 Causes and Drivers of NIRP

In introducing the literature of NIR, it is useful to begin with literature into the causes of NIR. In most cases, NIR in recent history has been precipitated by NIRP—i.e., driven by central bank policy decisions rather than by market forces. One might presume, then, that NIR is an artificial phenomenon that cannot arise naturally. Let's discuss some research relating directly to this question.

Economists describe the natural rate of interest as “the real interest rate consistent with output equaling potential and stable inflation” (Laubach and Williams, 2003). Laubach and Williams estimated the US natural interest rate for the period 1961–2000, finding that it varied over time in close correlation with the “trend growth rate” in potential GDP. Policy interest rates below the natural rate are considered accommodative or expansionary, while rates above the natural rate are considered contractionary. Laubach and Williams further found that “mismeasurement of the natural rate of interest can cause a significant deterioration in macroeconomic stabilization.” In the sense that monetary policy seeks to influence GDP growth and change the natural rate of interest, any type of interest rate policy can be considered artificial, but is NIRP more artificial than conventional interest rate policy and are NIR possible in the absence of NIRP?

Several authors have documented a decline in the natural rate of interest in specific countries like Japan (Han, 2019), the US (Del Negro et al, 2017) and more broadly in the world's advanced economies (Brand et al, 2018) since the global financial crisis that began in 2008. Han highlights the impact of demographics in reducing the natural interest rate in Japan, resulting in the ineffectiveness of Japan's Zero interest rate policy (ZIRP). Brand et al document a long-term decline in the natural interest rate, linking this decline to a number of factors, including “ageing, waning productivity growth, a rise in mark-ups, and a surge in risk aversion in the wake of the global financial crisis.” Del Negro et al have also found increased risk aversion, attributing the reduction in the US natural rate of interest since the late 1990s to an increased “premium for safety and liquidity” on US Treasury instruments. These authors' modeling also indicates that “the short-term interest rate was severely constrained by the effective lower bound on nominal interest rates starting in late 2008, when the natural rate of interest plunged well into negative territory” (Del Negro et al, 2017) and suggests that the natural rate of interest is likely to remain low into the future.

Several authors note that, historically, effective monetary stimulus in the face of a recession generally requires significant reductions in interest rates: “500–600 basis points cuts in policy rates have been typical during recessions in advanced countries” (Agarwald and Kimball, 2019). It is not hard to see that rates must exceed 5% at the start of the downturn to supply this degree of stimulus with conventional monetary policy. Thus, a decline in the natural interest rate limits the effectiveness of conventional interest rate policy to fight a contraction. This limitation is evident in the Negative Rate Jurisdictions, where policy rates

remain negative, but also in countries like the US, where short-term interest rates since the great recession have not exceeded 2.5%.

Other authors note that monetary policymakers have become the only game in town with respect to economic stimulus. Governments with high levels of debt have been loath to use fiscal stimulus since the great recession, in many cases using—or being driven to—austerity measures instead. Views differ as to the extent to which central bank policies are part of the problem or part of the solution. Hervé Hannoun, former deputy general manager of the Bank of International Settlements, has argued that NIRP (and ultra-low interest rates generally) enable fiscal irresponsibility and distract from “the real economic policy challenges of raising real growth potential and productivity through structural reforms” (Hannoun, 2015). Conversely, a 2016 report from Lazard Asset Management argued that “NIRPs are a symptom of the problems facing the global economy, not the cause” and that monetary policymakers have responded the best way they can, as “fiscal policy has worked at cross purposes with monetary policy” (Temple and Alcalá, 2016).

But can NIR arise naturally, in the absence of NIRP? This is not a hypothetical question. We found reports that yields on short-term government bonds turned negative in Denmark prior to the Danmarks Bank’s first foray into NIRP (Acher and Mikkelsen, 2012) and that, in the US, rates on some Treasury bills turned negative during 2015 (Leong, 2019). In a blog post in 2019, PIMCO predicted that in the next recession the yields on US Treasury bonds could turn negative even without NIRP, driven by the long-term decline in natural interest rates (Fels, 2019). PIMCO attributes this decline in the natural rate of interest to the combined effects of the demographics of population aging, capital-saving technology and a retirement savings needs contributing to a “negative time preference for money.” Thus, while NIRP is a likely precursor of negative market rates, there is reason to believe it is not a necessary condition.

4.2 Effect and effectiveness of NIRP

Much of the literature of NIR studies the effectiveness of NIRP, and we now turn to this literature. To introduce this discussion, we begin with a discussion of the mechanisms by which interest rate policy, including NIRP, are supposed to impact the broader economy—“transmission channels” in the economists’ terminology. Fundamentally, NIRP is intended to stimulate increases in spending and investment and discourage saving. Various authors (Arteta et al, 2016; Hannoun, 2015) discuss the key transmission channels by which this may occur and how they may operate differently when rates are negative than when they are positive. While different authors describe these transmission channels in somewhat different ways, Arteta et al describe four primary channels—the interest rate channel, the credit channel, the portfolio channel and the exchange rate channel.

The following is a summary of how these channels work under NIRP, as described by both Arteta and Hannoun. Most directly, negative rates encourage banks to increase lending to avoid paying what amounts to a fee or a tax on its cash reserves at the central bank (credit channel). Banks, in turn, encourage borrowing by passing negative rates on to lenders in the form of lower lending rates and discourage saving by passing negative rates on to depositors in the form of lower deposit rate (interest rate channel). Reduction in savings translates to an increase in spending and/or an increase in demand for longer-term or riskier assets (portfolio channel) as investors search for yield, the former directly increasing economic activity and the latter indirectly increasing economic activity through increased business investment. Prices of risky assets increase due to the increase in demand for these assets as well as to the decrease in discount rates. Currency prices may be expected to weaken under NIRP, increasing export competitiveness of exports (exchange rate channel). Long-term interest rates may decline as the lower short-term rates shift the entire yield curve and as a search for yield creates higher demand for longer-term assets (interest

rate channel). Finally, by stimulating inflation, NIR are intended to reduce the real value of debt and protect against a deflationary spiral in the real value of debt. Other authors (Bernoth and Haas, 2018; Sims and Wu, 2019) additionally argue for the importance of the signaling channel in NIRP's effectiveness, i.e., that NIRP signals to markets an extended period of low interest rates.

Arteta et al (2016) also provide a useful overview of the ways that these transmission channels may break down below the zero lower bound. The long-held basis for belief in a zero lower bound is that depositors may choose to withdraw their money from financial institutions and hold it directly rather than pay an NIR. The interest rate channel may break down if banks are unwilling or unable to pass negative rates on to depositors because of the risk of lost deposits. In this event, banks may not reduce lending rates, further interrupting the interest rate channel, or may suffer financially from the reduction in their lending margins, leading to a contraction rather than an expansion in lending, interrupting the credit channel. Interruption of the interest rate and credit channels then leads to interruption of the remaining channels. Much of the literature on the effectiveness of NIRP attempts to identify, theoretically and empirically, where these transmission channels break down.

With respect to the interest rate channel, Eggertsson et al have studied the effects of NIRP on deposit rates and have concluded "that deposit rates stopped responding to policy rates once they went negative and that bank lending rates in some cases increased rather than decreased in response to policy rate cuts" (2019). By contrast, a recent report from the ECB found that "sound banks can pass negative rates on to their corporate depositors without experiencing a contraction in funding," with the effects becoming "stronger as policy rates move deeper into negative territory" (Altavilla et al, 2019). This report highlights two key distinctions we also observed elsewhere in the literature. First, rates on corporate and other large deposits may be less constrained by the zero bound than retail deposit rates, due the cost and practicality of holding large amounts of cash. This argument is borne out by a Bloomberg report on Aug. 6, 2019, that UBS was set to impose a fee of 0.60% on Swiss cash accounts exceeding 500,000 euro, down from 1 million euro (Winters, 2019). The second distinction, that financially sound banks are better able to pass on NIR to their customers, is discussed further in Section 4.4.

With respect to the credit channel, a number of authors have studied the effect of NIRP on the supply of credit and banks' lending behavior, with predictably mixed results. Several authors have investigated the behavior of banks in different jurisdictions—the European Union broadly (Demiralp et al, 2019), Italy specifically (Bottero et al, 2019), Japan (Hong and Kandrac, 2018) and Switzerland (Basten and Mariathan, 2018)—in response to NIRP, with several of these studies attempting to identify and stratify results between banks with greater and lesser exposure to NIRP. These studies have consistently found increased lending in response to NIRP and greater increases in lending among banks with greater exposure to NIRP, suggesting effective transmission through the credit channel. Altavilla et al (2018) found that NIRP, as well as quantitative easing policies, stimulated the supply of credit among European banks; and they also studied demand for credit, finding that banks' balance sheet strength significantly affects credit demand.

Converse to these findings, Molyneux et al (2018) have contrasted bank lending behavior between banks in Negative Rate Jurisdictions and their counterparts in Non-negative Rate Jurisdictions, finding weaker lending in the Negative Rate Jurisdictions, with adverse effects most pronounced "for banks that were smaller, more dependent on retail deposit funding, less well capitalized, had business models reliant on interest income, and operated in more competitive markets." Further, in another ECB paper studying European banks, Heider et al (2017) found that banks with high deposits, which are more exposed to NIRP, responded by reducing lending volume but increasing risk within their lending portfolio, suggesting that NIRP may both contract lending supply and increase financial stability risk, at least among some banks.

Those authors generally caution against the financial stability risks of banking decisions to reduce reserves and increase risk while noting that they have not observed decreases in financial stability to date.

With respect to the shape of the yield curve, we have identified less literature explicitly addressing the impact of NIRP on longer-term interest rates. As discussed above, some authors specifically highlight the importance of the signaling channel for the transmission of NIRP, and such signaling is important to transmitting NIRP across the yield curve. Wu and Xia (2019) studied the effect of the ECB's four NIRP events across the yield curve, finding two instances where the ECB issued forward guidance accompanying the rate change and two instances where it did not. The authors found that the forward guidance was important to fully transmitting the rate change across the yield curve.

The literature discussed above is focused on proximate measures of effectiveness—whether NIRP has the expected effects on interest rates and credit supply. Other authors have attempted to assess the effectiveness of NIRP more broadly on the macroeconomic measures that are its ultimate targets and have generally found its effectiveness to be consistent with conventional policies of similar magnitude. Arteta et al (2018), studying the early evidence in Europe, have found the evolution of financial variables in the Eurozone under NIRP to be consistent with those under conventional interest rate policy. Nishad (2018), studying results in Japan, concluded that results of its zero and negative interest rate policies had been “disappointing,” not because of policy errors but because of a series of adverse shocks that the policies were not enough to overcome. In the US, a 2019 research article by Federal Reserve Bank of San Francisco staff concluded that during the Great Recession, “allowing the federal funds rate to drop below zero may have reduced the depth of the recession and enabled the economy to return more quickly to its full potential. It also may have allowed inflation to rise faster toward the Fed's 2% target. In other words, negative interest rates may be a useful tool to promote the Fed's dual mandate” (Cúrdia, 2019).

Finally, some other authors (Lilley and Rogoff, 2019; Sims and Wu, 2019) have studied the efficacy of NIRP relative to other unconventional monetary policies—quantitative easing, forward guidance and helicopter money—with contrasting results. Lilley and Rogoff conclude that NIRP would be the most effective and “elegant” of the unconventional policies if it could be fully implemented and that the legal, regulatory and tax obstacles to full implementation of NIRP, while significant, are surmountable. Sims and Wu, by contrast, conclude that “To generate the same output response, the requisite NIRP and forward guidance interventions are twice as large as a conventional policy shock” but that the effectiveness of QE is higher.

While both empirical and theoretical/model-based literature show mixed results, the majority of authors have found NIRP to be broadly effective, in contrast to the characterizations often seen in the popular press.

4.3 Measures to Improve NIRP Effectiveness

While economists do not agree on whether zero is an effective lower bound on interest rates, there is general consensus that such a lower bound exists. Negative interest rates implemented thus far have been modest, and some authors have found market behavior in Negative Rate Jurisdictions consistent with the constraints of a lower bound (Fatum et al 2019). It is now thought that the lower bound relates to the cost of holding cash—if interest rates become sufficiently negative as to exceed the cost of holding cash outside a bank, then cash hoarding would ensue, undermining the policy. Brunnermeier and Koby use the term “reversal interest rate” for “the rate at which accommodative monetary policy ‘reverses’ its intended effect and becomes contractionary for lending” (2017). They have concluded that the reversal interest rate is not necessarily zero and can be either positive or negative, with the key determining factors being banks’

proportion of fixed-rate assets, their capital constraints and the extent to which they can pass through policy rate changes to deposit and lending rates.

With interest rates remaining at historically low levels, advocates of expansive monetary policy worry that the lower bound, even if it is modestly below zero, will constrain monetary policies even more significantly in the next downturn than it did in the last one. As such, there is a growing body of literature advocating the development of mechanisms to eliminate the lower bound, allowing the effective use of what some have called “deep” negative rates. These mechanisms often involve either the limitation or elimination of physical currency or introduction of mechanisms (e.g., fees or taxes) to impose negative rates on physical currency holdings.

In an International Monetary Fund (IMF) Working Paper, Agarwal and Kimball (2019) have surveyed the literature for approaches to eliminating the lower bound that arises due to physical currency. We do not attempt to reproduce their sources here, but they identify a significant body of literature, most of it relatively recent but some dating back as far as 1916. Agarwal and Kimball discuss proposed approaches that include elimination of physical currency, in whole or in part; fee mechanisms that are automatically charged against paper currency; dual electronic and physical currency systems, whereby the value of physical currency can be depreciated relative to the value of electronic currency; taxation schemes for cash holdings or transactions conducted in cash; restrictions on quantities of physical cash, rather than abolition. The authors study the operational and political feasibility of various approaches and advocate two approaches. They describe their preferred approach as the “clean approach”—which would create an electronic money system and establish an exchange rate between electronic money and physical currency. Their alternative approach, in the event of legal hurdles to the clean approach, is described as the “rental fee approach”—which would maintain parity between the value of electronic and paper currency but would allow the central bank to charge a rental fee when physical cash is withdrawn from a member bank’s account.

It should be noted that in the US, the Fed may face additional constraints to implement NIRP. A Fed staff memo from 2010 identified potential legal and operational hurdles to the implementation of NIRP in the US, including inability to handle negative rates in the Fed computer systems; systems limitations within the US Treasury auction system, in the event that Treasury rates also became negative; limitations in the Fed’s capacity to fund a run on reserve balances; and lack of clarity regarding the Fed’s statutory authority to impose NIR (Burke, et al, 2010). These authors do not suggest that these hurdles are insurmountable, nor do they indicate how significant these hurdles might be. We have not identified literature to indicate whether the Fed has taken steps to address these hurdles since 2010, but they could slow the potential adoption of NIRP in the US.

Based on our review, the proposals to eliminate the effective lower bound on interest rates remain theoretical at this point. We have not identified literature indicating that any jurisdiction has acted to implement any of the proposed approaches to eliminating the lower bound. However, the volume of literature is significant enough that such measures should not be considered out of the question.

4.4 Risks and Unintended Consequences of NIRP

A significant volume of the coverage of NIRP in the popular press relates to risks and unintended consequences. While research has taken time to develop, at this time, a fair amount of research literature exists regarding risks and unintended consequences. These potential unintended consequences of NIRP generally fall into two categories—consequences of failure and consequences of success. One line of argument is that NIRP cannot succeed because the breakdown in transmission channels leads to economic

contraction rather than expansion—that beyond being ineffective, NIRP causes the opposite of its intended effect. Another line of argument is that if NIRP does work as intended, the ultimate negative consequences outweigh the benefits. We address literature related to both arguments.

Let us first discuss literature on unintended consequences associated with the failure of NIRP, i.e., contractionary effects instead of expansionary effects. As discussed in the prior section, Brunnermeier and Koby (2017) contend that lower interest rates, including negative rates, are expansionary to a point, the reversal rate, but that reductions beyond the reversal rate (whether that rate is positive or negative) are contractionary. Working from this premise, what evidence exists that NIRP decisions to date have been contractionary? Eggertsson et al have found evidence that deposit rates in Negative Rate Jurisdictions had encountered a zero floor and that some banks had increased lending rates as a result, using these data to project that “a policy rate of -0.50 percent increases borrowing rates by 15 basis points and reduces output by 7 basis points” (Eggertsson et al, 2019). Other authors have investigated more direct links to the various transmission channels, as discussed further below.

One widely discussed potential unintended consequence associated with NIRP failure involves the credit channel. As the thinking goes, banks would be unable to pass negative rates on to depositors and, in response to narrower interest margins, would reduce lending rather than increasing lending. Heider et al have identified “less lending by euro-area banks with greater reliance on deposit funding” (Heider et al, 2017). However, as discussed in Section 4.2, other authors (Demiralp et al, 2019; Bottero et al, 2019; Hong and Kandrac, 2018; Basten and Mariathasan, 2018) have not found broad-based contraction in credit supply as a result of NIRP.

A second widely discussed potential unintended consequence associated with NIRP failure involves both the credit and interest rate channel—the run on the bank phenomenon. As discussed in Section 4.2, depositors’ ability to remove their funds from the banking system and hold cash directly is the primary basis of the zero lower bound assumption. However, we have found surprisingly little literature studying empirically whether this phenomenon has occurred in the Negative Rate Jurisdictions. A paper by Moody’s Analytics did study this phenomenon using Swedish bank data, finding little impact on the total volume of deposits but also finding a shift from “term deposits” to “demand deposits” (Hughes, 2016). A bit of anecdotal evidence of corporate depositors converting deposits to cash is provided by a 2016 report that Munich Re had added directly held cash reserves “in the two-digit million euros” (Huebner and Gold, 2016). However, we have not seen widespread reports of similar behavior or other evidence of significant increases in cash hoarding associated with NIRP.

A third potential unintended consequence leading to NIRP failure is loss of confidence in the monetary system leading to increased savings. A 2016 Deutsche Bank report warned that “the channel of trust, which plays a considerable role in the transmission of monetary policy decisions to the real economy, is completely ignored” in NIRP decisions but without offering evidence of the erosion of that trust (Schneider, 2016). In addition, some have argued that the unpopularity of NIRP limits its potential for more widespread adoption (Danthine, 2017, 2018). However, we have not reviewed literature studying empirically whether uncertainty or loss of confidence in the monetary system has countered the intended effects of NIRP.

Let’s now turn to literature on the unintended consequences associated with successful NIRP—that is, consequences if NIRP operates as intended. Popular press coverage includes widespread warnings about financial stability risks associated with NIRP: financial pressure on banks and other financial intermediaries (including insurance companies); excessive risk-taking in the search for yield; asset valuation bubbles; risk of increased leverage among households and firms; risk of stoking runaway inflation. There have also been warnings about the potential of NIRP to exacerbate income and wealth inequality by rewarding borrowers

and penalizing savers. Some have mused about the dynamics of NIRP and the interaction between sovereign currencies and so-called crypto-currencies such as Bitcoin. Finally, many have expressed concern that NIRP and other unconventional monetary policies distort markets and distract from fiscal policy changes and structural changes in the real economy that are necessary to stimulate growth.

Of the financial stability concerns, we observed the most literature related to the impact on bank profitability and capitalization. Various authors have observed that, to date, NIRP has had little adverse impact on bank financials measured broadly. While banks may experience reduced interest margins, they have effectively offset this squeeze with a combination of increased loan volumes, increased noninterest revenue, portfolio rebalancing and the like (Urbschat, 2018; Nucera et al, 2017; Altavilla et al, 2019; Lopez et al, 2019; Altavilla et al, 2017). While these authors have seen little broad impact on bank profitability, they have observed variation among banks in the impact of NIRP and in their responses, with the differences associated with financial strength and business model. Most significantly, some authors have found that banks that are less well capitalized and whose business model is heavily weighted toward retail deposits are most likely to have experienced adverse financial consequences to which they have been unable to respond (Altavilla et al, 2019). Many authors also caution that adverse financial effects become more likely the longer that NIRP persists and that the early results do not imply that this risk does not exist. Nucera et al have found moderate risk of NIRP related to banks' "propensity to become undercapitalized" (Nucera et al, 2017), and Kerbl and Sigmund have concluded that a rate of about -2% would pose a "significant burden to banks' profitability" (Kerbl and Sigmund, 2017). With respect to longer-term impact on bank profitability, Altavilla et al (2017) conclude that "a protracted period of low interest rates might have a negative effect on profits that, however, only materialises after a long period of time and tends to be counterbalanced by improved macroeconomic conditions."

With respect to other types of financial stability risk, one may say that these risks could arise because NIRP works too well or is maintained for too long. NIRP is intended to increase inflation, and overshoot is a risk. NIRP is intended to increase credit supply, which may contribute to the risk of unsustainable debt levels. NIRP is intended to increase investment and demand for higher risk assets, which may contribute to the risk of excessive risk-taking and asset bubbles. There can be little question that NIRP may contribute to these risks, in the same way that overaccommodative conventional policies may contribute to these risks. However, we have not reviewed literature that finds current evidence of increases in these risks as a result of NIRP. With respect to the risk of unsustainable debt levels, some authors actually see NIRP as a (perhaps underhanded) mechanism to reduce the debt load. A Bloomberg Opinion piece from March 2019 views current debt levels as unsustainable and sees NIRP as a way for central banks to "covertly use negative rates to reduce excessive debt levels by transferring wealth from savers to borrowers through the slow confiscation of capital" (Das, 2019). We note that such a reduction in debt would only occur if the real negative rate of interest exceeded the pace of new borrowing. More broadly, Arteta et al (2018) studied evidence for financial stability risks broadly, concluding that "NIRP could pose risks to financial stability but there is no conclusive evidence as yet of a significant impact on bank profitability or of a broad-based increase in leverage."

Let's turn now to risks or unintended consequences not directly related to financial stability. A novel possibility is associated with Bitcoin and other unregulated cryptocurrencies, which could increase in popularity as a way to avoid deep NIR. Material shifts toward these alternatives could, in turn, lead to policymakers' increased efforts to establish control over digital currencies (Co, 2019). Another concern in this so-called new gilded age is the impact of NIRP on inequality. Tzamourani (2018) has studied this impact by analyzing the "unhedged interest rate exposure (URE)" of Eurozone households by income level, among other variables. The URE measures the extent to which a household's net interest flows are affected by a change in interest rates, with a positive exposure indicating that an increase in rates is favorable and a

negative exposure indicating that a decrease in rates is favorable. This study indicates that a higher URE is associated with higher income, indicating that the poorest households are more likely to experience a net benefit from interest flows under NIRP, while median and wealthy households are likely to experience a net cost. We note that this analysis provides a very narrow measure of the impact on inequality, because it does not capture the impact on asset values, which are concentrated among the wealthy.

