THE INFLUENCE OF NEGATIVE INTEREST RATE POLICY ON BANKS' PROFITABILITY

by

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Kyiv School of Economics

Abstract

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«You can read Adam Smith, you can read [John Maynard] Keynes, you can read anybody and you can't find a word to my knowledge on prolonged zero interest rates – that is a phenomenon nobody dreamed would ever happen» – Warren Buffett told in an interview a year ago. His words reflect the reality of current monetary policy in which central banks go into uncharted territory by using negative interest rates. Today, if you randomly buy developed country bond, there is 1 in 3 chance that you will lose your money if you hold it to maturity, meaning investors are paying to lend to those governments. Three years of negative interest rates environment created unprecedented challenges for the financial system and banking industry in particular. Using a quarterly data of 500 banks from 33 OECD countries for the period from 2009 to 2016 we found that implementation of negative interest policy led to a relative decrease in profitability, measured by return on assets, by 12-15 bp. This change is both statistically and economically significant, which gives us the basis to discuss the effectiveness of monetary policy conducted by the central banks.

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GLOSSARY

ZIRP – zero interest rate policy

NIRP – negative interest rate policy

ECB – European Central Bank

DNB – Denmarks Nationalbank

BOJ – Bank of Japan

SNB – Swiss National Bank

Fed – Federal Reserve System

NIM – net interest margin

ROA – return on assets

Chapter 1

INTRODUCTION

Since 2008, we observe a steep decline in the interest rates worldwide. This was the first response to the shock of the global financial crisis 2008-2009 caused by subprime mortgage crisis in the US. The central banks around the world took steps to increase money supply through open market operations and lower discount rates, at which the commercial banks could borrow money to meet reserve requirements and increase lending.

However, when short-term interest rates reach ultra-low territory, this traditional expansionary monetary policy no longer works. Therefore, the next step was a wide implementation of the expansionary monetary policy represented by quantitative easing. This policy implies large-scale purchases of financial assets from the commercial banks in order to increase money supply while decreasing long-term yields.

Unfortunately, these market interventions did not provide the intended results. The economic growth remained low, as commercial banks were cautious to provide loans to general population. In addition to this, European debt crisis started to show up in early 2010. In order to combat these problems, the most controversial and least predictable monetary policy was implemented – negative interest rate policy (NIRP), that implies setting nominal target interest rates below zero percent bound.

In order to understand the unusual level of current interest rates, we should look at historical trends. Homer and Sylla in the book «A History of Interest Rates»

managed to combine data from different sources since 3000 BC (Figure 1). As the result, we can state with the confidence that interest rates did not cross zero bound during previous five millenniums. In the period 1900-2000 the average level of interest rates was roughly 4%, compared to 2% so far in this century.