Most of the literature we have reviewed evaluates effectiveness and unintended consequences of NIRP within the context of the dominant economic theories that underlie both conventional and unconventional monetary policy decisions. This theory is blind to any potential demographic or physical limits to growth, holding that sufficient monetary stimulus will generate investment that eventually leads to a combination of productivity improvement and increased employment that restores growth. Some authors have noted the possibility that the era of growth could be subject to limits not contemplated in the theory, in which case NIRP (along with other monetary policy interventions) may be rendered ineffective and unintended consequences would dominate. See Alberts and Rudolph (2019) for more discussion of potential limits to economic growth, including limits to monetary policy interventions.

Coverage in the popular press often raises the specter of catastrophic unintended consequences of NIRP. Overall, the literature does not indicate evidence that significant unintended consequences have occurred to date. However, it does indicate that these risks remain real and present.

4.5 Impact of NIRP on the Insurance Industry

The fundamental elements of the risks of negative rates to the insurance industry are well known to actuaries. Insurance companies are fixed-income investors, and NIRP can lead to reduced returns on investment holdings. The life insurance industry, in particular, writes long-term interest guarantees and relies heavily on interest margin as a source of income. Insurers generally cannot reset guarantees on existing policies and face greater regulatory restrictions than banks do in setting the guarantees for new policies. Insurance company balance sheets may be impaired, because the discount rates underlying liability valuations are adjusted for the impact of negative rates.

We have identified a limited body of research providing additional insight into the impact, or potential impact, of NIRP on the insurance industry as well as actual and potential responses. Some papers or presentations provide additional analysis of the impact of NIRP (or the low-interest-rate environment in general) on insurers (Davies, 2016; “Low Interest Rates,” 2019; Bruning et al, 2012). Several other papers highlight actual or potential industry responses. Rudolph (2014) provides a broad study of the impact of the low-interest-rate environment, although not NIR specifically, with a good overview of product characteristics, the impact of low interest rates on the types of assets that insurers typically hold, and potential industry and regulatory responses. Studying European and Japanese insurance industry responses to NIRP and prolonged low rates in general, authors have found identified some of the following: reduction in credit and equity risk (to reduce capital charges) but increased bond duration and foreign bond exposure; product mix shifts to variable products, foreign-denominated products and protection-focused product with minimal savings elements; demutualization and shift toward nonparticipating products; expansion in foreign markets; shift to new, variable cost distribution channels (Nieder, 2016; Nogami, 2016; Bacchus, 2016). PwC issued a 2017 report on the potential impact of NIRP on US life insurers that suggested insurers may shift from guaranteed to indexed products, manage in force blocks using policyholder buyouts and divestitures, and ultimately reduce pricing return targets (PwC, 2017). While some reports noted above indicate that insurers in affected areas have reduced asset risk to reduce capital requirements, other literature indicates that insurance have or may increase asset risk to mitigate the reduction in investment return (Bruning et al, 2012; Lee, 2016; Bacchus, 2016; Hegge, 2016).

From a global perspective, the IMF issues a semi-annual *Global Financial Stability Report* (GFSR), which has frequently addressed risks related to the insurance industry and NIR in recent years. The April 2016 report noted that “the contribution of the insurance sector—particularly life insurers—to systemic risk has increased ... partly because insurers’ interest rate sensitivity has risen and partly because of higher correlations across asset classes,” calling for a “more macroprudential approach to supervision and regulation of insurance companies.” The October 2016 report said that “The solvency of many life insurance companies and pension funds is threatened by a prolonged period of low interest rates” and that concerns with insurer solvency could lead to increased saving, calling for prompt action by insurance supervisors to “sustain the strength of insurance and pension fund balance sheets.” The April 2017 report included an analysis of the impact of an indefinite low-rate environment on the banking and insurance sectors, foreseeing a flattening of the yield curve “presenting long-lasting challenges for life insurers and defined-benefit pension funds” and weakening demand for long-term guaranteed interest rates offered by insurance companies along with increased demand for health and long-term care coverages. The October 2017 report, while noting improved economic conditions at that time, identified financial stability vulnerabilities related to the search for yield and urged that regulators “fully address crisis legacy problems and require banks and insurance companies to strengthen their balance sheets in advanced economies.”

While the pension system was outside the scope of this report, we did not observe a significant amount of literature on the impact of NIR on the pension system.

We note some significant gaps in the actuarial and insurance industry literature, including:

- Empirical studies of the impact of NIRP on insurance company financials and how insurers in Negative Rate Jurisdictions have adapted—both effectively and ineffectively—to NIR.
- Studies forecasting the impact of long-lasting NIRP on solvency in the insurance industry and on pension funding.
- Studies of regulatory changes that may be needed as a result of NIR, including changes related to solvency regulation as well as changes related to nonforfeiture regulation.

In regard to potential need for regulatory changes, we note several areas that may be particularly impacted by NIR within the US regulatory system:

- The Academy’s Interest Rate Generator (AIRG), used for stochastic modeling used in life insurance and variable annuity principle-based reserve calculations (as well as variable annuity required capital) floors interest rates at 0.01%. We have also encountered extensive use of the AIRG for reserve testing and other purposes by US life insurers.
- The Enhanced C3 Phase I Interest Rate Generator, used for modeling capital requirements for certain life insurance and annuity products, floors interest rates at zero.
- For reserve testing purposes, the so-called New York 7 deterministic interest rate scenarios, required for cash flow testing in New York and a handful of other states but widely used by life appointed actuaries in all states, sets rate floors based on 50% of the starting five-year rate, which breaks down if the five-year rate approaches zero or turns negative. In addition, a 2017 report by Alberts developed an alternative deterministic scenario methodology, which also does not accommodate NIR (Alberts, 2017).
- Under the NAIC Standard Nonforfeiture Law for Individual Deferred Annuities, the interest rate underlying the minimum nonforfeiture amount may not be less than 1.00% and under the NAIC Standard Nonforfeiture Law for Individual Life Insurance, the interest rate used to compute present values in the minimum value computations may not be less than 4%.

- Valuation interest rates for many products are based on a reference interest rate (Moody's Corporate Bond Yield Average), and the prescribed calculations produce valuation interest rates exceeding the reference rate when it falls below 3%, which is likely under NIR.

4.6 Likelihood of Future NIRP Use

We have identified many opinion pieces, not represented in the literature discussed above, expressing strong opinions about whether NIRP should be a monetary policy tool. However, we have identified little in the way of literature explicitly studying the likelihood that NIRP will be employed in the future. Therefore, we apply our own reading of the literature to assess likelihood.

We have discussed literature that, more often than not, finds NIRP to be generally effective at the modest levels of negative rates that have been used up until now, that finds little evidence of adverse consequences to date—albeit with concern for future consequence—and that suggests measures that central banks could take to improve the efficacy and feasibility of deeper negative rates. We have also discussed literature suggesting persistent reduction in natural rates of interest in many advanced nations, which inhibits the effectiveness of conventional interest rate policy. Finally, we have noted that interest rates remain negative in all jurisdictions that have employed NIRP and remain low throughout the advanced world, many years into the recovery from the Great Recession. Overall, this literature appears to support the future use of NIRP as likely.

Outside of the literature discussed herein, the US popular and business press have been awash in articles about NIR in 2019, mostly suggesting the increased likelihood of NIRP. The US president has repeatedly criticized the Fed for monetary policy that he considers too contractionary, and multiple news outlets have documented his comments in support of NIRP.

In addition, it could be said that the Fed has warmed to the idea of NIRP over time. The previously mentioned 2010 memo prepared by Fed staff for the Federal Open Market Committee (FOMC) was lukewarm, at best, regarding NIRP (Burke et al, 2010); and we have not identified any literature indicating that the Fed seriously contemplated NIRP at the time. In a speech at the University of Wisconsin in 2015, James McAndrews, executive vice president and director of research for the Federal Reserve Bank of New York, delivered remarks highlighting the obstacles and potential adverse effects of NIRP. In 2016, Christopher Waller, executive vice president and director of research for the Federal Reserve Bank of St. Louis, called NIRP a “tax in sheep’s clothing,” arguing that a tax is never expansionary.

Since then, several Fed research papers related to NIRP have tended to find more favorable impact of NIRP (Arseneau, 2017; Reinbold and Wen, 2018; Cúrdia, 2019). Fed Chair Janet Yellen caused a bit of a stir in 2016 when she testified that the Fed would not take interest rates off the table (Long, 2016). Ben Bernanke, Fed chair from 2006 until 2014, has written favorably about NIRP as a potential Fed tool (Bernanke, 2016). In 2019, Alan Greenspan, Fed chair from 1987 to 2006, said of NIRP, “It’s only a matter of time before it’s more in the United States” (Imbert, 2019).

Notwithstanding these developments, it has been reported that current Fed Chairman Jerome Powell stated after the September 2019 FOMC meeting that quantitative easing and forward guidance had operated effectively during the financial crisis and that in the event of another downturn, “I do not think we’d be looking at using negative rates, I just don’t think those will be at the top of our list” (Fitzgerald, 2019).

Considering all these factors, we assess the likelihood of future use of NIRP globally as very high. The most likely disincentive to its future use would be the emergence of clear evidence that the current policies have

seriously undermined financial stability, which is not indicated in the literature we have reviewed. Within the Negative Rate Jurisdictions, it is not unlikely that a downturn will occur while rates remain negative, which could prompt efforts to implement deeper negative rates, including previously untried approaches to eliminating the lower bound as discussed in Section 4.3. Within the US, Chairman Powell's comments would seem to take NIRP off the table in the immediate future. However, the preponderance of other developments leads us to share Greenspan's view that it is only a matter of time before NIRP reaches the US.

Section 5: SOA Survey on Negative Interest Rates—Discussion of Results

Sections 3 and 4 make the case that insurers need to be concerned about NIR. Economies representing 25% of global GDP are living under NIRP and have been for several years. NIRP has been long lived in those economies, and the likelihood of NIRP spreading to other parts of the world is high. While the depth of negative rates has been modest to date, policymakers may be incented to make changes that would enable much deeper negative rates. While research into the impact of NIRP on bank profits has indicated little overall impact, one may expect the effect of persistent negative rates to be more adverse to insurers than to banks, and little research exists studying the impact of negative rates on the insurance industry.

With this backdrop, the sponsoring organizations undertook to survey practicing actuaries regarding their knowledge and opinions regarding NIR, their opinions regarding the benefits and risks of negative rates, and how they have considered NIR in their work and how their firms have considered NIR in their risk management programs. Section 5 discusses this survey’s results.

5.1 Survey Design and Administration

SOA staff administered the NIR survey using Qualtrix online survey software. The SOA sent participation requests to 6,015 practicing actuaries via email, with a link to the online survey included in the email request. Participation requests were sent to the following email lists maintained by, or available to, the sponsoring organizations: SOA Financial Reporting, International, Investment and Modeling Section members; sponsoring organization Joint Risk Management Section members; the International Actuarial Risk Managers listserv.

The survey on NIR was broken into five sections, as shown in Table 4. For each survey section, the discussion below includes a summary of the analysis followed by a more detailed discussion.

Table 4
SOA SURVEY ON NEGATIVE INTEREST RATES SECTIONS

Section	Questions	Section Description
Instructions	Q1	Survey instructions (no responses required)
Section I	Q2–Q6	Participant information
Section II	Q7–Q8	Awareness of NIR
Section III	Q9–Q12	Opinions on use and effectiveness of NIRP
Section IV	Q13–Q20	Opinions on risks and consequences of NIRP
Section V	Q21–Q22	Negative interest rate modeling capabilities and risk management practices

Appendix A contains the instructions, questions, possible responses and response counts. Analysis of survey responses follows.

5.2 Number of Participants and Criteria for Analyzing Responses

In total, 365 people provided some sort of response to the online survey. Some participants completed the earlier survey sections but did not complete the later sections. In addition, some participants left individual questions blank when answering other questions in a section. For some questions, a blank response could be interpreted as a negative response, so it was necessary to develop criteria to distinguish “blank” responses, which were included in the analysis, from nonresponses, which were excluded.

One hundred and four participants provided responses only for Section I, and we entirely excluded these responses from our analysis. Sixty participants provided responses for Sections I–II only, and another 13 provided responses for Sections I–III only; we included these responses in the analysis up through the last

section to which they responded but excluded them from the analysis for subsequent sections. One hundred and eighty-eight participants provided responses to all sections and were included in all analyses.

Table 5 shows the total number of responses included in the analysis for each section.

Table 5
PARTICIPANTS RESPONDING TO EACH SURVEY SECTION

Sections	Responses Analyzed
Sections I–II	261
Section III	201
Sections IV–V	188

We expected to see differences in response patterns depending on how much of the survey participants completed. For instance, we expected that those responding only through Section II would indicate lower awareness of NIR than those responding to the entire survey. Overall, we found this not to be the case, instead finding similar patterns of responses among these groups. Where a meaningful difference was observed, we note it in the discussion below.

We also expected to see differences in response patterns between participants located in, or doing work related to, Negative Rate Jurisdictions. In the discussion of survey results to follow, we use the following terminology with respect participants’ jurisdictions:

NNR resident—participant located in a Non-negative Rate Jurisdiction, per Q2 response

NR resident—participant located in a Negative Rate Jurisdiction, per Q2 response

NNR work/worker—participant whose work relates only to Non-negative Rate Jurisdictions, per Q3 response

NR work/worker—participant whose work relates to one or more Negative Rate Jurisdictions, per Q3 response

5.3 Survey Section I Analysis—Participant Characteristics

Summary of Section I Analysis

Participants in the NIR survey are overwhelmingly located in the US and Canada, and their work relates to the US and Canada. Only 4% of participants are NR residents, and only 9% do NR work. This distribution significantly limited our ability to compare responses between those with and without significant exposure to NIR, which was one objective of the study. Most participants are employed by insurance companies or consulting firms, which we expected. The majority of participants work in life insurance, with a reasonable number (17%–26%) working in each of the general insurance, health insurance, asset management and pension practice areas. Participants’ roles in their firms varied, with about 25% working in liability valuation, 50% working in some role related to risk management or modeling, and 15% working in product development and pricing.

A key objective of capturing these participant characteristics was to stratify our analysis and identify patterns of responses by these characteristics. In general, we found that there was little difference in the

response patterns or insufficient data to establish such patterns. In the cases where we did observe a notable pattern, it is discussed in our analysis of subsequent sections.

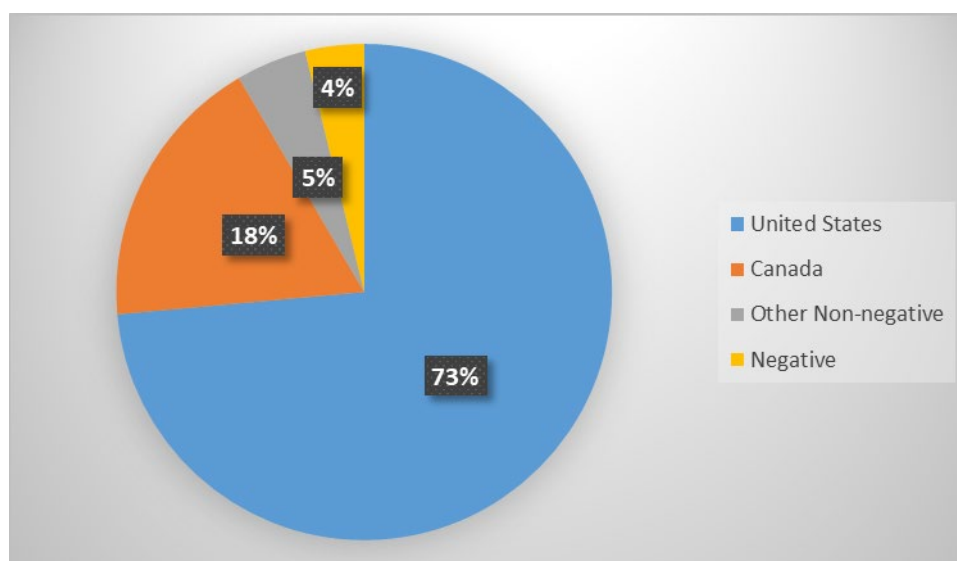
Discussion of Section I Analysis

Section I, Questions 2–6, gathers information regarding the participants to provide context for their responses, including information on: the jurisdictions in which participants are located and to which their work pertains, the type of company they work for, the type of work they do and the lines of business to which their work pertains. In particular, an objective of the survey was to compare and contrast responses from NR residents/workers and NNR residents/workers. As discussed next, the number of responses received from NR residents/workers was very small, so only for a few questions was any meaningful distinction in responses noted.

Responses to the individual questions are discussed below.

Figure 8 summarizes responses to Question 2, the jurisdiction where the participant is located.

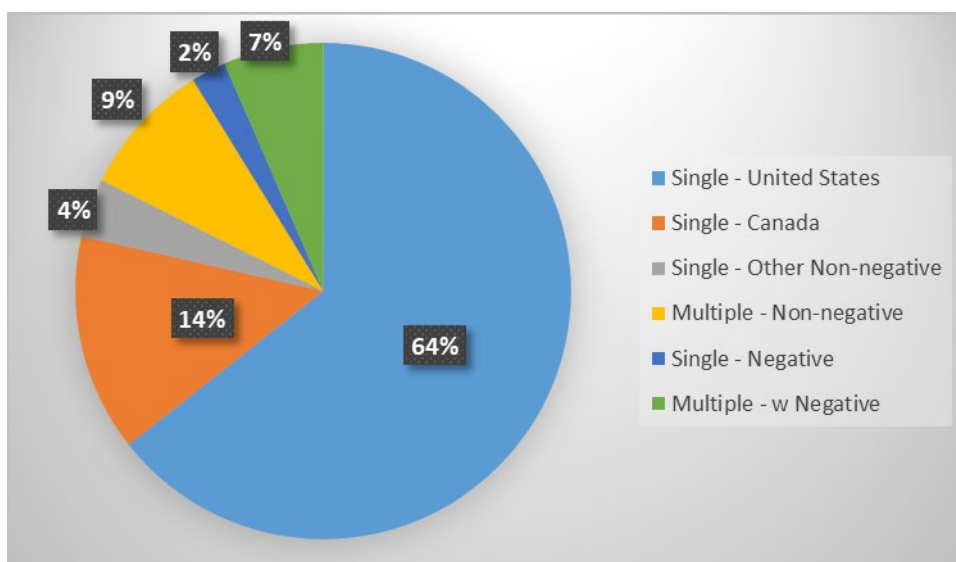
Figure 8
RESPONDENT LOCATION



The vast majority of participants are located in North America, 74% (192) in the US and 18% (47) in Canada, with 5% (12) in other Non-negative Rate Jurisdictions and only 4% (10) in Negative Rate Jurisdictions. For the subsets of participants completing Section III, IV and V, the percentage distributions were virtually the same. Of the 10 responses from NR residents, five were from the European Monetary Union, three were from Japan and two were from Switzerland.

Figure 9 summarizes responses to Question 3, the primary jurisdictions to which the participant’s work pertains. In responding to Question 3, participants were allowed up to three responses.

Figure 9
PARTICIPANT WORK JURISDICTIONS (UP TO 3 REPORTED PER PARTICIPANT)



Eighty-six percent of participants reported that their work pertains to a single jurisdiction, generally the jurisdiction where they are located, including 78% whose work only relates to the US or Canada. Forty participants (16%) do work related to two or more jurisdictions, of which 23 relate only to Non-negative Rate Jurisdictions and 17 relate to both Negative and Non-negative Rate jurisdictions.

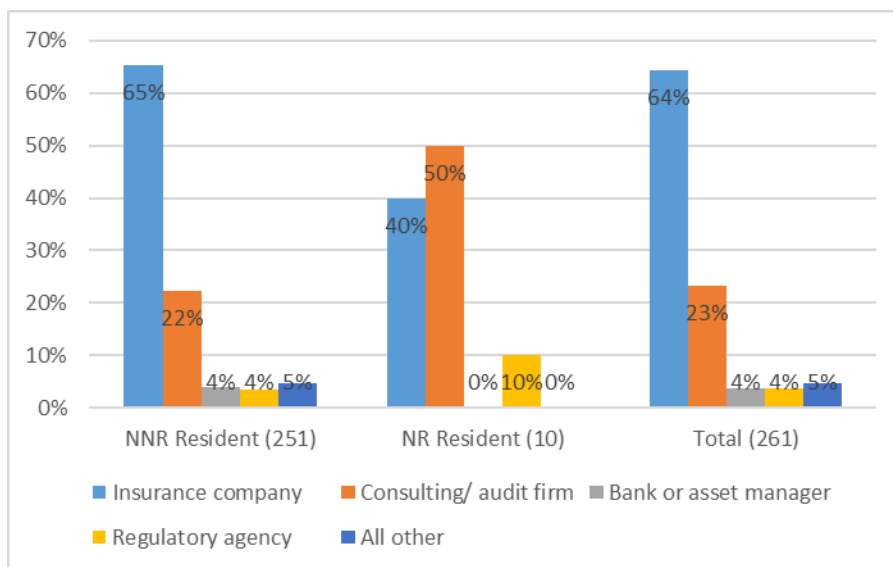
A total of 23 participants do NR work, with six whose work relates to a single jurisdiction and 17 working in multiple (Negative and Non-negative) jurisdictions. Table 6 shows the number of participants whose work relates to each of the five Negative Rate Jurisdictions.

Table 6
PARTICIPANTS WORKING IN NEGATIVE RATE JURISDICTIONS

Negative Rate Jurisdiction	Participants with Work Pertaining to the Jurisdiction
European Monetary Union	15
Japan	7
Switzerland	3
Denmark	0
Sweden	0

Question 4 gathered information on the type of firms that employ the survey participants and the responses are summarized, separately for NNR and NR Residents, in Figure 10.

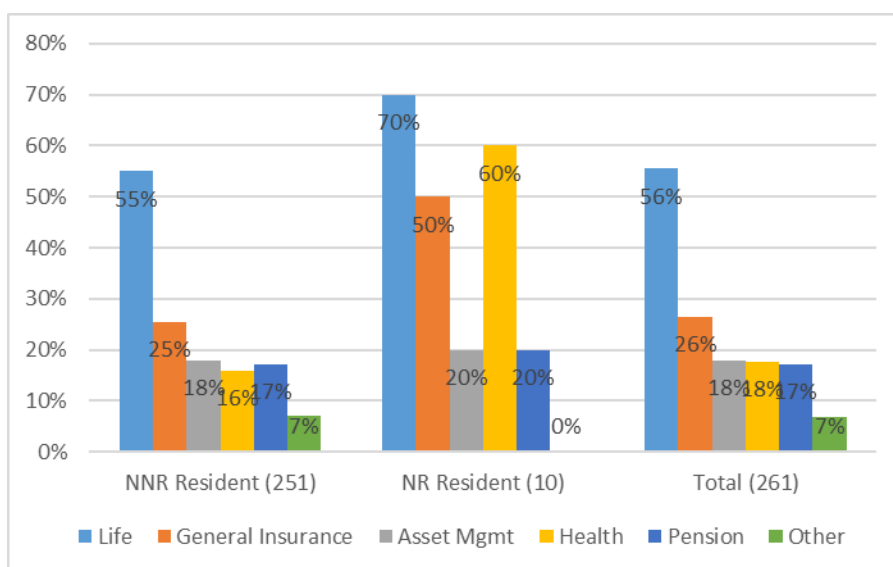
Figure 10
PARTICIPANT EMPLOYER TYPES



Eighty-seven percent of participants are employed by either insurance companies or consulting firms. Roughly equal numbers of participants are employed by banks or asset management firms, regulatory agencies, or other types of employers. The other employer types represented a broad mix. We noted that the NR residents were more heavily weighted to consultants but also noted the small sample size and did not observe any notable pattern of results related to this difference.

Question 5 gathered information on the lines of business to which the participants' work relates, and responses are summarized in Figure 11. Multiple responses were allowed, and 26% of participants reported that they work in multiple lines of business.

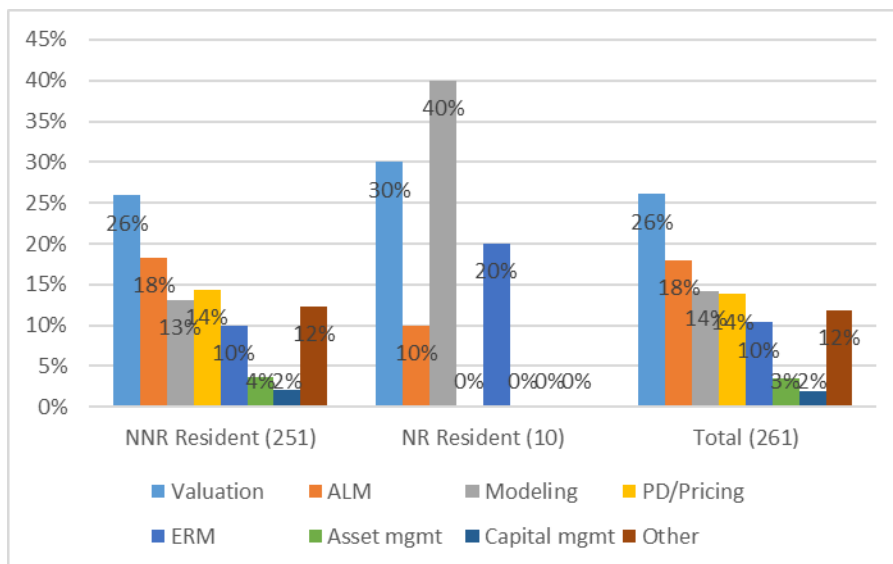
Figure 11
PARTICIPANT LINES OF BUSINESS



The majority of participants, 56%, work in life insurance, including 34% who work exclusively in life insurance and 22% who also work in one or more other lines of business. Between 17% and 26% work in each of general insurance, asset management, health insurance and pensions, with 7% reporting an other line of business. Review of the other responses indicates that several appear to relate to one of the listed lines of business, but the number was small enough that we did not attempt to assign them.

Question 6 gathered information on the participant’s role at their firm, and responses are summarized in Figure 12. Only one response was allowed for this question.

Figure 12
PARTICIPANT ROLE IN THEIR FIRM



The reported roles were varied. A plurality of participants, 26%, reported a liability valuation role. Forty-eight reported a role that we would characterize as related to risk management or modeling—asset/liability management (ALM), modeling, ERM, asset management or capital management. Twelve percent reported an other role, and most of these reported a management role, multiple actuarial roles or other actuarial roles (e.g., experience analysis). Not surprising because of the small sample, the distribution of roles for NR residents was fairly different than the overall distribution.

5.4 Survey Section II Analysis—Awareness of NIR

Summary of Section II Analysis

Section II, Questions 7 and 8, gathers information regarding participants’ awareness of NIR throughout the world. Question 7 addresses policy interest rates set directly by the central banks for monetary policy purposes, while Question 8 addresses yields on long-term (five years or longer) government bonds. Two hundred and sixty-one participants responded to some or all of the questions in Section III, including 251 NNR residents and 10 NR residents, and these counts are used in the denominators of proportions reported for this section.

We would characterize the overall awareness of NIR as low to moderate. About 60% of participants were able to identify at least one of the five Negative Rate Jurisdictions, and only about 17% were able to identify at least three. Given the economic importance of the Negative Rate Jurisdictions—collectively

representing 24% of world GDP—we were surprised that the awareness of negative rates among actuaries is not higher. Awareness was greatest for the Eurozone, followed closely by Japan, with approximately 40% being aware of negative policy rates in each of them. Awareness that Denmark, Sweden and Switzerland have experienced NIR was considerably lower, perhaps due to the smaller sizes of their economies.

We did not note any significant difference in the awareness rates for negative long-term corporate bond yields and awareness rates for negative policy interest rates. This may indicate that those with general awareness of negative rates also tend to have fairly detailed awareness of negative rate dynamics. Conversely, since the same five jurisdictions have experienced both negative policy rates and negative long-term government bond yields, this result may just reflect general awareness of negative rates among these participants.

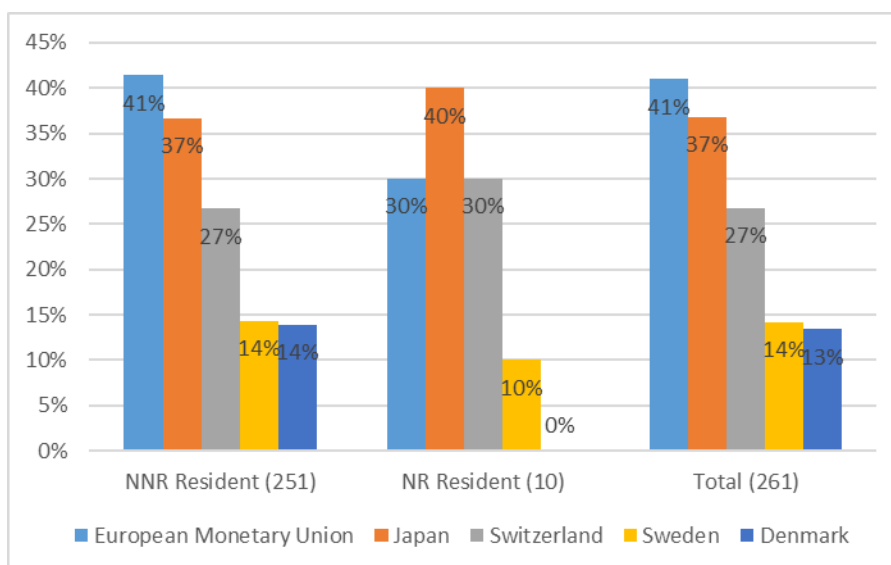
We found the number of responses incorrectly identifying jurisdictions as Negative Rate Jurisdictions—while modest—to be significant, particularly for long-term government bond yields. More participants incorrectly identified one or more Non-negative Rate Jurisdictions as having negative rates than correctly identified at least three Negative Rate Jurisdictions. For long-term government bond yields, 18% of participants incorrectly identified the US as having negative rates, leading us to surmise that these participants were considering real interest rates rather than nominal rates.

Discussion of Section II Analysis

Question 7 addresses awareness of negative policy interest rates set by central bankers. As discussed in Section 4, central bankers in five jurisdictions—Denmark, the Eurozone, Japan, Sweden and Switzerland—have employed NIR since 2012 (along with Hungary, which as noted earlier was not a focus of our research).

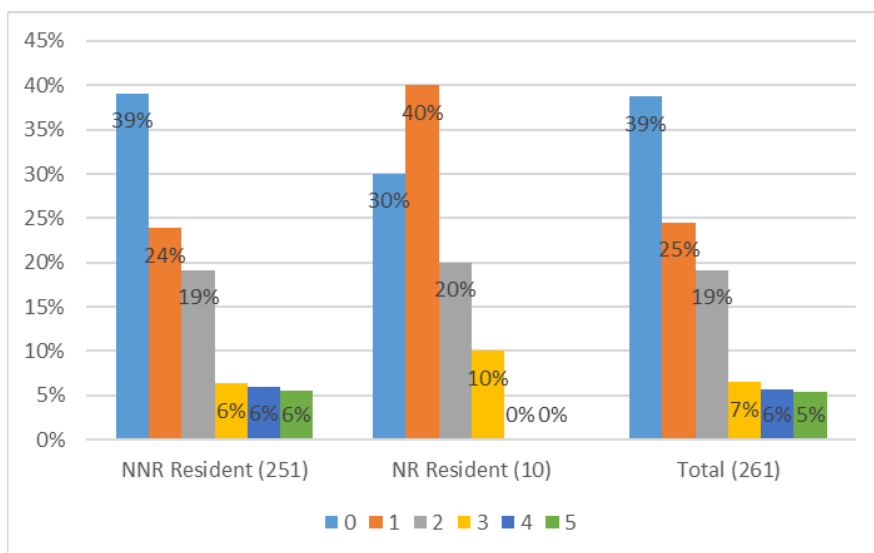
We analyzed the responses to Question 7 in a couple of different ways. First, we looked at awareness of negative policy interest rates in individual jurisdictions, as shown in Figure 13. Awareness was greatest for the Eurozone and Japan, with approximately 40% awareness for each. Awareness for Switzerland was 27%, with Sweden and Denmark the lowest at 14%. We expected NR residents to have awareness of negative rates throughout the world, but the responses do not support this expectation. While not shown here, we also did not observe significantly different awareness rates for NR workers.

Figure 13
NEGATIVE RATE AWARENESS BY JURISDICTION—POLICY INTEREST RATES



As shown in Figure 14, we also analyzed awareness in terms of the number of Negative Rate Jurisdictions correctly identified by each participant. Thirty-nine percent of participants did not identify any of the Negative Rate Jurisdictions, 44% identified one or two, and only 17% identified three or more. A total of 14 of the 261 participants correctly named all five Negative Policy Rate Jurisdictions. Consistent with above, NR residents did not indicate greater awareness than NNR residents by this measure, and none of the NR residents identified all five Negative Rate Jurisdictions.

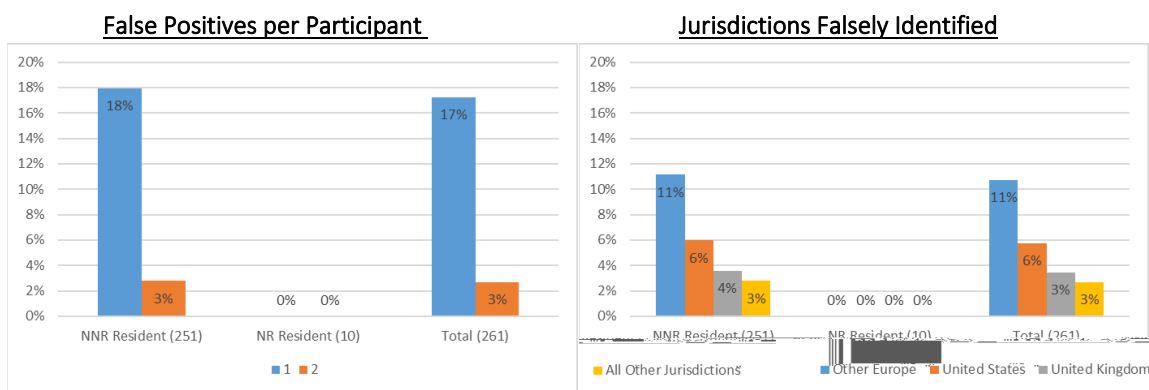
Figure 14
NEGATIVE RATE AWARENESS, NUMBER OF JURISDICTIONS—POLICY INTEREST RATES



Finally, in analyzing question 7, we considered false positives—Non-negative Rate Jurisdictions incorrectly identified as Negative Rate Jurisdictions. Figure 15 summarizes the false positives. Overall, 20% of

responses included one or two false positives. The most prevalent false positives were unnamed Other European Jurisdictions,³ as well as the US. Given that participants are predominantly located in the US, the number of US false positives may indicate that some participants considered real, rather than nominal, interest rates.

Figure 15
PARTICIPANTS WITH FALSE POSITIVES—POLICY INTEREST RATES



Question 8 addresses awareness of negative yields on long-term government bonds, defined in the survey as five-year or longer maturity periods. As discussed in Section 4, three of the five Negative Policy Rate Jurisdictions—the Eurozone (with Germany used a proxy for the broader Eurozone), Japan and Switzerland—have experienced negative yields on 10-year government bonds since 2012. Upon additional research, we found that Denmark and Sweden, while not experiencing negative yields on 10-year bonds, have experienced negative five-year yields.

Our analysis of Question 8 took the same views discussed above for Question 7—correct identification of individual Negative Rate Jurisdictions, number of Negative Rate Jurisdictions correctly identified, and number of false positives. Generally, the result for the two questions were very consistent. A slightly smaller number of participants—3% versus 5%—correctly identified all five Negative Rate Jurisdictions for long-term bond yields, perhaps because some participants were considering 10-year rates, which have not been negative in Denmark and Sweden. In addition, the rate of false positives was significantly higher for Question 8 than for Question 7—35% versus 20% of participants having one or more false positive, and 18% incorrectly identifying the US as having negative long-term government bond yields compared with only 6% identifying the US as having negative policy interest rates. While we did not gather additional information allowing us to assess the reason for the higher false positive rate on Question 8, we surmise that some participants interpreted bond yields to refer to real rather than nominal rates.⁴ Figures 16–18 present the same information for Question 8 as was presented above for Question 7.

³ It is possible that some of these had awareness of Hungary’s negative rates, but given the low identification rates for Denmark, Sweden, and Switzerland, we surmise that this number was few.

⁴ A flat yield curve combined with higher long-term than short-term inflation expectations could imply long-term real interest rates lower than short-term rates.

Figure 16
NEGATIVE RATE AWARENESS BY JURISDICTION—LONG-TERM GOVERNMENT BONDS

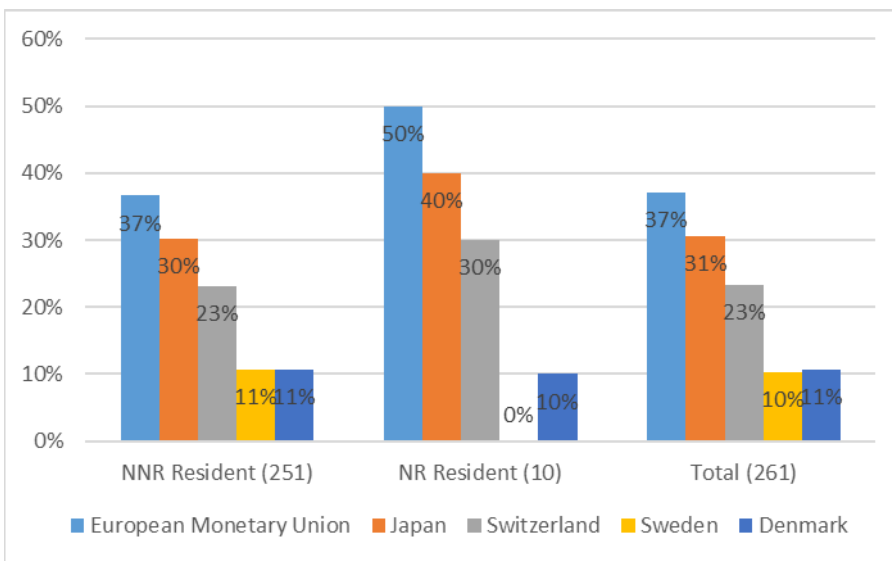


Figure 17
NEGATIVE RATE AWARENESS, NUMBER OF JURISDICTIONS—GOVERNMENT BOND YIELDS

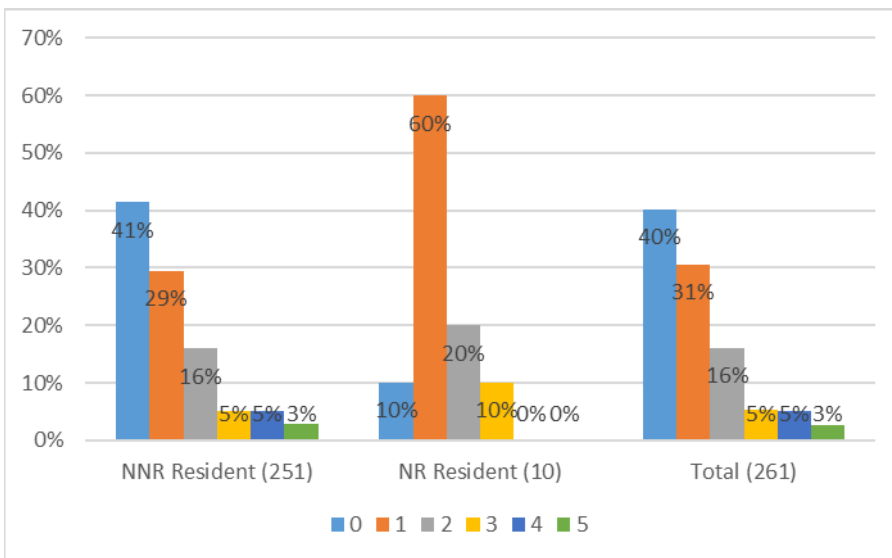
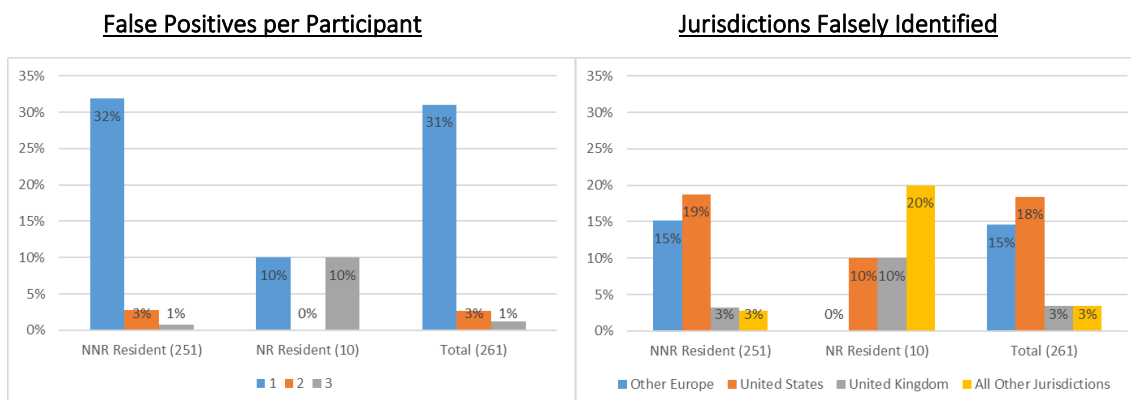


Figure 18
PARTICIPANTS WITH FALSE POSITIVES—GOVERNMENT BOND YIELDS



5.5 Survey Section III Analysis—Likelihood and Effectiveness of NIRP

Summary of Section III Analysis

Section III, Questions 9–13, gathers opinions regarding the likelihood of the use of NIRP and the effectiveness of those policies, if used. Participants were presented with four economic issues (economic growth below target, price inflation below target, currency inflation above target and unemployment above target) and were also given opportunities to write in responses.

In Section III, 201 participants responded to some or all of the questions, including 193 NNR residents and eight NR residents, and these counts are used in the denominators of proportions reported for this section.

A majority of participants indicated that NIRP could be effective to address one or more economic issues, with 57% identifying one or two such issues, 17% identifying three or more such issues, and 26% identifying no issues for which these policies could be effective. No single issue was cited by a majority of participants as effectively addressed by NIRP. Economic growth below target was the issue most frequently cited, by 46% of participants.

Opinions on the effectiveness of NIRP roughly comported with perceptions of the likelihood of their future use by some central banks. Seventy-two percent responded that central bankers in some jurisdiction would be likely or very likely to use NIRP in the future, very close to the 74% who identified NIRP as effective for one or more issues. With respect to specific economic issues, 59% of participants believe some central bankers would be likely or very likely to employ NIRP in response to economic growth below target, which is higher than the 46% who responded that NIRP would be effective to address this issue. For the other issues, the proportion of participants responding that some jurisdictions were likely or very likely to use NIRP was about 5% higher than the proportion responding that the policies would be effective.

Overall, a much lower proportion (28%) of participants responded that the central bank in their primary jurisdiction would be likely or very likely to utilize NIRP in the future, with 51% responding that such use is unlikely or very unlikely. The expectation that the central bank in one’s own jurisdiction is much less likely to use NIRP than central banks in general is not surprising given the preponderance of US participants. As discussed in Section 4.6, some Fed staff and governors have in the past publicly expressed antipathy to NIRP, which may contribute to these opinions. However, in light of the discussion in Section 4.6, we consider the future use of NIRP in the US to be more likely than the majority of the survey participants. NR

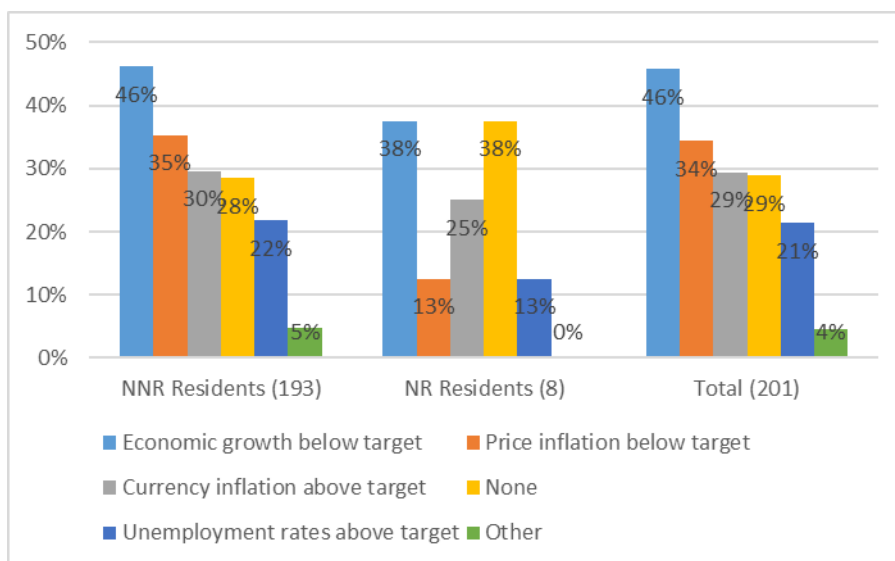
residents, while very few, perceive a much higher likelihood that their own central bank would use NIRP in the future, as expected.

Discussion of Section III Analysis

Question 9 addresses the effectiveness of NIRP to address several specified economic issues, also providing participants the opportunity to write in other issues for which NIRP may be effective. Participants selected the issues for which they believed NIRP would be effective but were not asked to predict the relative level of effectiveness. The question was intended to encourage participants to think about which issues NIRP may be most efficacious to address, so “none” was not a specific response option; some participants left the question blank, and others provided a write-in response equivalent to “none,” and these responses are combined as “none” in our analysis of results. Responses are summarized in Figure 19.

Figure 19

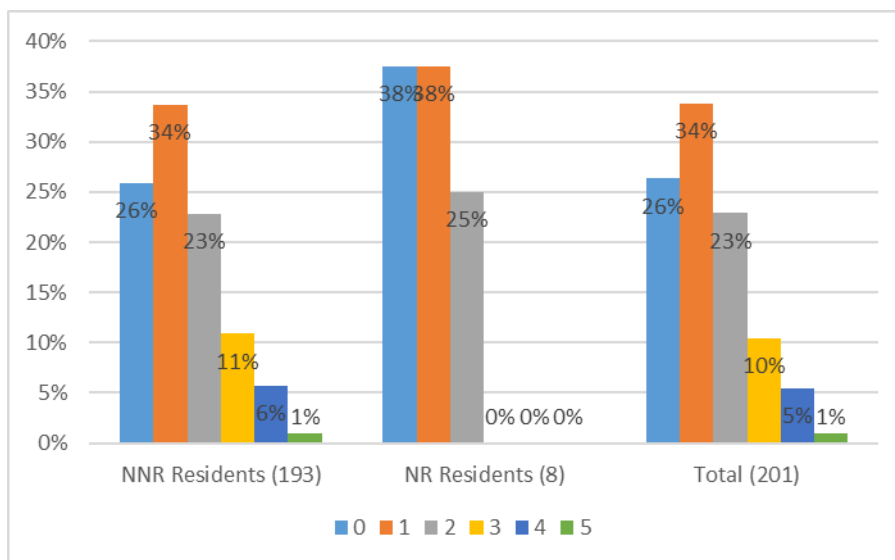
PROPORTION OF PARTICIPANTS EXPECTING NIRP TO BE EFFECTIVE FOR VARIOUS ISSUES



Economic growth below target was considered by participants to be the issue that NIRP could most effectively address, with 46% responding in the affirmative. Thirty-four percent responded affirmatively for price inflation below target, and 29% responded affirmatively for currency inflation above target. As discussed in Section 3, economic growth, price inflation and currency inflation are among the issues that policymakers in the Negative Rate Jurisdictions cite in their use of NIRP. Twenty-nine percent responded that there are no issues that can be effectively mitigated by negative rates, with some of these participants providing emphatic comments. This question provided some interesting distinctions between NR residents and NNR residents; while not statistically significant, a significantly lower proportion of the NR residents responded that NIRP could effectively mitigate price inflation issues, and a somewhat higher proportion of the NR residents responded that NIRP were not effective to address any of these issues.

We also analyzed the number of affirmative responses to Question 9 per participant. As shown in Figure 20, a relatively low number responded that NIRP could be effective for multiple issues. Sixty percent responded that NIRP would be effective for only one issue or none at all; conversely, only 17% responded that NIRP could be effective to address three or more issues.

Figure 20
 NUMBER OF ISSUES FOR WHICH NIRP IS EXPECTED TO BE EFFECTIVE



Write-in responses to issues that could be effectively addressed by NIRP included excess savings or business underinvestment in three responses and debt burden in three responses. This response is consistent with opinions expressed in one of the articles discussed in Section 4.4 (Das, 2019). One participant noted that NIRP could be effective to address any of these issues if the debt/GDP ratio was lower than it is currently, suggesting limits to the capacity of debt to address economic issues.

Questions 10 and 11 address the likelihood of central bankers using NIRP in the future—with Question 10 relating to central bankers generally and Question 11 relating to the central bank in the participant’s primary jurisdiction. Participants responded—on a scale of 1 to 5—on their perception of the likelihood that central bankers would use NIRP in the future to address the same economic issues included in Question 9. Figures 21 and 22 summarize the perceived likelihood that central bankers would use NIRP in the future to address at least one economic issue—first for central bankers in any jurisdiction and then for central bankers in the participant’s primary jurisdiction.

Figure 21
 LIKELIHOOD OF CENTRAL BANKERS IN SOME JURISDICTION USING NIRP IN THE FUTURE

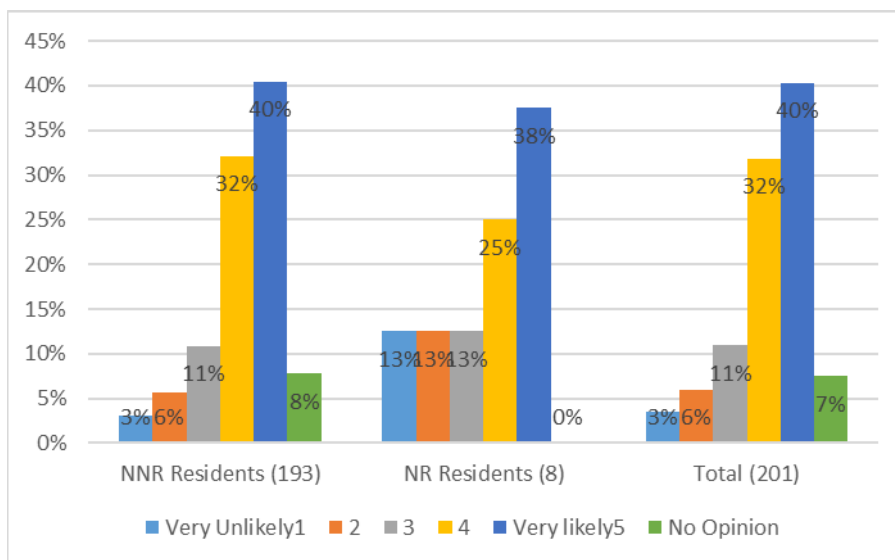
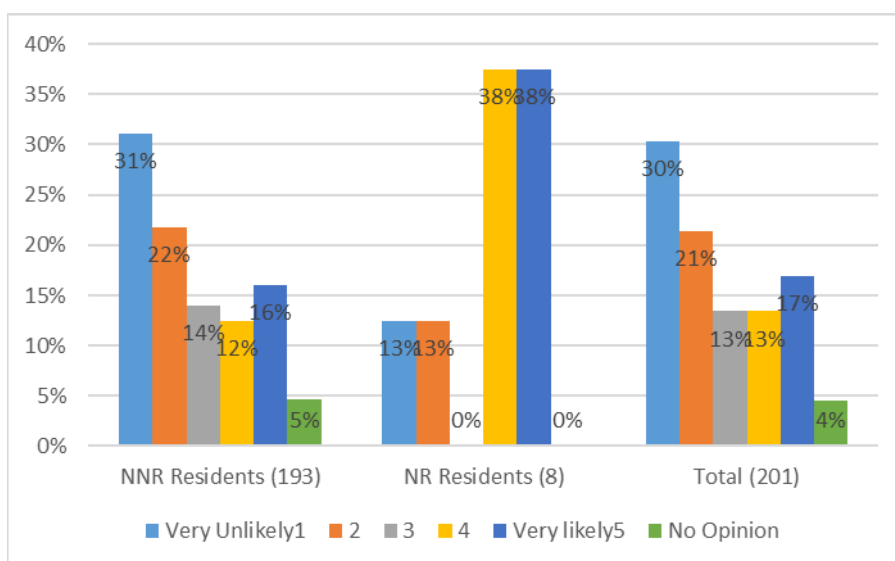


Figure 22
 LIKELIHOOD OF CENTRAL BANKERS IN ONE’S OWN JURISDICTION USING NIRP IN THE FUTURE



Overall, 72% responded that central bankers in some jurisdiction would be likely or very likely to use NIRP in the future to address at least one economic issue, while only 28% responded that the central bank in their primary jurisdiction would be likely or very likely to use such policies. Conversely, 10% of participants responded that the future use of NIRP by any central bank was unlikely or very unlikely, while 51% responded that future use in their primary jurisdiction was unlikely or very unlikely. These differences in response rates for Questions 10 and 11 make directional sense to us, because the likelihood of any central banker using NIRP is a logical ceiling for the likelihood of any individual central bank using such policies but also because such a high proportion of participants are located in the US, where the Fed has in the past publicly rejected NIRP. Seventy-five percent of NR residents responded that future use of NIRP in their primary jurisdiction was likely or very likely, an expected result given their historical use of these policies. Perhaps the most significant finding from these questions is that barely more than half of the NNR

residents responded that it was unlikely or very unlikely that the central bank in their primary jurisdiction would use these policies in the future, suggesting that a significant minority of US survey participants believe the Fed may undertake NIRP in the future.

We also analyzed the perceived likelihood that NIRP would be used in the future for the individual economic issues. Figure 23 summarizes these perceptions for some jurisdiction, and Figure 24 summarizes these perceptions for one's own jurisdiction.

Figure 23
 LIKELIHOOD OF CENTRAL BANKERS IN SOME JURISDICTION USING NIRP IN THE FUTURE—SPECIFIC ISSUES

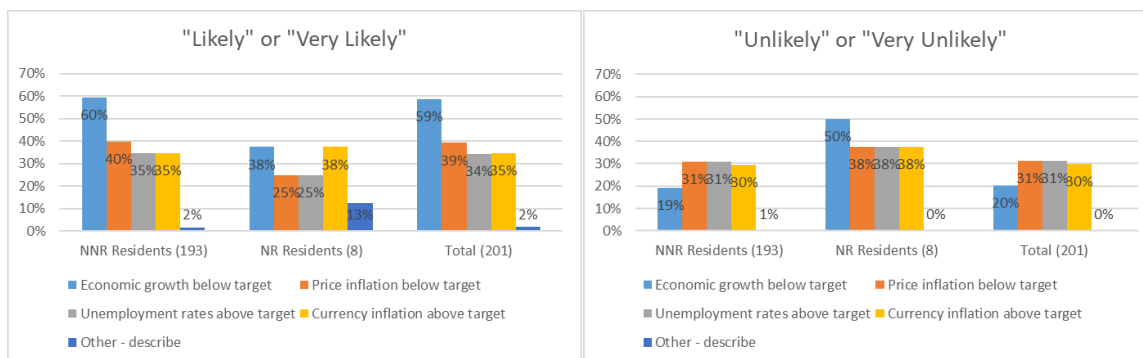
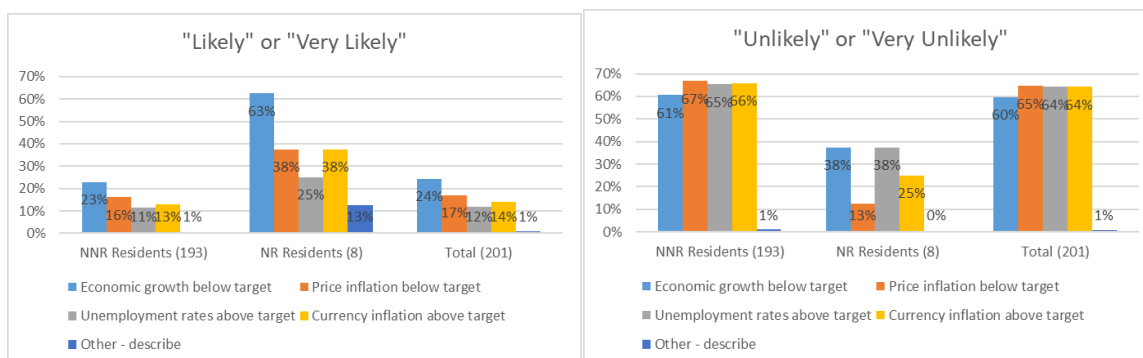


Figure 24
 LIKELIHOOD OF CENTRAL BANKERS IN ONE'S OWN JURISDICTION USING NIRP IN THE FUTURE—SPECIFIC ISSUES



These charts do not provide a great deal of additional insight. The most significant additional observation is that NNR residents indicate that spurring economic growth is the most likely reason for the use of NIRP, while NR residents perceive similar likelihoods for the various issues listed. This likely reflects the fact that the central bankers in Negative Rate Jurisdictions have stated various objectives in their use of these policies.

To conclude Section III, Question 12 asked whether participants believe the experience with NIRP to date increases or decreases the likelihood of their use in the future, with results summarized in Figure 25.

Figure 25
DOES PAST NIRP EXPERIENCE MAKE FUTURE NIRP MORE OR LESS LIKELY?



These charts indicate a broad range of opinions on how policymakers’ experience with NIRP affects the likelihood that NIRP will be used in the future. A greater proportion of participants (39%) perceived an increase in likelihood than perceived a decrease in likelihood (28%), with 33% seeing no change in likelihood or having no opinion. This dispersion is probably reflective of the general perception that NIRP has not been effective, while on the other hand, it has not triggered significant adverse consequences to date. For our part, we believe the literature supports the view that NIRP has become more likely in the future as a result of the experience in Negative Rate Jurisdictions.

5.6 Survey Section IV Analysis—Consequences and Effects of NIRP

Summary of Section IV Analysis

Section IV, Questions 13–20, gathers opinions regarding the risks and consequences of the use of NIRP. Question 13 gathered opinions regarding the likelihood of several potential unintended consequences of NIRP identified in the literature and in the popular press, also allowing participants to write in responses. Questions 14 and 15 queried participants’ expectations of the impact of NIR on the term structure of interest rates and on credit spreads. Questions 16 and 17 queried participants’ views of the balance between risks and benefits of NIRP for the economy and for their firms, respectively. Questions 18 and 19 asked participants to compare, respectively, the relative risk to their firm and the relative likelihood of NIR on one hand and rapidly rising interest rates on the other hand. Finally, Question 20 gathered opinions on the relative risk of NIR to various insurance products.

Asked to select the three most likely unintended consequences of NIRP, 60% of participants selected “excessive risk-taking and asset bubbles.” An increase in inequality as savers are penalized was considered next most likely, named by 45% of NNR residents but, curiously, not by any of the seven NR residents. After these two, there was a diversity of views regarding the most likely unintended consequences of NIRP, suggesting a great deal of uncertainty regarding their ultimate effects.

In one of the areas where geographic differences were notable, NR residents and NNR residents have different views of the effect of NIR on the term structure of interest rates and on credit spreads. Nearly

50% of NNR residents expect increases in liquidity and credit risk premia as a result of NIR, with fewer than 30% expecting decreases to these premia. Conversely, fewer than 30% of NR residents expect increases in these premia, with nearly 60% expecting decreases. We consider the NNR resident expectation to be more consistent with one's intuition—i.e., that the market would tend to compensate for negative rates through higher risk premia—while the NR resident expectation appears to be more consistent with actual experience in Negative Rate Jurisdictions, as discussed in Section 3.

Participants in all locations were nearly unified in the view that the risks NIRP introduces outweigh the benefits of these policies, both to their firms and to the broader economy. Approximately half consider the risks to be much greater than the benefits, and another one-third consider the risks to be moderately greater than the benefits, while only 5% believe the benefits exceed the risks.

A strong majority of participants, 62%, view an NIR environment over the next five years, should it occur or persist, to pose greater risk to their firms than rapidly increasing interest rates, compared with only 26% who view a rapidly increasing interest rate environment as more risky. Participants expressed more mixed views on the relative likelihood of negative rates and rapidly increasing rates over the next five years, with 33% considering rapidly rising interest rates to be more likely, 23% considering negative rates to be more likely, and 44% considering the risks to be comparable or having no opinion. Views on the relative likelihood of NIR and rapidly increasing interest rates showed expected geographic variation, with NR residents indicating a higher likelihood of negative rates, but the views of the relative risks of the two interest rate patterns did not vary as much by geography.

The views that survey participants expressed diverge from the empirical data and the literature in several significant ways. Although participants responded that NIRP poses greater risks than benefits, and greater than the risks of rapidly increasing interest rates, they appear to view the financial risk to the financial sector as modest relative to other risks, while the literature suggests that this is among the most significant risks. With respect to benefits of NIRP, participants overwhelmingly express the view that risks outweigh benefits, which contrasts with literature indicating that, to date, benefits have been largely in line with expectations while adverse consequences have been limited.

Views of the impact of NIR by line of business (life insurance, health insurance, annuities and general insurance) and by more detailed product type were consistent with our expectations. With participants selecting up to three product choices among 15 options, life insurance and annuity product types were considered to be more affected by NIR by wide margins—77% of participants selected at least one life product type, 72% selected at least one annuity product type, while only 8% selected at least one health product type and 7% selected at least one general insurance product type. The specific product types identified as most affected were also consistent with our expectations, with general account accumulation annuities selected by 49% of participants, guaranteed nonparticipating permanent life insurance selected by 45%, and payout annuities selected by 40%. No other product type was selected by more than 20% of participants.

In Section IV, 188 participants responded to some or all of the questions, including 181 NNR residents and seven NR residents, and these counts are used in the denominators of proportions reported for this section.

Discussion of Section IV Analysis

Question 13 presented 11 potential unintended consequences of NIRP and asked participants to choose and rank the three most likely consequences. The question also allowed participants to write in up to two

responses or to choose none of the above. Table 7 summarizes the proportion of participants who included each option among their three choices and who ranked each option No. 1.

Table 7
RANKING OF RISKS ARISING FROM NIRP

	Proportion Ranking No. 1, 2 or 3			Proportion Ranking No. 1		
	NNR Residents (181)	NR Residents (7)	Total (188)	NNR Residents (181)	NR Residents (7)	Total (188)
Excessive risk-taking, asset bubbles as investors search for yield	60%	43%	60%	28%	14%	28%
Increase in inequality as savers are penalized and borrowers are rewarded	46%	0%	45%	13%	0%	13%
Loss of confidence, central bank credibility	34%	43%	34%	11%	14%	11%
Adverse impact on financial sector—Reduced profitability, increased solvency risk, contraction of sector	31%	86%	34%	11%	43%	12%
Disincentive to correct fiscal imbalances or implement fiscal/structural reforms to foster long-term growth.	33%	29%	33%	6%	14%	6%
Misallocation of economic resources due to market distortions	26%	43%	27%	5%	0%	5%
Increased arbitrage opportunities due to market distortions	22%	29%	22%	8%	0%	7%
Increased risk of inflation above target	19%	0%	18%	9%	0%	9%
Increase in credit spreads	14%	29%	14%	4%	14%	5%
Other unintended consequence—describe in this space	5%	0%	5%	1%	0%	1%
Other unintended consequence—describe in this space	1%	0%	1%	0%	0%	0%
None of the above	1%	0%	1%	1%	0%	1%
Blanks	3%	0%	3%	3%	0%	3%

Among participants, excessive risk taking is clearly viewed as the most likely unintended consequence, with 60% including it in their three choices and 28% ranking it No. 1. Increase in inequality was considered the next most likely among NNR residents, with 45% including it among their three choices, but, interestingly, was not named by any of the NR residents. The third through fifth choices—loss of confidence, adverse impact on financial sector and disincentive to implement structural reforms—were all named by about 1 in 3 participants, although adverse impact on financial sector was named by six of the seven NR residents. Each of the suggested responses was named as one of the top three by more than 1 in 8 participants, which implies that participants see a wide range of risks associated with NIRP and that all of these risks can be viewed as significant.

How do these views compare with the literature we have reviewed? The most widely studied unintended consequence appears to be adverse impact on the financial sector. While most of the literature has investigated the effect on the banking sector specifically, many authors—notably the IMF in its Global Financial Stability Reports—warn of financial risks to the insurance and pension sectors. In addition, we note that excessive risk taking is most likely to arise as a response to adverse financial effects. The fact that NR residents cited this risk more frequently than any other suggests that they are more in tune to the

financial sector risks than the NNR residents. Based on these results, it appears that the financial risks to their firms may be underappreciated by the actuaries participating in the survey.

Questions 14 and 15 queried participants' expectations of the impact of NIRP on the term structure of interest rates and credit risk premia, respectively. Figures 26 and 27 summarize responses to these questions:

Figure 26
EXPECTED IMPACT OF NIRP ON YIELD CURVE SHAPE

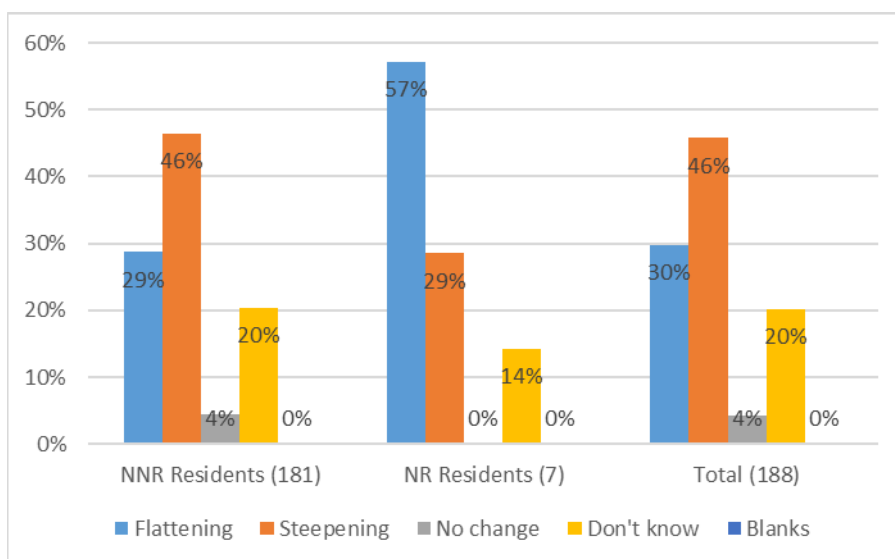
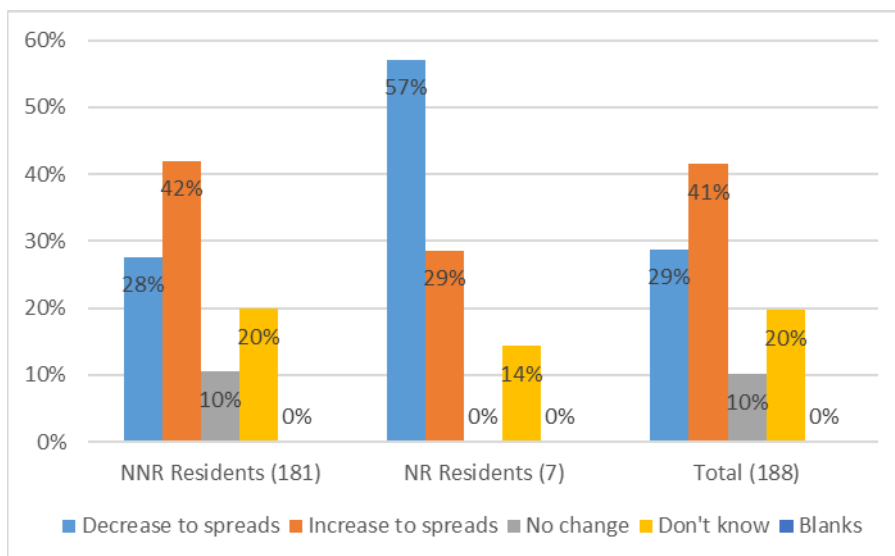


Figure 27
EXPECTED IMPACT OF NIRP ON CREDIT SPREADS



NNR Residents were more likely to expect NIRP to steepen the yield curve and increase credit spreads—42%–46% versus 28–29% who expect the opposite. Conversely, NR residents were more likely to expect NIRP to lead to a flattening yield curve and decreasing credit spreads—57% versus 29% who expect the opposite. While the survey did not provide insight into the reasons for these different views, the greater

expectation of steepening and credit spread widening among the NNR residents seems consistent with an intuition that the market would correct for negative rates in setting liquidity and credit premia. Conversely, the greater expectation of flattening and spread tightening among the NR residents is consistent with actual experience in those jurisdictions and with the literature on the transmission of interest rate policy through the real economy.

Questions 16 and 17 queried participants' expectation on the balance between risks and benefits arising from NIRP, for the economy and financial system as a whole and for their own firms, respectively. Figures 28 and 29 summarize participants' responses to Questions 16 and 17.

Figure 28
EXPECTED BALANCE OF NIRP RISKS/BENEFITS—SYSTEMIC

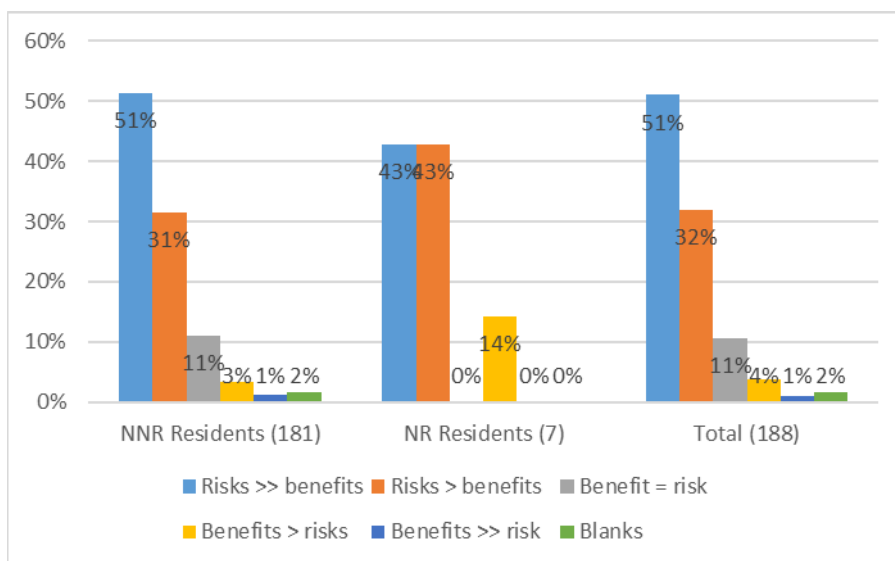
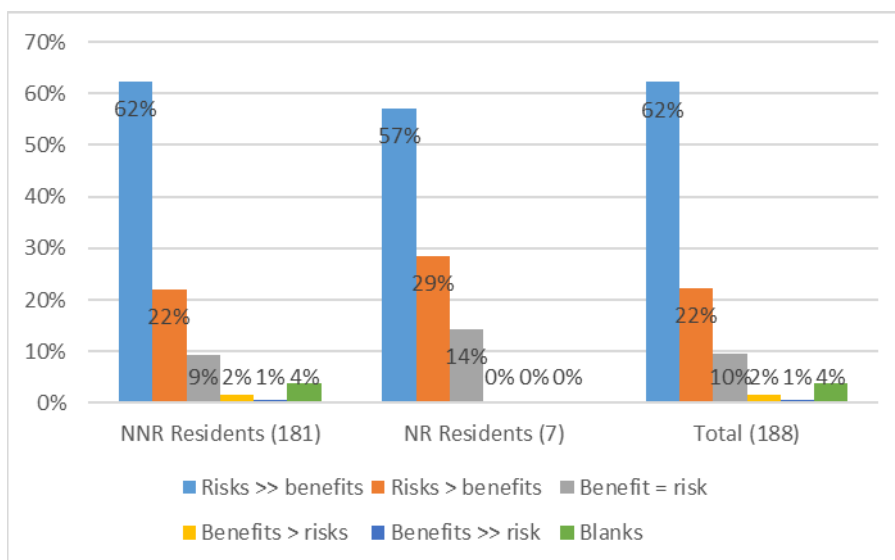


Figure 29
EXPECTED BALANCE OF NIRP RISKS/BENEFITS—ONE'S OWN FIRM



If NNR residents and NR residents differed in their expectation of market pricing for liquidity and credit risk under NIRP, they were very consistent in their views on the balance of risks and benefits arising from these policies. Approximately 85% responded that the risks of these policies exceed or greatly exceed their benefits, with fewer than 5% responding that the benefits exceed or greatly exceed the risks. These results were consistent for both NNR residents and NR residents and were consistent when considering systemic effects and when considering firm-specific effects. The main distinction in response rates was that participants generally viewed the risk/benefit balance as more adverse for their own firms than for the economy as a whole—of those who responded that the risks to their firms exceed or greatly exceed the benefits, nearly 75% chose “greatly exceed” compared with 60% when considering systemic risks.

While the NR residents and NNR residents were consistent in their views on the balance of risks and benefits, these views present a sharp contrast to the literature, which generally finds that benefits have been generally consistent with monetary policy above zero and that adverse consequences have not arisen to date. We do not mean—and most of authors we have reviewed do not mean—to suggest that the lack of adverse consequences to date lessens the future risk of such consequences. Indeed, if unintended consequences arise in a nonlinear way, the benign effects to date may embolden policy actions increasing the risk of unintended consequences. Taken together, the results of Questions 14–17 suggest to us an underappreciation of both the direct financial risks and the potential benefits of NIRP.

Questions 18 and 19 queried participants’ views, respectively, on the relative risks to their firms and the relative likelihood of NIR and rapidly increasing interest rates in the following five years. Results of Questions 18 and 19 are summarized in Figures 30 and 31.

Figure 30
INTEREST RATE PATTERN PRESENTING GREATER RISK TO FIRM OVER NEXT 5 YEARS

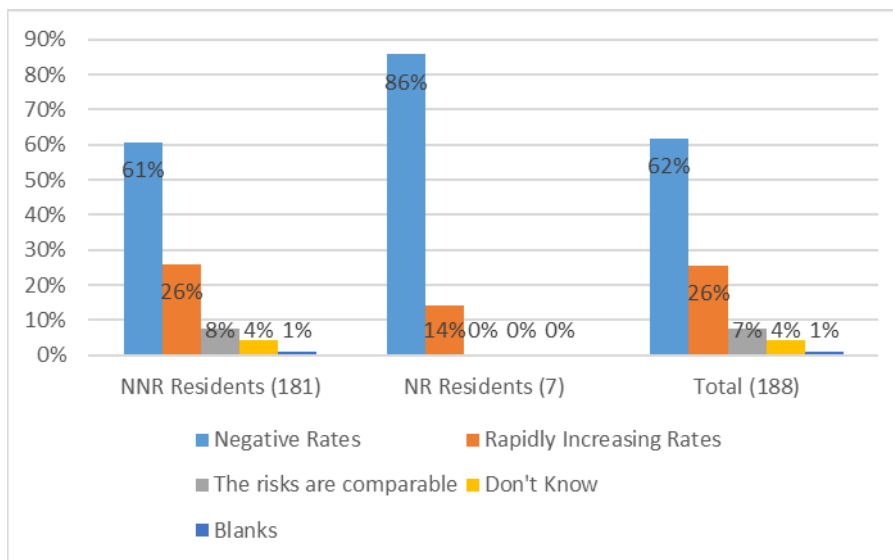
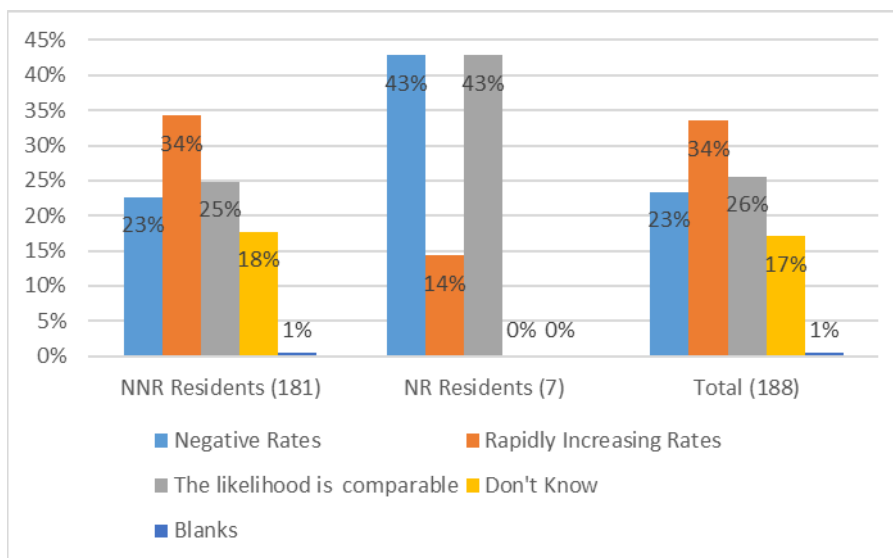


Figure 31
 MORE LIKELY INTEREST RATE PATTERN OVER NEXT 5 YEARS



More than twice as many participants responded that NIR, were they to occur or continue, would pose greater risk to their firm than responded that rapidly increasing interest rates would pose greater risk. Participants were more divided on their views of the likely direction of interest rates in the next five years, with 1 in 3 responding that rapidly increasing interest rates were more likely but with half responding either that negative rates were more likely or that the risks are comparable. NR residents, who have experienced interest rates continuing for several years already, saw the likelihood more heavily weighted to negative rates than to rapidly increasing rates.

The last question in Section IV, Question 20, queried the participants’ views of the risks of NIR by product line, asking participants to choose the product types that they believe would be most adversely affected by NIR. Participants selected up to three product types from among 15 choices, which included six life insurance, four health insurance, three annuity and two general insurance product types.

Figure 32 summarizes the proportion of participants who selected at least one product type from each of the four broad lines of business, showing that life insurance and annuity products are considered to be the most affected by NIR, with approximately 75% of participants selecting at least one life insurance product type and a comparable proportion selecting at least one annuity product type, compared with only 7%–8% selecting at least one health or general insurance product.

Figure 32
 LINES OF BUSINESS MOST AFFECTED BY NEGATIVE RATES

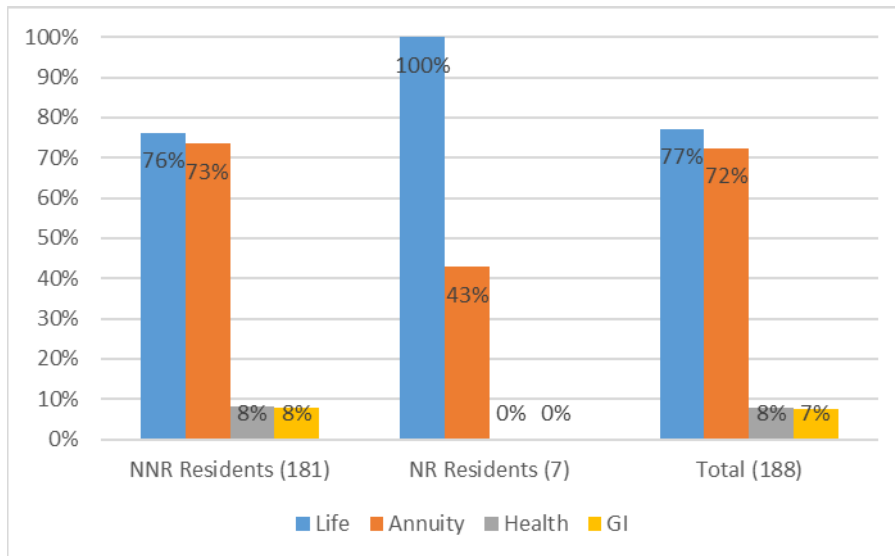
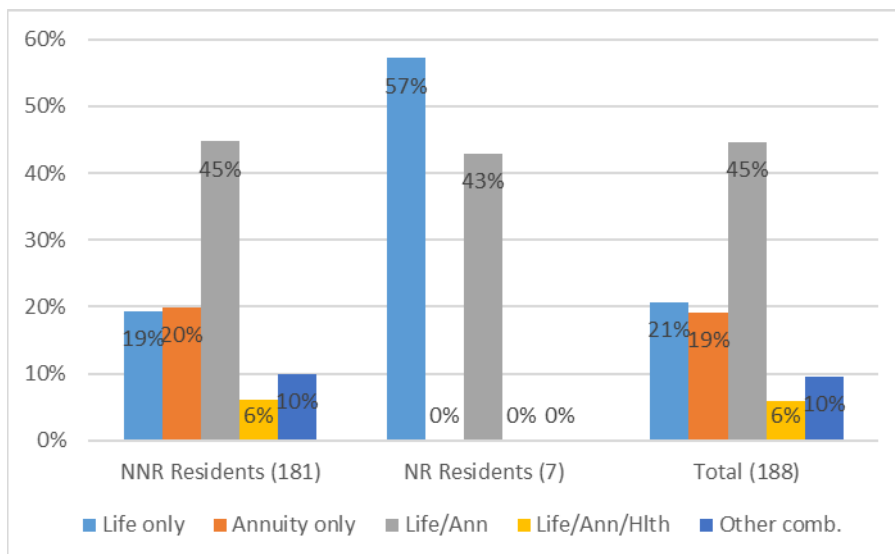


Figure 33 provides some additional detail on the combinations of lines of business selected by each participant. Forty-five percent of participants included both life and annuity product types among their three choices. A much smaller proportion, approximately 20% each, selected only life product types or only annuity product types. Another 6% selected life, annuity and health product types; the health product types selected by this group, disability and other health product types, appear to be long-duration nonmedical coverages such as disability and long-term care.

Figure 33
 LINE OF BUSINESS COMBINATIONS MOST AFFECTED BY NEGATIVE RATES



Finally, Table 8 ranks the responses by specific product type, with general account accumulation annuities, permanent life insurance with guarantees and payout annuities named far more frequently than any other product type.

Table 8
PRODUCTS MOST AFFECTED BY NEGATIVE RATES

	NNR Residents (181)	NR Residents (7)	Total (188)
Annuity—accumulation/deferred, general account	50%	29%	49%
Life insurance—non-participating, permanent, guaranteed	45%	43%	45%
Annuity—payout	41%	14%	40%
Life insurance—participating	19%	43%	20%
Life insurance—term	14%	43%	15%
Life insurance—variable or unit-linked	14%	29%	15%
Annuity—accumulation/deferred, variable or unit-linked	13%	0%	13%
Life insurance—non-participating, permanent, non-guaranteed	11%	29%	12%
General insurance—liability	7%	0%	7%
Health insurance—disability	4%	0%	4%
Health insurance—other	3%	0%	3%
General insurance—property	2%	0%	2%
Health insurance—supplemental medical	2%	0%	2%
Life insurance—other	1%	0%	1%
Health insurance—primary medical	0%	0%	0%

5.7 Survey Section V Analysis—Negative Interest Rate Modeling and Risk Management

Summary of Section V Analysis

Section V, Questions 21 and 22, gathers information on modeling capabilities regarding NIR and treatment of NIR in companies' modeling and ERM programs. Question 21 addresses, from the perspective of the participant's firm, 14 elements of modeling capability, modeling practice and ERM practice related to NIR. For participants employed by consulting firms, Question 21 gathers information from the consulting firm's perspective—i.e., the advice the firm gives to its clients. Question 22 addressed the same 14 elements but was presented only to employees of consulting firms, requesting their perceptions of the capabilities and practice among their client firms. In this way, we hoped to compare and contrast: i) insurance company capabilities and practice; ii) capabilities and practice recommended by the consultants; and iii) the consultants' perception of insurance company capabilities and practice. Therefore, to analyze this section, it was necessary to segregate consultant responses and nonconsultant responses, and Table 9 shows the distribution of Section V participants among firm type and jurisdiction.

Table 9
SECTION V PARTICIPANT COUNTS—CONSULTANT VS NONCONSULTANT

Firm Type	NNR Resident	NR Resident	Total
Consultant	48	4	52
Nonconsultant	133	3	136
Total	181	7	188

We would characterize modeling capabilities with respect to interest rates as moderately high, with approximately 70% of participants responding that their modeling software supports negative rates and 50%–60% reporting that their scenario generators support negative rates. These responses were consistent with the advice given by the consultants participating in the survey, while the consultants generally perceived a lower capability among their clients than reported by survey participants.

While modeling capabilities are relatively high, we would characterize the practice of modeling NIR as low, with fewer than 30% of participants currently modeling negative rates, compared with just over 40% who responded that they have modeled negative rates at some time. More than 60% floor their scenarios to prevent negative rates, and just over 40% include reinvestment limitations to prevent or limit purchase of securities with negative rates. These responses were generally consistent with the advice given by the consultants participating in the survey. The proportion of consultants reporting that most clients currently model negative rates was slightly higher than the proportion who currently advise the modeling of negative rates and the proportion of nonconsultants responding that they do currently model negative rates.

We would characterize the consideration of negative rates in the participants' ERM programs as very low, with only about 20% responding that their ERM program treats negative rates as a key risk and fewer than 25% responding that their ERM program includes management plans in the event of negative rates. Modestly higher proportions of the consultants report that their firms advise clients to consider negative rates in their ERM programs, but we did not consider the difference to be significant.

We would characterize the use of NIR hedging as moderate. Only 5% of nonconsultants reported hedging specifically against negative rates, but more than 40% reported hedging against low or declining rates, comparable to the proportion who reported hedging against high or increasing interest rates. These responses were generally consistent with the responses consultants provided regarding the advice given by their firms and regarding their perception of client practice.

Overall, the treatment of negative rates in modeling and ERM appears to reflect a strong conviction that NIRP would not be employed in the participants' jurisdictions and that their financial impact, if employed, would be manageable. This contrasts with the views on the balance of risks and benefits of negative rates as reported in Section IV.

Discussion of Section V Analysis

The following discussion of the Section V analysis is organized differently than the earlier survey section discussions, which were organized by question. Because Questions 21 and 22 both addressed the same 14 facets of capability and practice, discussion of the Section V responses combines the two questions and is organized in the following categories: i) modeling capabilities with respect to negative rates; ii) modeling practice with respect to negative rates; iii) consideration of negative rates in ERM; and iv) interest rate hedging.

The discussion explicitly compares the Question 21 responses for nonconsultants and consultants to the Question 22 responses for the consultants, and an adjustment was necessary to complete this comparison. Question 21 on company practice and consultant advice presented binary—yes or no—response options, while Question 22 presented three options regarding the consultants' perception of client capability and practice—"most do," "some do/some don't" and "most do not." For comparison to Question 21 responses, it was necessary to map the Question 22 responses to a binary equivalent. For this purpose, we assumed that "most" means 80% and "some" means 50%. Formulaically, then, Question 22 responses were mapped to yes/no results, as follows:

Yes = 0.8 x Most do + 0.5 x some do/some don't + 0.2 x most do not

No = 0.2 x Most do + 0.5 x some do/some don't + 0.8 x most do not

For the reader’s benefit, the figures presented for this section show these “mapped” results for the consultants’ perception, along with the direct response rates for the “most do” and “some do/some don’t” responses.

For Questions 21 and 22, we received a high proportion of nonresponses—“don’t know,” “not applicable” or blanks. This makes intuitive sense, because a participant’s role in the firm may not provide them with knowledge of these capabilities or practices. In our quantitative analysis of these questions, we excluded these nonresponses. Table 10 shows the response rates for each of the 14 elements addressed in these questions. Response rates are shown separately for the nonconsultants, the consultants’ responses regarding the advice their firms provide to clients, and the consultants’ responses regarding their clients’ capabilities and practices. The complement of the response rate shown below is the proportion of the Section V participants providing a nonresponse.

Table 10
MODEL CAPABILITY RESPONSE RATES

Response rates		Nonconsultants	Consultants (advice)	Consultants (view of clients)
Modeling software supports negative rates	Asset modeling	48%	71%	43%
	Liability or asset/liability modeling	57%	77%	43%
Scenario generators support negative rates	Deterministic	60%	65%	39%
	Real-world	58%	60%	29%
	Risk-neutral	44%	56%	29%
Negative rates modeled?	In the past	81%	79%	43%
	Currently	75%	77%	39%
Model assumptions limit negative rate impact?	Limit asset purchases with yield <0%	57%	54%	33%
	Interest Rate Floor >= 0%	68%	71%	33%
Negative rate consideration in ERM	Negative rates an ERM key risk?	57%	44%	31%
	ERM management plan if negative rates occur?	50%	38%	32%
Interest rate hedging	Hedge against negative rates	61%	52%	39%
	Hedge against low/decreasing rates	65%	50%	45%
	Hedge against high/increasing rates	67%	52%	45%

For the 136 nonconsultants completing Section V, response rates regarding modeling of negative rates were 75%–80% (100–110 responses), and response rates regarding interest rate hedging were 60%–70% (80–90 responses), but the other response rates were generally only 40%–60% (60–80 responses). For the 52 consultants, response rates regarding their firms’ advice were 70%–80% (35–40 responses) with regard to modeling software and modeling of negative rates were 70%–80%, but only 40%–60% (20–35 responses) with regard to the other items, which is comparable to the nonconsultant response rates. Response rates were the lowest for the consultants’ views of their client’ capabilities—30%–50% (15–25 responses) across the board. The low response rates for these questions and the low absolute number of responses for consultants combine to reduce the significance of the responses to this section.

To reiterate, in the analysis and discussion below, the denominators exclude the nonresponses described above.

Figure 34 summarizes the responses regarding modeling capability. Approximately 70% responded that their software supports negative rates, with approximately 60% reporting that their scenario generators support negative rates. This is relatively consistent with the responses from consultants regarding their firms’ advice to clients regarding NIR modeling capabilities. The consultants’ perception of their clients’ modeling capabilities generally indicated perception of lower capabilities than either the nonconsultants reported or the consultants advise. This could represent a misperception on the part of the consultant participants or could represent skewing of results due to the low response rates.

Figure 34
MODELING CAPABILITY—% OF PARTICIPANTS RESPONDING AFFIRMATIVE CAPABILITIES

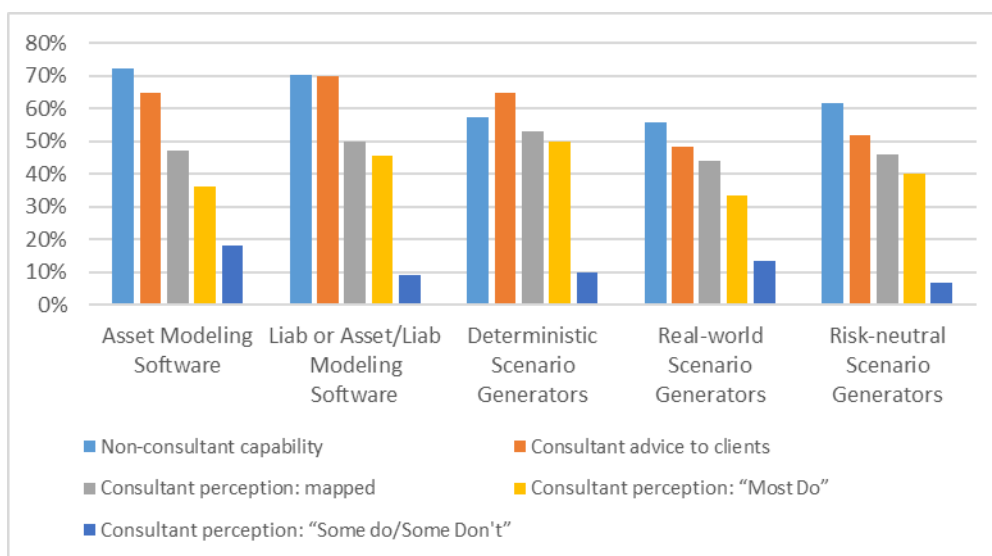
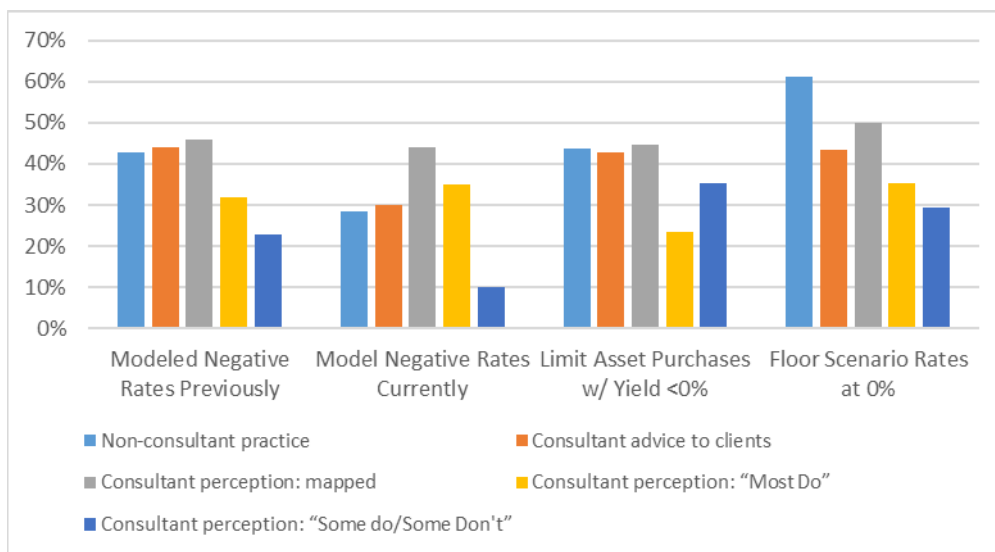


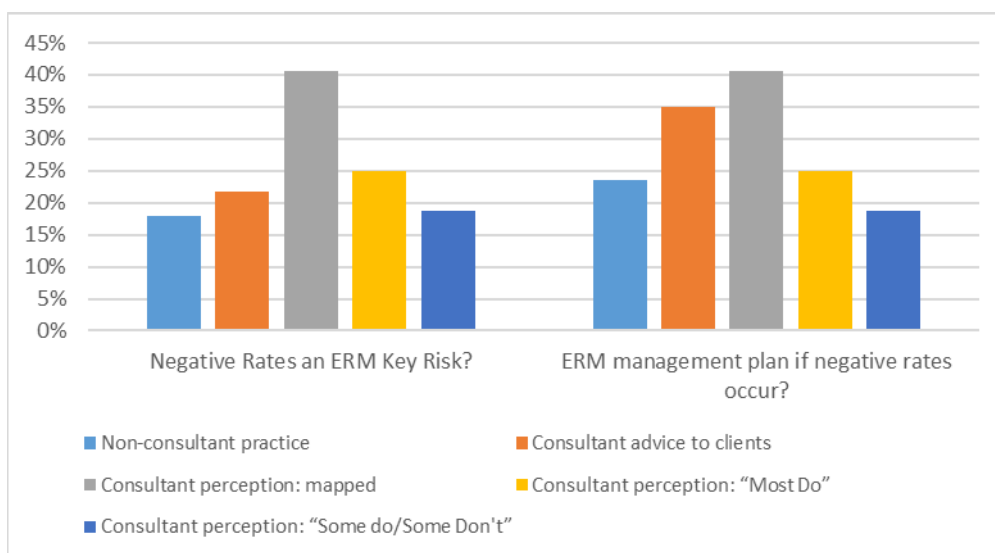
Figure 35 summarizes responses regarding modeling practice—i.e., whether participants have modeled NIR and whether they employ assumptions that prevent NIR or minimize the effect of negative rates in their models. The proportion reporting that they model, or have modeled, negative rates is well below the proportion who reported the capability to model them: Nearly 45% of nonconsultants have modeled negative rates at some time, while only about 30% do so currently. A majority, 61%, floor their interest rate scenarios to prevent negative rates, and 44% responded that their models limit or prohibit purchase of assets with a negative yield, with significant overlap between the two groups. The advice reported by the consultants was generally consistent with the practice reported by the nonconsultants, except that fewer consultants advised flooring interest rates. The consultants’ perception of their clients’ modeling practice appears consistent with the practice reported by nonconsultants and the practice advised by the consultants.

Figure 35
MODELING PRACTICE—% OF PARTICIPANTS RESPONDING AFFIRMATIVELY



As shown in Figure 36, an even smaller proportion of participants consider negative rates in their ERM program than model negative rates. Fewer than 25% either track negative rates as a key risk or have a management plan for negative rates. The proportion of consultants advising clients to consider negative rates in their ERM programs is modestly higher. Unlike the results for modeling capabilities and modeling practice, the consultants perceive a higher proportion of clients considering negative rates in their ERM programs than reported by the nonconsultants or than advised by the consulting firms. The proportion of consultants reporting that most or some of their clients consider negative rates in their ERM programs was the highest of the three but was still below 50%.

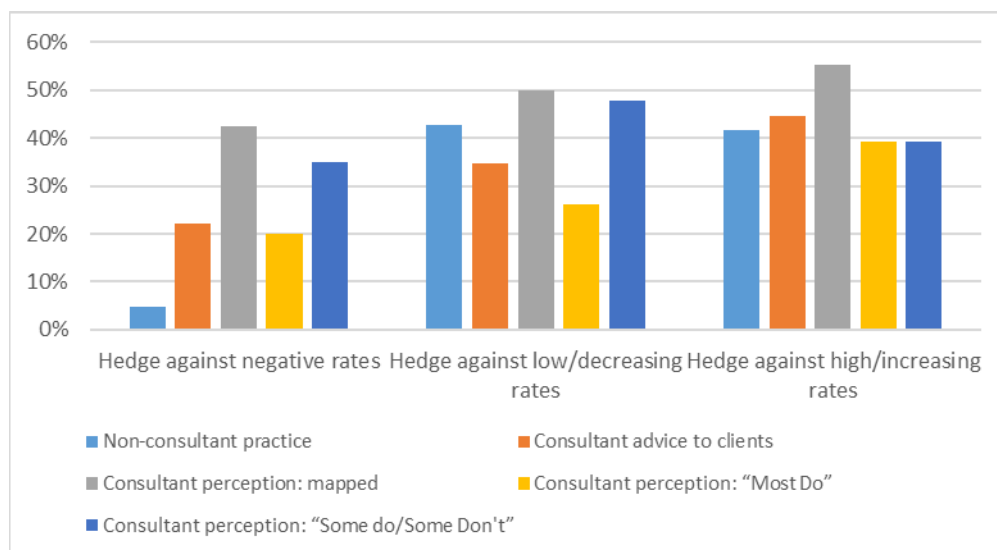
Figure 36
ERM PRACTICE—% OF PARTICIPANTS RESPONDING AFFIRMATIVELY



As shown in Figure 37, very few of the nonconsultants report that their companies hedge specifically against the risk of NIR, while nearly 45% report that they do hedge against the risk of low or declining

interest rates more generally, almost identical to the proportion reporting that they hedge against the risk of high or increasing interest rates. The distribution of consultant responses regarding their firms’ advice was comparable, except that more than 20% reported that their firms advise hedging against NIR risk. Comparatively, the consultants’ perception of interest rate hedging among their clients was modestly higher than that reported by the nonconsultants or advised by the consultants.

Figure 37
INTEREST RATE HEDGING- % OF PARTICIPANTS RESPONDING AFFIRMATIVELY



5.8 Summary of Survey Analysis

We were pleased with the number of responses to the survey but disappointed by the small number of responses received from individuals located in or working in Negative Rate Jurisdictions. Participants were predominantly North American, and the responses reflect a North American perspective. The geographic distribution of participants limited our ability to compare and contrast opinions and practice between those who have experienced negative rates directly and those who have not. We received a good mix of responses by employer type, allowing us to compare the practices recommended by the consulting firms with the practices employed by insurance companies. Participants were more heavily weighted to life and annuity actuaries, consistent with the perception that these lines of business are more subject to the effects of NIR than health or general insurance lines.

Awareness of NIR was fairly low, with approximately 60% of participants able to name at least one Negative Rate Jurisdiction, but only 17% able to name three or more. Awareness was highest for the European Monetary Union and Japan, at approximately 40%, but lower for Switzerland, Sweden and Denmark. Awareness of negative yields on long-term government bonds in these jurisdictions was somewhat lower than awareness of NIRP. The rate of false positives was also significant, with 20% of participants incorrectly identifying at least one Non-negative Rate Jurisdiction as having NIRP and 35% incorrectly identifying at least one Non-negative Rate Jurisdiction as having negative yields on long-term government bonds. We surmise that some of these false positives were due to participants considering real rates rather than nominal rates.

If awareness of the actual use of NIRP was low, the perception of the likelihood of their use in the future and their potential to effectively mitigate some economic ills were relatively high, at least in the abstract. Presented with four economic ills—growth below target, price inflation below target, currency inflation

above target and unemployment above target—and with an opportunity to write in other responses, 72% of participants responded that the central bank in some jurisdiction would be likely or very likely to employ NIRP for at least one issue, and 74% identified at least one issue for which they believed NIRP could be employed effectively. When asked about the central bank in their own primary jurisdiction, participants perceive a much lower likelihood of the use of negative rates, with only 30% responding that their use would be likely or very likely. The perception regarding one's own central bank was highly correlated with the participant's location, with 75% of NR residents responding that their use would be likely or very likely. Even among NNR Residents, a group dominated by US residents, only 51% responded that the use of NIRP by their own central bank would be unlikely or very unlikely, a proportion we may have expected to be higher in light of past Fed statements regarding negative rates. This response pattern may reflect shifts in the Fed's position in recent years. Participants were split on whether the experience in Negative Rate Jurisdictions had increased or decreased the likelihood that NIRP may be employed in the future. With respect to the specific economic ills, 59% of participants responded that central bankers would be likely or very likely to use NIRP to boost economic growth, with 35%–40% responding that their use would be likely or very likely to address the other issues.

While awareness of negative rates was relatively low and likelihood of their future use was perceived to be fairly high (at least in the abstract), opinions on the risks associated with NIRP were nearly uniform. Participants saw potential for a wide range of unintended consequences, with excessive risk taking and asset bubbles and an increase in inequality at the top of the list. While the potential for adverse consequences was judged to be high, the potential for adverse financial consequences for financial firms was judged to be lower than we expected. Eighty-four percent of participants responded that the risks of negative rates moderately or greatly exceed the benefits, compared with 5% responding that the benefits exceed the risks; and 62% see a negative rate environment as riskier to their firms than a rapidly increasing rate environment, compared with 26% who see the rapidly increasing rate environment as more risky. Participants have split views on the likely future direction of interest rates, with 33% seeing a rapidly increasing rate environment as more likely, 23% seeing a negative rate environment as more likely and 44% seeing a comparable likelihood or having no opinion. The perception of the risks of NIRP was not notably different for NR residents and NNR residents, but expectations regarding market responses to these risks did vary significantly. Among NNR residents, 42%–46% expect that negative rates would lead to a steeper yield curve and higher credit spreads, compared with 28%–29% expecting the opposite. Conversely, among NR residents, 29% expect a steeper yield curve and higher spreads, compared with 57% expecting the opposite.

How then, given relatively low awareness of negative rates, relatively high perceived likelihood of their use and a perception of significant risks associated with negative rates, have the participants' firms responded in their modeling and risk management programs? It appears that modeling and ERM practice correlate more with the awareness of negative rates and the perceived likelihood of NIRP use in one's own jurisdiction than with their perceived risk or the likelihood of their use more broadly. While modeling capabilities appear moderately high, with approximately 70% responding that their modeling software can handle negative rates and 50%–60% responding that their scenario generators can accommodate negative rates, their actual use in modeling practice is much lower, with only 30% currently modeling negative rates, 60% using floors to prevent negative rates and more than 40% limiting their effect through their modeled investment strategies. Consideration of negative rates in ERM programs is even lower, with fewer than 20% considering negative rates to be a key risk and slightly more than 20% having management plans in place in the event of negative rates. The most significant treatment of negative rates from a risk management perspective is in companies' interest rate hedging programs, where 40%–45% reported hedging against low or decreasing interest rates, comparable to the proportion who report hedging against high or increasing

interest rates. Generally speaking, company practice in these areas is consistent with the advice given by consulting firms, according to the consultants participating in the survey.

Section 6: Conclusions

We have studied the impact of NIR on the insurance industry from three perspectives. We have reviewed the evolution of interest rates in the Negative Rate Jurisdictions since the introduction of NIRP, including the development of the bond yields that correspond to the typical returns on insurance company asset portfolios. We have reviewed existing literature related to negative rates and assessed future prospects for NIR. Finally, we have surveyed practicing actuaries regarding their awareness of negative rates, their opinions regarding negative rates, and their firms' modeling and risk management practices related to negative rates. In concluding, we bring together these three threads of inquiry into five major conclusions:

1. Effort is needed to improve the awareness of negative rates among actuaries and among insurance regulators. Although jurisdictions with NIR represent nearly 25% of world GDP and include such major regions as the Eurozone and Japan, only 61% of survey participants were able to identify even one such jurisdiction, as discussed in Section 5. Although only a small number of survey participants are employed by insurance regulators, their responses did not differ from those of other recipients in any significant way. As well, we have noted that US solvency and nonforfeiture frameworks may not be robust with respect to NIR, indicating a lack of regulatory preparedness for this eventuality.
2. While our survey participants perceive limited potential for NIRP to benefit the economy, NIRP employed to date has had the sorts of effects intended by central bankers. As discussed in Section 3, NIRP has progressively and consistently flowed through to yields on government and corporate bonds. As discussed in Section 4.2, various authors have found that, whether measured through proximate metrics or broad macroeconomic measures, the effects of NIRP are consistent with expectations. While some authors have identified limits in the transmission of NIRP, these limitations have generally not been broad-based. This contrasts with the survey results discussed in Section 5.3. While 74% of participants, when presented with a list of issues, responded that NIRP could be effective to mitigate one or more economic issues, fewer than 50% responded that it could be effective for any individual issue. In addition, 51% responded that the systemic risks of NIRP are much greater than the benefits, with another 32% responding that the risks are greater than the benefits.
3. While the unintended consequences of NIRP to date have been limited, the risk of unintended consequences remains significant. Survey participants, while perceiving that the risks associated with NIRP were significant and greatly outweighed the benefits, did not indicate a high degree of concern with the potential financial impacts for the financial sector, including the insurance industry—with only 34% identifying adverse consequences for the financial sector among their top three risks.
4. The likelihood of NIRP use in a future economic downturn is quite high and probably higher than the expectations indicated by the survey participants. The likelihood of NIRP in the US may be lower than in other jurisdictions but is significant, nonetheless. This conclusion reflects literature indicating a decline in the natural rate of interest, literature finding current NIRP efforts to be

effective with minimal adverse effects, and reports of political responses to recent data suggesting that growth may be slowing. Given that interest rates remain so low worldwide, it is reasonable to expect that conventional measures will be of limited effectiveness in the next downturn, leading to greater reliance on unconventional measures. As NIRP comes to be regarded as within the range of normal responses, objections to its use will fade. In our opinion, only a significant adverse development directly attributable to NIRP is likely to slow its acceptance. With the possibility that the next downturn occurs while rates remain negative, we see a likelihood of some central bankers experimenting with mechanisms to enable deeper negative rates.

5. The survey responses, combined with the empirical data and review of existing literature, indicate that survey participants and their firms are not well prepared for the prospect of negative rates, particularly those in the life insurance sector where effects are expected to be more significant. While a majority of survey participants indicate that their modeling systems can accommodate negative rates, 30% indicated that their modeling software packages do not accommodate negative rates, and nearly 50% indicated that their scenario generators do not. Fewer than 30% model negative rates, with significantly greater proportions employing floors to prevent negative rate scenarios or to limit purchase of assets with negative yields. Similarly, fewer than 30% have identified negative rates as a key risk or have management plans in place in the event of negative rates. We recommend that firms consider the need to explicitly model NIR and incorporate risks associated with NIR into their ERM programs.

From an industry-wide perspective, literature investigating the impact of NIRP on the insurance industry is very limited. While a number of reports exist, few of them investigate the phenomenon in a systematic way. The reports raising the most significant concerns regarding the impact of NIRP on insurance have been generated outside the industry. Most empirical studies of the effect of NIRP on financial results and the ways firms have adapted to NIRP are focused on the banking industry, and similar empirical studies of the insurance industry are key areas where future research is needed. Similarly, literature exists that forecasts the effect of NIRP on bank financials, but there is little similar for the insurance industry. Because life insurance firms write long-term rate guarantees and invest in long-term assets, the onset of adverse financial consequences is likely to be slower than for banks, making forecast-based studies important for evaluating long-term effects.

Finally, NIR may require rapid and significant responses by insurance regulators and supervisors. In the US, numerous reserve, capital and nonforfeiture requirements are based on models or calculations that break down under negative rates. While we have not investigated similar issues in other Non-negative Rate Jurisdictions, they likely exist. Particularly in these jurisdictions, we recommend additional research to identify potential changes to regulatory frameworks to ensure the continued financial strength of the industry.

Section 7: Acknowledgments

The researchers' deepest gratitude goes to those without whose efforts this project could not have come to fruition: the Project Oversight Group and SOA staff for their diligent work overseeing questionnaire development, analyzing and discussing participant responses, and reviewing and editing this report for accuracy and relevance; the individuals (and their firms) who took the time to respond to the negative interest rate survey; and the Canadian Institute of Actuaries, Casualty Actuarial Society and Society of Actuaries, who recognized the need to develop research on the topic of negative interest rates.

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Appendix A: SOA Survey on Negative Interest Rates—Detailed Responses

(Author's note: Appendix A includes the unedited text of the survey questions and the participants' responses.)

Survey Instructions

Q1.

RSVP 3/14/2019 Negative Interest Rate Survey

The Joint Risk Management Section, sponsored by the Casualty Actuarial Society, the Canadian Institute of Actuaries, and the Society of Actuaries plus the Joint Risk Management Research Committee are sponsoring a survey on negative interest rates. The project is meant to provide insurance company actuaries and risk managers information on the range of attitudes and risk management practices across the insurance industry regarding negative interest rates. Findings will be summarized in a report expected to be made available to members via the SOA website in last quarter 2019.

To meet research objectives, we are requesting your participation in the study by completing the online survey by March 14, 2019. The survey should take on average 15 minutes to complete. The survey is intended to capture individual opinions and perspectives, so responses by multiple employees of the same firm are accepted and encouraged. All responses will be kept confidential, and neither the individual nor their firm will be identifiable.

Participants are encouraged to answer all survey questions if possible. Each time you press the Next button, the questions you answered will be saved, but will not be finalized until you have pressed the Submit button. Should you be interrupted while taking the survey, you can return to the survey from the same computer at a later time. For the best viewing of the survey, please maximize your browser window.

SURVEY TERMINOLOGY: As used in the survey, a "Negative" interest rate is a Negative Nominal Rate. "Policy Interest Rate" or "Interest Rate Policy" refers to interest rates set by central banks to manage monetary policy. A jurisdiction refers to a country or supranational regions.

Questions may be addressed to the lead researcher, Mark Alberts, at mark@albertsactuary.com or 317-205-9343 or SOA research actuary, Ronora Stryker at rstryker@soa.org or 847-706-3614.

We look forward to your response and thank you in advance for your consideration to participate in the study.

Section I – Participant Info (Questions 2-6)

Instruction. Q2-Q6 capture information about you as a respondent.

Section I Response Count 261

Q2.

In which of the following jurisdictions are you located? (Choose one. Scroll down to see additional options.)

Jurisdiction Location	Total	Negative
United States	192	N
Canada	47	N
Other Asia	6	N
United Kingdom	3	N
China	2	N
Other Europe	1	N
Africa	0	N
Australia, New Zealand	0	N
Other	0	N
Other North America (Mexico, Central America, Caribbean)	0	N
South America	0	N
Non-negative Sub-total	251	
European Monetary Union	5	Y
Japan	3	Y
Switzerland	2	Y
Denmark	0	Y
Sweden	0	Y
Negative Sub-total	10	
Blank	0	
Total	261	

Q3.

What primary jurisdictions does your work relate to (choose up to 3)? (Scroll down to see additional options. Hold control key to select more than one option.)

Work Jurisdictions	Total	Negative
United States	168	N
Canada	37	N
United States, Canada	6	N
Other Asia	4	N
United States, Canada, United Kingdom	4	N
China	2	N

United States, Other North America (Mexico, Central America, Carribbean)	2	N
United States, Other Asia	2	N
United States, Canada, Other North America (Mexico, Central America, Carribbean)	2	N
Africa	1	N
Other Europe	1	N
United Kingdom	1	N
Other	1	N
United States, United Kingdom	1	N
Canada, Other North America (Mexico, Central America, Carribbean)	1	N
Other Asia, Other	1	N
United States, Canada, South America	1	N
United States, United Kingdom, Other Europe	1	N
United States, Canada, China	1	N
United States, Canada, Australia, New Zealand	1	N
Non-negative Sub-total	238	
European Monetary Union	4	Y
United States, European Monetary Union, United Kingdom	4	Y
Japan	2	Y
United States, Japan	2	Y
United States, Canada, European Monetary Union	2	Y
European Monetary Union, United Kingdom	1	Y
Japan, Other Asia	1	Y
Canada, European Monetary Union, United Kingdom	1	Y
United States, European Monetary Union, Switzerland	1	Y
European Monetary Union, Switzerland, South America	1	Y
United States, European Monetary Union, South America	1	Y
United States, Switzerland, Other Europe	1	Y
United States, Japan, Other Asia	1	Y
United States, United Kingdom, Japan	1	Y
Negative Sub-total	23	
Blanks	0	
Total	261	

Q4.
What type of firm do you work for? (choose one)

Employer Type	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Insurance company	164	4	168
Actuarial consulting firm	49	5	54
Accounting or Business Consulting Firm	7	0	7
Asset manager	8	0	8
Bank	2	0	2
Regulatory agency	9	1	10
Other (describe)	12	0	12
Blanks	0	0	0
Total	251	10	261
Description of "Other":			
research	1	0	1
Investment Consultant	1	0	1
University	1	0	1
Rating agency	1	0	1
Pension Fund	1	0	1
Life insurance brokerage	1	0	1
Association	1	0	1
Retired. Had worked for pension/investment firm.	1	0	1
Work as corporate director (retired)	1	0	1
Pupblic Pension Plan Board Member	1	0	1
Reinsurance Broker	1	0	1
semi-retired	1	0	1

Q5.
What primary lines of business does your work relate to? (check all that apply)

Lines of Business	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Life Insurance	87	1	88
General Insurance/Property & Casualty Insurance	53	1	54
Pension	21	0	21
Life Insurance, Health Insurance	17	0	17
Asset Management	12	1	13
Health Insurance	7	0	7
Life Insurance, Asset Management	7	0	7

Life Insurance, Health Insurance, Asset Management	6	1	7
Pension, Asset Management	5	0	5
Life Insurance, General Insurance/Property & Casualty Insurance	3	1	4
Life Insurance, Health Insurance, General Insurance/Property & Casualty Insurance	1	3	4
Life Insurance, Health Insurance, General Insurance/Property & Casualty Insurance, Pension, Asset Management	3	0	3
Life Insurance, Pension, Asset Management	3	0	3
Health Insurance, Pension	1	1	2
Life Insurance, Pension	2	0	2
Pension, Other (describe)	2	0	2
Health Insurance, Pension, Asset Management	1	0	1
Life Insurance, Asset Management, Other (describe)	1	0	1
Life Insurance, General Insurance/Property & Casualty Insurance, Asset Management	1	0	1
Life Insurance, General Insurance/Property & Casualty Insurance, Pension, Other (describe)	1	0	1
Life Insurance, Health Insurance, General Insurance/Property & Casualty Insurance, Asset Management	1	0	1
Life Insurance, Health Insurance, General Insurance/Property & Casualty Insurance, Asset Management, Other (describe)	1	0	1
Life Insurance, Health Insurance, Pension	0	1	1
Life Insurance, Health Insurance, Pension, Asset Management	1	0	1
Life Insurance, Health Insurance, Pension, Asset Management, Other (describe)	1	0	1
Life Insurance, Other (describe)	1	0	1
Life Insurance, Pension, Asset Management, Other (describe)	1	0	1
Pension, Asset Management, Other (describe)	1	0	1
Other (describe)	9	0	9
Blanks	1	0	1
Total	251	10	261
Description of "Other":			
Actuarial evidence	1	0	1
Investment consulting	1	0	1
Teaching	1	0	1
Hedging	1	0	1
Expert Witness—pension & health insurance	1	0	1
OPEB	1	0	1

Morgage Insurance	1	0	1
Insurance Linked Securities	1	0	1
LTC	1	0	1
Annuities?	1	0	1
Bank	1	0	1
Accounting	1	0	1
Annuities	2	0	2
Banking	1	0	1
Corporate Risk Management	1	0	1
Worker's compensation	1	0	1
Financial Risk Management	1	0	1

Q6.

What best describes your role in the firm? (choose one)

Role in Firm	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Liability valuation	65	3	68
Asset/liability risk management	46	1	47
Actuarial modeling	33	4	37
Product development/pricing	36	0	36
Enterprise risk management	25	2	27
Asset management	9	0	9
Capital management	5	0	5
Other—describe	31	0	31
Blanks	1	0	1
Total	251	10	261
Description of "Other":			
client service	1	0	1
reinsurance	1	0	1
Research	1	0	1
Chief Actuary	2	0	2
Insurance industry Consulting and Teaching	1	0	1
Product development/pricing and liability valuation and capital management	1	0	1
Board director	1	0	1
Product Development, Valuation, ERM, ALM	1	0	1
Experience Analysis	1	0	1
experience study	1	0	1
Product and Inforce Management	1	0	1
Recently Retired Chief Actuary	1	0	1

Senior Management	1	0	1
Finance and Administration	1	0	1
all actuarial work	1	0	1
Risk Surveillance	1	0	1
Pension Plan management	1	0	1
Technical actuarial expertise	1	0	1
Actuarial Pricing, Valuation, Modeling and Risk Management	1	0	1
Finance	1	0	1
Asset Liability Management	1	0	1
Oversight of Investment Policy	1	0	1
Accounting policy	1	0	1
Executive management	1	0	1
Owner	1	0	1
Financial forecasting	1	0	1
Many	1	0	1
Experience Studies/Assumptions	1	0	1
semi-retired	1	0	1

Section II – Awareness of negative interest rates (Questions 7-8)

Instruction. Q7-Q8 gather information on awareness of negative interest rates and should be completed based on your current knowledge.

Section II Response Count 261

Q7.

Are you aware of negative policy interest rates in the last 5 years in any of the following jurisdictions? (Check all that apply, or "none" if you are not aware of any. Scroll down to see additional options. Hold control key to select more than one option.)

Negative Policy Rate Responses	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
None	63	3	66
Japan	26	3	29
European Monetary Union	22	1	23
European Monetary Union, Japan	18	0	18
European Monetary Union, Switzerland	11	1	12
European Monetary Union, Denmark, Sweden, Switzerland, Japan	10	0	10
European Monetary Union, Switzerland, Japan	9	1	10
United States	10	0	10
European Monetary Union, Denmark, Sweden, Switzerland	5	0	5

Switzerland, Japan	5	0	5
European Monetary Union, Denmark, Sweden, Switzerland, Other Europe	4	0	4
Denmark, Sweden, Switzerland, Japan	3	0	3
Other Europe	3	0	3
Other Europe, Japan	3	0	3
Switzerland	3	0	3
Switzerland, Other Europe, Japan	3	0	3
United States, European Monetary Union, Japan	3	0	3
European Monetary Union, Denmark, Sweden, Switzerland, Other Europe, Japan	2	0	2
European Monetary Union, Other Europe	2	0	2
European Monetary Union, Sweden, Other Europe	2	0	2
European Monetary Union, Switzerland, Other Europe	2	0	2
United States, Canada	2	0	2
Canada, European Monetary Union	1	0	1
Denmark, Sweden, Japan	1	0	1
Denmark, Sweden, Switzerland	1	0	1
Denmark, Sweden, United Kingdom, Japan	1	0	1
European Monetary Union, Denmark	1	0	1
European Monetary Union, Denmark, Sweden	1	0	1
European Monetary Union, Denmark, Sweden, Switzerland, Other Europe, Japan, Other	1	0	1
European Monetary Union, Denmark, Sweden, Switzerland, United Kingdom, Other Europe	1	0	1
European Monetary Union, Denmark, Sweden, Switzerland, United Kingdom, Other Europe, Japan	1	0	1
European Monetary Union, Denmark, Switzerland, Japan	1	0	1
European Monetary Union, Denmark, Switzerland, United Kingdom	1	0	1
European Monetary Union, Denmark, United Kingdom	1	0	1
European Monetary Union, Sweden, Switzerland	1	0	1
European Monetary Union, Sweden, Switzerland, Japan	1	0	1
European Monetary Union, Switzerland, Other Europe, Japan	1	0	1
European Monetary Union, United Kingdom	1	0	1
European Monetary Union, United Kingdom, Japan	1	0	1
Other Asia	1	0	1
Other Europe, Japan, Other Asia	1	0	1
Other North America (Mexico, Central, America, Carriibbean)	1	0	1
Sweden, Japan	1	0	1
Sweden, Switzerland	0	1	1

Switzerland, Other Europe	1	0	1
United Kingdom	1	0	1
United Kingdom, Other Europe	1	0	1
Blanks	16	0	16
Total	251	10	261

Q8.

Are you aware of negative market yields on government bonds (5 year maturity or longer) in the last 5 years in any of the following jurisdictions? (Check all that apply, or "none" if you are not aware of any. Scroll down to see additional options. Hold control key to select more than one option.)

Negative 10-Yr Government Bond Rate Responses	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
None	64	1	65
European Monetary Union	30	2	32
United States	29	0	29
Japan	18	3	21
European Monetary Union, Japan	12	0	12
Switzerland	7	1	8
European Monetary Union, Switzerland	6	0	6
European Monetary Union, Switzerland, Japan	5	1	6
European Monetary Union, Denmark, Sweden, Switzerland	5	0	5
Other Europe	5	0	5
Switzerland, Japan	5	0	5
European Monetary Union, Other Europe	4	0	4
Other Europe, Japan	4	0	4
Switzerland, Other Europe, Japan	4	0	4
United States, European Monetary Union, Japan	4	0	4
European Monetary Union, Denmark, Sweden, Switzerland, Japan	3	0	3
Switzerland, Other Europe	3	0	3
United States, Japan	3	0	3
Canada	2	0	2
European Monetary Union, Denmark	2	0	2
European Monetary Union, Denmark, Sweden, Switzerland, Other Europe	2	0	2
European Monetary Union, Denmark, Sweden, Switzerland, Other Europe, Japan	2	0	2
European Monetary Union, Sweden, Other Europe	2	0	2
United States, Switzerland, Other Europe, Japan	2	0	2
Denmark, Japan, Other	1	0	1

Denmark, Sweden, Switzerland	1	0	1
Denmark, Sweden, Switzerland, Japan	1	0	1
Denmark, Sweden, Switzerland, Other Europe, Japan	1	0	1
Denmark, Sweden, Switzerland, United Kingdom, Other Europe, Japan	1	0	1
Denmark, Sweden, United Kingdom, Japan	1	0	1
Denmark, Switzerland, Japan, Other	1	0	1
European Monetary Union, Denmark, Sweden	1	0	1
European Monetary Union, Denmark, Switzerland, Other Europe	1	0	1
European Monetary Union, Sweden, Switzerland	1	0	1
European Monetary Union, Sweden, Switzerland, Other Europe	1	0	1
European Monetary Union, Sweden, Switzerland, Other Europe, Japan	1	0	1
European Monetary Union, Switzerland, United Kingdom	0	1	1
European Monetary Union, United Kingdom	1	0	1
European Monetary Union, United Kingdom, Japan	1	0	1
European Monetary Union, United Kingdom, Other Europe, Japan	1	0	1
Japan, Other	1	0	1
Other North America (Mexico, Central America, Carribbean)	1	0	1
United Kingdom	1	0	1
United States, Canada	1	0	1
United States, Canada, Other North America (Mexico, Central America, Carribbean), European Monetary Union, Denmark	0	1	1
United States, European Monetary Union	1	0	1
United States, European Monetary Union, Denmark, Sweden, Japan	1	0	1
United States, European Monetary Union, Denmark, Sweden, Switzerland, Japan	1	0	1
United States, European Monetary Union, Denmark, Sweden, Switzerland, United Kingdom, Other Europe	1	0	1
United States, European Monetary Union, Denmark, Sweden, Switzerland, United Kingdom, Other Europe, Japan	1	0	1
United States, European Monetary Union, Other Europe	1	0	1
United States, European Monetary Union, Switzerland, Japan	1	0	1
United States, Switzerland, Other Europe	1	0	1
Blanks	1	0	1
Total	251	10	261

Section III - Questions 9-12

Instruction. Q9-Q12 gather opinions on the likelihood that negative interest rate policies will be used in the future to address various economic issues, and their effectiveness if used. Unless noted, responses should reflect your personal viewpoint and should be general with respect to jurisdiction.

Section III Response Count 201

Q9.

Which of these issues do you believe negative interest rates can effectively mitigate if used as a policy tool? (check all that apply)

Negative Rate Effectiveness for Economic Issues	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Other—describe	21	2	23
Economic growth below target	20	2	22
Currency inflation above target	19	1	20
Economic growth below target, Price inflation below target	18	0	18
Price inflation below target	17	0	17
Economic growth below target, Price inflation below target, Unemployment rates above target, Currency inflation above target	10	0	10
Economic growth below target, Currency inflation above target	8	1	9
Economic growth below target, Price inflation below target, Unemployment rates above target	8	0	8
Economic growth below target, Unemployment rates above target	8	0	8
Economic growth below target, Unemployment rates above target, Currency inflation above target	8	0	8
Price inflation below target, Currency inflation above target	6	0	6
Economic growth below target, Other—describe	3	0	3
Economic growth below target, Price inflation below target, Currency inflation above target	3	0	3
Other—describe, Other—describe	3	0	3
Unemployment rates above target	3	0	3
Economic growth below target, Price inflation below target, Other—describe	1	0	1
Economic growth below target, Price inflation below target, Unemployment rates above target, Currency inflation above target, Other—describe	1	0	1
Economic growth below target, Price inflation below target, Unemployment rates above target, Other—describe, Other—describe	1	0	1

Price inflation below target, Other—describe	1	0	1
Price inflation below target, Unemployment rates above target	0	1	1
Price inflation below target, Unemployment rates above target, Currency inflation above target	1	0	1
Unemployment rates above target, Currency inflation above target	1	0	1
Unemployment rates above target, Other—describe	1	0	1
Blanks	31	1	32
Total	193	8	201
Description of "Other":			
Artificially disrupts the economy. Does not mitigate a damn thing.	1	0	1
Company infrastructure/productivity under-investment	1	0	1
it is not effective	1	0	1
ultimately, none of these	1	0	1
inflates asset prices (equities, property)	1	0	1
Nothing - it will solve nothing	1	0	1
None effectively.	1	0	1
Not all of the above at once	1	0	1
Excess savings rates	1	0	1
Government deficit spending, bonds mature for less than collected.	1	0	1
I do not believe negative interest rates can effectively mitigate any of the above.	1	0	1
None - it is not a viable policy tool	0	1	1
Cannot mitigate demographic	1	0	1
None- they don't stimulate demand	1	0	1
Inability of Governments to support sovereign debt	1	0	1
I believe inefficiencies are created any time interest rates are artificially set for policy purposes	1	0	1
None of the issues can be effectively mitigated by negative interest rates	1	0	1
Reduce saving and incentivize spending	1	0	1
nothing	1	0	1
none of the above long term	1	0	1
None of the above; negative rates will prove deflationary	1	0	1
Risk assets depressed	1	0	1
None. It's a farce used to keep the ponzi debt scheme alive	1	0	1
none effectively as seen in EMU	0	1	1
Debt burden (public / private)	1	0	1
Monetary supply. Other effects are indirect.	1	0	1

Q10.

On a scale of 1 to 5 where 1= very unlikely, 5= very likely, please rate the likelihood that central bankers in SOME JURISDICTION would use negative interest rate policies in the future to respond to each of the following economic issues.

Likelihood of SOME central bank using negative rates for each issue	Very Unlikely 1	2	3	4	Very likely 5	No Opinion	Blanks	Total
Participants Located in Non-negative Rate Jurisdictions								
Economic growth below target	14	23	21	55	60	16	4	193
Price inflation below target	21	39	30	36	41	18	8	193
Unemployment rates above target	26	34	35	34	33	23	8	193
Currency inflation above target	27	30	30	33	34	31	8	193
Other - describe	0	0	2	1	2	18	170	193
Other - describe	0	1	0	0	0	16	176	193
Participants Located in Negative Rate Jurisdictions								
Economic growth below target	1	3	1	0	3	0	0	8
Price inflation below target	2	1	1	2	0	1	1	8
Unemployment rates above target	2	1	1	0	2	1	1	8
Currency inflation above target	1	2	0	2	1	1	1	8
Other - describe	0	0	0	1	0	2	5	8
Other - describe	0	0	0	0	0	2	6	8
All Participants								
Economic growth below target	15	26	22	55	63	16	4	201
Price inflation below target	23	40	31	38	41	19	9	201
Unemployment rates above target	28	35	36	34	35	24	9	201
Currency inflation above target	28	32	30	35	35	32	9	201
Other - describe	0	0	2	2	2	20	175	201
Other - describe	0	1	0	0	0	18	182	201
Description of "Other":								
Excess savings rates			1					1
stressed stock markets			1					1
deflation				1				1
Risk assets depressed					1			1
hidden agenda: financing of governments				1				1
Debt burden					1			1
Too much savings		1						1

Q11.

On a scale of 1 to 5 where 1= very unlikely, 5= very likely, please rate the likelihood that central bankers in YOUR PRIMARY JURISDICTION would use negative interest rate policies in the future to respond to each of the following economic issues.

Likelihood of SOME central bank using negative rates for each issue	Very Unlikely 1	2	3	4	Very likely 5	No Opinion		Total
Participants Located in Non-negative Rate Jurisdictions								
Economic growth below target	71	46	21	23	21	8	3	193
Price inflation below target	83	46	20	10	21	8	5	193
Unemployment rates above target	80	46	28	8	14	12	5	193
Currency inflation above target	90	37	14	12	13	22	5	193
Other - describe	1	0	1	0	1	17	173	193
Other - describe	0	1	0	0	0	15	177	193
Participants Located in Negative Rate Jurisdictions								
Economic growth below target	1	2	0	2	3	0	0	8
Price inflation below target	1	0	2	2	1	1	1	8
Unemployment rates above target	1	2	1	0	2	1	1	8
Currency inflation above target	2	0	1	1	2	1	1	8
Other - describe	0	0	0	1	0	1	6	8
Other - describe	0	0	0	0	0	2	6	8
All Participants								
Economic growth below target	72	48	21	25	24	8	3	201
Price inflation below target	84	46	22	12	22	9	6	201
Unemployment rates above target	81	48	29	8	16	13	6	201
Currency inflation above target	92	37	15	13	15	23	6	201
Other - describe	1	0	1	1	1	18	179	201
Other - describe	0	1	0	0	0	17	183	201
Description of "Other":								
help banks increase earnings spread on loans vs deposits			1					1
Risk assets depressed					1			1
hidden agenda: financing of governments				1				1
Debt burden	1							1
Too much savings		1						1

Q12.

Do you think the experience in jurisdictions that have used negative interest rates make it more or less likely that central bankers will use negative interest rate policies in the future? (choose one)

Change in Likelihood of Negative Rates, Given Experience	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
More likely	76	2	78
Less Likely	53	3	56
Equally likely	31	2	33
No opinion, don't know	33	1	34
Blanks	0	0	0
Total	193	8	201

Section IV - Questions 13-20

Instruction. Q13-Q20 gather opinions on consequences and risks of negative interest rate policies. Unless noted, responses should reflect your personal viewpoint and should be general with respect to jurisdiction.

Section IV Response Count188

Q13.

Which of the following do you believe are the most likely unintended consequence of negative interest rate policies? Select your top choices and rank them 1-3 in the boxes below.

Ranking of Unintended Consequences	Rank			
	1	2	3	1-3
Participants Located in Non-negative Rate Jurisdictions				
Excessive risk-taking, asset bubbles as investors search for yield	51	36	22	109
Increase in inequality as savers are penalized and borrowers are rewarded	24	26	34	84
Loss of confidence, central bank credibility	20	17	24	61
Disincentive to correct fiscal imbalances or implement fiscal/structural reforms to foster long-term growth.	10	22	28	60
Adverse impact on financial sector - Reduced profitability, increased solvency risk, contraction of sector	20	25	12	57
Misallocation of economic resources due to market distortions	9	19	19	47
Increased arbitrage opportunities due to market distortions	14	9	16	39
Increased risk of inflation above target	17	6	11	34
Increase in credit spreads	8	13	4	25
Other unintended consequence - describe in this space	2	3	4	9
Other unintended consequence - describe in this space	0	0	2	2
None of the above	1	0	0	1
Participants Located in Negative Rate Jurisdictions				

Adverse impact on financial sector - Reduced profitability, increased solvency risk, contraction of sector	3	2	1	6
Excessive risk-taking, asset bubbles as investors search for yield	1	1	1	3
Loss of confidence, central bank credibility	1	1	1	3
Misallocation of economic resources due to market distortions	0	1	2	3
Increase in credit spreads	1	1	0	2
Increased arbitrage opportunities due to market distortions	0	0	2	2
Disincentive to correct fiscal imbalances or implement fiscal/structural reforms to foster long-term growth.	1	1	0	2
Increased risk of inflation above target	0	0	0	0
Increase in inequality as savers are penalized and borrowers are rewarded	0	0	0	0
Other unintended consequence - describe in this space	0	0	0	0
Other unintended consequence - describe in this space	0	0	0	0
None of the above	0	0	0	0
All Participants				
Excessive risk-taking, asset bubbles as investors search for yield	52	37	23	112
Increase in inequality as savers are penalized and borrowers are rewarded	24	26	34	84
Loss of confidence, central bank credibility	21	18	25	64
Adverse impact on financial sector - Reduced profitability, increased solvency risk, contraction of sector	23	27	13	63
Disincentive to correct fiscal imbalances or implement fiscal/structural reforms to foster long-term growth.	11	23	28	62
Misallocation of economic resources due to market distortions	9	20	21	50
Increased arbitrage opportunities due to market distortions	14	9	18	41
Increased risk of inflation above target	17	6	11	34
Increase in credit spreads	9	14	4	27
Other unintended consequence - describe in this space	2	3	4	9
Other unintended consequence - describe in this space	0	0	2	2
None of the above	1	0	0	1
Description of "Other":				
What's really the difference between rates falling from 2% to 1% and rates going from 0% to -1%?		1		1
deflation			1	1
Loss of trust in state institutions due to perceived penalizing of savers		1		1
people hoarding cash in home safes			1	1
Misleading valuation of illiquid cashflow instruments, aka life insurance			1	1
balloon in debt	1			1
Deflation		1		1
Preference for liquidity. No incentives to invest	1			1
fewer retirements			1	1
same as above [What's really the difference between rates falling from 2% to 1% and rates going from 0% to -1%?]			1	1
Cash hoarding/sales of safes/ gun sales			1	1

Q14.

What impact would you expect negative interest rate policies to have on the shape of the yield curve? (choose one)

Expected yield curve impact of negative rates	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Flattening	52	4	56
Steepening	84	2	86
No change	8	0	8
Don't know	37	1	38
Blanks	0	0	0
Total	181	7	188

Q15.

What impact would you expect negative interest rate policies to have on the market spread of non-government fixed income instruments? (choose one)

Expected spread impact of negative rates	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Decrease to spreads	50	4	54
Increase to spreads	76	2	78
No change	19	0	19
Don't know	36	1	37
Blanks	0	0	0
Total	181	7	188

Q16.

What do you see as the balance between benefits and risks of negative interest rate policy for the economy and financial system as a whole? (choose one)

Risk/benefit tradeoff to financial system	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Risks much greater than benefits	93	3	96
Risks moderately greater than benefits	57	3	60
Benefit and risk evenly balanced	20	0	20
Benefits moderately greater than risks	6	1	7
Benefits much greater than risk	2	0	2
[blank]	3	0	3
Total	181	7	188

Q17.

What do you see as the balance between benefits and risks of negative interest rate policy for your firm or clients? (choose one)

Risk/benefit tradeoff to own firm	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Risks much greater than benefits	113	4	117
Risks moderately greater than benefits	40	2	42
Benefit and risk evenly balanced	17	1	18
Benefits moderately greater than risks	3	0	3
Benefits much greater than risk	1	0	1
[blank]	7	0	7
Total	181	7	188

Q18.

Which interest rate pattern over the next 5 years poses a greater risk to your firm or clients if it occurs? (choose one)

Risk/benefit tradeoff to own firm	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Interest rates declining to, or remaining at, negative levels	110	6	116
Rapid increase in interest rates	47	1	48
The risks are comparable	14	0	14
Don't know	8	0	8
[blank]	2	0	2
Total	181	7	188

Q19.

Which interest rate pattern do you consider more likely over the next 5 years?(choose one)

Risk/benefit tradeoff to own firm	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Interest rates declining to, or remaining at, negative levels	41	3	44
Rapid increase in interest rates	62	1	63
The likelihood is comparable	45	3	48
Don't know	32	0	32

[blank]	1	0	1
Total	181	7	188

Q20.

Which product types would you expect to be most adversely affected by negative interest rates, in terms of risk and resulting management effort? (choose up to three. Scroll down to see additional options. Hold control key to select more than one option.)

	Jurisdiction Where Located		
	Negative Rate	Non-negative Rate	Total
Life insurance - non-participating, permanent, guaranteed, Annuity - payout, Annuity - accumulation/deferred, general account	20	0	20
Annuity - payout	13	0	13
Annuity - accumulation/deferred, general account	12	0	12
Life Insurance - term	10	1	11
Life insurance - non-participating, permanent, guaranteed	8	0	8
Annuity - payout, Annuity - accumulation/deferred, general account, Annuity - accumulation/deferred, variable or unit-linked	7	0	7
Life insurance - participating, Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, general account	5	1	6
Life insurance - participating, Annuity - payout, Annuity - accumulation/deferred, general account	5	0	5
Life insurance - variable or unit-linked	5	0	5
Life insurance - non-participating, permanent, guaranteed, Life insurance - non-participating, permanent, non-guaranteed, Annuity - accumulation/deferred, general account	4	0	4
Life insurance - variable or unit-linked, Annuity - accumulation/deferred, general account, Annuity - accumulation/deferred, variable or unit-linked	4	0	4
Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, general account	3	0	3
Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, general account, Health insurance - other	3	0	3
Life insurance - non-participating, permanent, guaranteed, Annuity - payout	3	0	3
Life insurance - non-participating, permanent, guaranteed, Life insurance - non-participating, permanent, non-guaranteed, Annuity - payout	3	0	3
Life insurance - participating	2	1	3
Life insurance - participating, Life insurance - variable or unit-linked, Annuity - accumulation/deferred, general account	3	0	3

Life insurance - participating, Life insurance - variable or unit-linked, Life insurance - non-participating, permanent, guaranteed	3	0	3
Life Insurance - term, Annuity - payout, Annuity - accumulation/deferred, general account	3	0	3
Life Insurance - term, Life insurance - non-participating, permanent, guaranteed, Annuity - payout	3	0	3
Life insurance - variable or unit-linked, Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, variable or unit-linked	3	0	3
Annuity - accumulation/deferred, variable or unit-linked	2	0	2
General Insurance - liability	2	0	2
Health insurance - supplemental medical	2	0	2
Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, general account, Annuity - accumulation/deferred, variable or unit-linked	2	0	2
Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, general account, Health insurance - disability	2	0	2
Life insurance - non-participating, permanent, guaranteed, Annuity - payout, Health insurance - other	2	0	2
Life insurance - participating, Annuity - accumulation/deferred, general account	2	0	2
Life insurance - participating, Annuity - accumulation/deferred, general account, Annuity - accumulation/deferred, variable or unit-linked	2	0	2
Life insurance - participating, Life insurance - non-participating, permanent, guaranteed	2	0	2
Life insurance - participating, Life insurance - non-participating, permanent, guaranteed, Life insurance - non-participating, permanent, non-guaranteed	2	0	2
Life Insurance - term, Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, general account	1	1	2
Life Insurance - term, Life insurance - participating, Annuity - payout	2	0	2
Life insurance - variable or unit-linked, Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, general account	2	0	2
Life insurance - variable or unit-linked, Life insurance - non-participating, permanent, guaranteed, Annuity - payout	2	0	2
Annuity - payout, Annuity - accumulation/deferred, general account	1	0	1
Annuity - payout, Annuity - accumulation/deferred, general account, Health insurance - disability	1	0	1
Annuity - payout, Annuity - accumulation/deferred, variable or unit-linked	1	0	1
General Insurance - property	1	0	1
General Insurance - property, General Insurance - liability	1	0	1
Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, general account, General Insurance - liability	1	0	1

Life insurance - non-participating, permanent, guaranteed, Annuity - accumulation/deferred, variable or unit-linked, Health insurance - disability	1	0	1
Life insurance - non-participating, permanent, guaranteed, Annuity - payout, General Insurance - liability	1	0	1
Life insurance - non-participating, permanent, guaranteed, Annuity - payout, Health insurance - disability	1	0	1
Life insurance - non-participating, permanent, guaranteed, Life insurance - non-participating, permanent, non-guaranteed	1	0	1
Life insurance - non-participating, permanent, guaranteed, Life insurance - non-participating, permanent, non-guaranteed, General Insurance - liability	1	0	1
Life insurance - non-participating, permanent, non-guaranteed, Annuity - accumulation/deferred, general account	1	0	1
Life insurance - non-participating, permanent, non-guaranteed, Annuity - accumulation/deferred, general account, Annuity - accumulation/deferred, variable or unit-linked	1	0	1
Life insurance - non-participating, permanent, non-guaranteed, Annuity - accumulation/deferred, general account, Health insurance - disability	1	0	1
Life insurance - non-participating, permanent, non-guaranteed, Annuity - accumulation/deferred, general account, Health insurance - other	1	0	1
Life insurance - non-participating, permanent, non-guaranteed, Annuity - payout, Annuity - accumulation/deferred, general account	1	0	1
Life insurance - non-participating, permanent, non-guaranteed, General Insurance - liability	1	0	1
Life insurance - other, Annuity - payout, Annuity - accumulation/deferred, general account	1	0	1
Life insurance - participating, Annuity - payout	0	1	1
Life insurance - participating, Annuity - payout, General Insurance - liability	1	0	1
Life insurance - participating, General Insurance - liability	1	0	1
Life insurance - participating, General Insurance - property, General Insurance - liability	1	0	1
Life insurance - participating, Life insurance - non-participating, permanent, non-guaranteed, Annuity - accumulation/deferred, general account	1	0	1
Life insurance - participating, Life insurance - variable or unit-linked, Annuity - payout	1	0	1
Life Insurance - term, Annuity - accumulation/deferred, general account	1	0	1
Life Insurance - term, Annuity - payout, General Insurance - liability	1	0	1
Life Insurance - term, General Insurance - property, General Insurance - liability	1	0	1

Life Insurance - term, Life insurance - non-participating, permanent, guaranteed, Life insurance - non-participating, permanent, non-guaranteed	1	0	1
Life Insurance - term, Life insurance - non-participating, permanent, non-guaranteed, Annuity - payout	1	0	1
Life Insurance - term, Life insurance - participating, General Insurance - liability	1	0	1
Life Insurance - term, Life insurance - variable or unit-linked, Life insurance - non-participating, permanent, non-guaranteed	0	1	1
Life insurance - variable or unit-linked, Annuity - payout, Annuity - accumulation/deferred, variable or unit-linked	1	0	1
Life insurance - variable or unit-linked, Health insurance - supplemental medical, Health insurance - disability	1	0	1
Life insurance - variable or unit-linked, Life insurance - non-participating, permanent, guaranteed	1	0	1
Life insurance - variable or unit-linked, Life insurance - non-participating, permanent, guaranteed, Life insurance - non-participating, permanent, non-guaranteed	0	1	1
Total	181	7	188

Section V – Questions 21-22
Section V Response Count 188

Q21.

This question gathers information and modeling capabilities and risk management practices related to negative interest rates, FROM THE PERSPECTIVE OF YOUR FIRM. Responses should reflect your understanding of modeling capabilities and risk management practices of your firm. If your firm is a consulting or advisory firm, responses should reflect the advice you give clients concerning these matters. If any of these questions are not relevant to your work, choose N/A.

(Author’s note: The following three tables summarize responses to this question for all participants, non-consultant participants and consultant participants, respectively.)

All Participants	Yes	No	Don’t Know	N/A	Blanks	Total
Does your asset modeling software support negative interest rates?	71	31	56	26	4	188
Does your liability or asset/liability modeling software support negative interest rates?	83	35	42	24	4	188
Do your deterministic scenario generators allow for negative interest rates?	69	47	39	29	4	188
Do your real-world stochastic scenario generators allow for negative interest rates?	59	51	36	38	4	188

Do your risk-neutral stochastic scenario generators allow for negative interest rates?	52	37	49	46	4	188
Have you ever used scenarios with negative interest rates in your work?	65	86	13	19	5	188
Do you currently use scenarios with negative interest rates in your work?	41	101	18	23	5	188
Do your reinvestment assumptions prevent or limit purchases of assets with negative yields?	46	60	47	31	4	188
Do your scenarios include floors to prevent negative interest rates?	73	57	33	20	5	188
Is the risk of Negative Interest Rates Considered a Key Risk in your company's ERM program?	19	82	46	35	6	188
Does your company's ERM program include management plans in the event of Negative Interest Rates?	23	65	58	38	4	188
Does your company currently hedge against negative interest rates?	10	100	43	31	4	188
Does your company currently hedge against low or decreasing, but not necessarily negative, interest rates?	47	68	38	30	5	188
Does your company currently hedge against high or increasing interest rates?	50	68	35	31	4	188

Non-consultants only	Yes	No	Don't Know	N/A	Blanks	Total
Does your asset modeling software support negative interest rates?	47	18	49	18	4	136
Does your liability or asset/liability modeling software support negative interest rates?	55	23	38	16	4	136
Do your deterministic scenario generators allow for negative interest rates?	47	35	30	20	4	136
Do your real-world stochastic scenario generators allow for negative interest rates?	44	35	30	23	4	136
Do your risk-neutral stochastic scenario generators allow for negative interest rates?	37	23	40	32	4	136

Have you ever used scenarios with negative interest rates in your work?	47	63	11	11	4	136
Do you currently use scenarios with negative interest rates in your work?	29	73	14	15	5	136
Do your reinvestment assumptions prevent or limit purchases of assets with negative yields?	34	44	39	15	4	136
Do your scenarios include floors to prevent negative interest rates?	57	36	26	12	5	136
Is the risk of Negative Interest Rates Considered a Key Risk in your company's ERM program?	14	64	35	17	6	136
Does your company's ERM program include management plans in the event of Negative Interest Rates?	16	52	44	20	4	136
Does your company currently hedge against negative interest rates?	4	79	34	15	4	136
Does your company currently hedge against low or decreasing, but not necessarily negative, interest rates?	38	51	28	14	5	136
Does your company currently hedge against high or increasing interest rates?	38	53	28	13	4	136

Non-consultants only	Yes	No	Don't Know	N/A	Blanks	Total
Does your asset modeling software support negative interest rates?	47	18	49	18	4	136
Does your liability or asset/liability modeling software support negative interest rates?	55	23	38	16	4	136
Do your deterministic scenario generators allow for negative interest rates?	47	35	30	20	4	136
Do your real-world stochastic scenario generators allow for negative interest rates?	44	35	30	23	4	136
Do your risk-neutral stochastic scenario generators allow for negative interest rates?	37	23	40	32	4	136
Have you ever used scenarios with negative interest rates in your work?	47	63	11	11	4	136

Do you currently use scenarios with negative interest rates in your work?	29	73	14	15	5	136
Do your reinvestment assumptions prevent or limit purchases of assets with negative yields?	34	44	39	15	4	136
Do your scenarios include floors to prevent negative interest rates?	57	36	26	12	5	136
Is the risk of Negative Interest Rates Considered a Key Risk in your company's ERM program?	14	64	35	17	6	136
Does your company's ERM program include management plans in the event of Negative Interest Rates?	16	52	44	20	4	136
Does your company currently hedge against negative interest rates?	4	79	34	15	4	136
Does your company currently hedge against low or decreasing, but not necessarily negative, interest rates?	38	51	28	14	5	136
Does your company currently hedge against high or increasing interest rates?	38	53	28	13	4	136

Q22.

This question gathers information and modeling capabilities and risk management practices related to negative interest rates, FROM THE PERSPECTIVE OF YOUR FIRM'S CLIENTS. Responses should reflect your understanding of modeling capabilities and risk management practices of your firm's clients. If your firm does not advise clients on these matters or these questions are not relevant to your work, choose N/A.

(Author's note: This question was presented only to employees of consulting firms, defined in Q4 as Actuarial Consulting Firm, Accounting or Business Consulting Firm, or Asset Manager)

Consultants only	Most Do 1	Some do/ some don't	Most Do Not	Don't Know	N/A	Blanks	Total
Do your clients' asset modeling software support negative interest rates?	8	4	10	13	16	1	52
Do your clients' liability or asset/liability modeling software support negative interest rates?	10	2	10	13	16	1	52

Do your clients' deterministic scenario generators allow for negative interest rates?	10	2	8	14	17	1	52
Do your clients' real-world stochastic scenario generators allow for negative interest rates?	5	2	8	17	19	1	52
Do your clients' risk-neutral stochastic scenario generators allow for negative interest rates?	6	1	8	16	20	1	52
Have your clients used scenarios with negative interest rates in their work?	7	5	10	14	15	1	52
Do your clients currently use scenarios with negative interest rates in their work?	7	2	11	16	15	1	52
Do your clients' reinvestment assumptions prevent or limit purchases of assets with negative yields?	4	6	7	19	15	1	52
Do your clients' scenarios include floors to prevent negative interest rates?	6	5	6	19	15	1	52
Is the risk of Negative Interest Rates Considered a Key Risk in your clients' ERM programs?	4	3	9	17	18	1	52
Do your clients' ERM programs include management plans in the event of Negative Interest Rates?	4	3	9	17	17	2	52
Do your clients currently hedge against negative interest rates?	4	7	9	17	14	1	52
Do your clients currently hedge against high or increasing interest rates?	9	9	5	14	14	1	52
Do your clients currently hedge against high or increasing interest rates?	9	9	5	14	14	1	52

Comments?

Do you have any comments or suggestions for this research study of negative interest rates?

(Author's note: 22 participants included comments—20 located in Non-negative Rate Jurisdictions and 2 located in Negative Rate Jurisdictions. These comments are presented in their entirety)

Comments from participants located in Non-negative Jurisdictions

As a property/casualty actuary I haven't heard much about significant swings in interest rates - either positive or negative.
The study should include a review of the impact of negative interest rates in those jurisdictions that have used them long term (e.g. Japan) or following the 2008/09 economic crisis (various European central banks).
The inevitable situation. I suspect that a situation where longer term negative rates might be considered will cause a large structural breakdown and a flight from central banks. Derivatives, including the hedging, will be empty promises.
Hopefully, it does not come to that.
Negative interest rates are a bad idea. They are nonsensical and could have many unintended consequences.
Hopefully central banks will not employ them in the future.
See recent paper released by the San Francisco Fed regarding negative interest rates and the recovery after the Global Financial Crisis.
How negative can rates go before people find a way around paying others to hold on to their cash?
Interesting survey - where do you assume LTC fits in the product mix (since it's not listed)? Surveys like this get people thinking about the risk even if they haven't before - this may be the greatest benefit of the report!
In my opinion, negative interest are not a naturally occurring phenomenon of the market, but rather are artificial products that result from government and central bank policies. They have happened in Japan as a result of misguided government interference in the financial markets, and the results have not been good. I think it is unlikely to happen in the United States or the Anglosphere because these countries still retain a large degree of market discipline despite constant meddling by the Federal Reserve and other central banks. However, I think it could happen in Europe because recent history has shown a strong tendency toward central-government control. Despite bad results in Europe, left-leaning politicians show an amazing ability to not learn the lessons of the past and just might think this is a good way to rescue Europe from 50 years of bad government intervention. Negative interest rates are not a market risk, but rather a political risk. They should not be considered in setting reserves in the United States, but may need to be considered as part of C4 capital in RBC.
Please avoid contaminating the study with the narrow interests of guarantee writers without considering the greater macro effects.
The section around how you allow for negative interest rates in company/client models/scenarios could be expanded as the answers may not give the full picture.
In the pension consulting business most ALM models are based on one distribution. So the long term interest rate is set to -say 3%, and the model produces a distribution of scenarios around 3%. In theory these models do allow for negative interest rates - in that the tails of the distribution may produce rates that go below zero. Due to the nature of the modelling - the negative rates are temporary - for one or two years at most before the model reverts towards to the mean.
However, what the models are not good at allowing for is the 'Japan' scenarios where interest rates stay negative and low for a number of years. Given experience since 2008, (and Japan since 1990), it seems that low interest rate environments can be 'sticky'. It is likely that even though low interest rates are modelled (and no doubt many participants will answer yes), most models underestimate the impact of negative interest rate environments, as experience shows they tend to be low and stable, whereas in most models they are temporary and result in quicker reversions to higher rates.

<p>My concern is that the probability of low interest rate environments may be appropriately modelled - however most models are insufficient to deal with the impact of low interest rate environments (i.e they tend to be multi-year). I therefore suspect that certainly in the DB Pension world - negative interest rates scenarios are mispriced by most consultants and plans.</p> <p>I think this nuance in reality is difficult to approach in a survey, but I hope will help add some context in the interpretation of the results.</p>
<p>Interesting topic. To my knowledge there have been very few negative interest rates with regard to US treasuries. That said it's my understanding that in Germany and Japan in particular have had negative interest rates for various durations of their government bonds with seemingly very little negative effects.</p>
<p>This survey was too long</p>
<p>Aren't negative interest rates more of a symptom of a larger problem (the economy cratering) than the problem itself? Alternatively how do you split the effects of a negative interest rate policy or environment from the effects of the cratered economy that caused such a policy or environment?</p>
<p>I understand the governmental/public sector uses of a negative interest rate policy but struggle with the implications in the private sector.</p>
<p>Rates could be heading lower again, or not increasing (for those already negative). But actuaries should already be doing something about negative rates as USA was very close and Europe went negative. Can't depend on Central bankers, especially where influenced by politicians</p>
<p>Are they effective? To do what? Did they increase corporate investment? I think they are pushing on a string.</p>
<p>I think it is a bit late. The horse has already left the barn.</p>
<p>Negative Interest Rates are possible for Governments, though extremely unlikely for Corporate assets. There seems to be a very academic concern that models allow negative interest rates, when in fact, the likelihood of any extended period of negative interest rates is extremely low.</p> <p>One thing I think the survey might consider is temporary negative interest rates instead of focusing solely on negative interest rates as if they are permanent. It is much more possible for a temporary dip into negative territory under some extreme economic conditions than it is for a longer-term dip into negative territory. It is much more immediate if models don't run because the end of quarter yield curved dipped negative. That is a much more realistic possibility than a longer-term issue.</p>
<p>There needs to be more focus on the positive correlation between rates and risk assets (equities) in the real world and risk neutral generators(vm21 assumes 0 correlation is acceptable). Also co-calubration and that these markets are not continuous (the esg proscribed and used do not have discontinuities). The actuarial profession is behind the rest of finance and underestimating. The risks.</p> <p>Also the real world calibrations are not realistic at all with respect to the cost of risk. Market consistent approaches as in Europe etc need to be adopted. At least fasb targeted improvements gets there for some products. The recent variable annuity reform is a temporary bandaid that only partially addresses issues and wa as watered down significantly.</p>
<p>Research is being done jointly by SoA and CIA on low interest rates. There may be some findings in both pieces of work that would be of interest to the other. Steve Siegel is invovled in low interest rate research.</p>

Comments from participants located in Negative Jurisdictions

The negative interest rate phenomenon has been seen in Switzerland for a long time. Researchers may want to explore the experience of Switzerland's Central Bank and FINMA if they have not already done so.

Influence of cash on a floor for negative rates: How likely is it, that cash will be removed or other ways are found to have the possibility to set stronger negative interest rates?

At some questions I could not clearly make a difference between the effect from negative interest rates and those from quantitative easing. I think government debt is a main Driver for low / negative yields in the EMU.

Appendix B: Glossary of Terms and Abbreviations

ECB—European Central Bank

Fed—US Federal Reserve Bank

Jurisdiction—country or supranational region served by a single central bank

Lower bound—theoretical floor beyond which policy interest rate cuts are no longer effective—i.e., cease to be expansionary

Negative interest rate (NIR)—nominal interest rate below zero.

Negative Interest Rate Jurisdiction/Negative Rate Jurisdiction—a jurisdiction that has experienced negative interest rates since 2012

Negative Interest Rate Policy (NIRP)—monetary policy under which a central bank has set one or more policy interest rates at negative levels

NNR resident—within the context of the negative interest rate survey, a survey participant who resides in a Non-negative Rate Jurisdiction

Non-negative Interest Rate Jurisdiction/Non-negative Rate Jurisdiction—a jurisdiction that has not experienced negative interest rates since 2012

NR resident—within the context of the negative interest rate survey, a survey participant who resides in a Negative Rate Jurisdiction

Policy interest rate—interest rate set by a central bank in its exercise of monetary policy, including interest rates on deposits at the central bank

Transmission channel—the pathway by which a policy action may be transmitted to the real economy

Zero Lower Bound (ZLB)—theoretical floor whereby policy interest rate cuts below zero are considered to be ineffective

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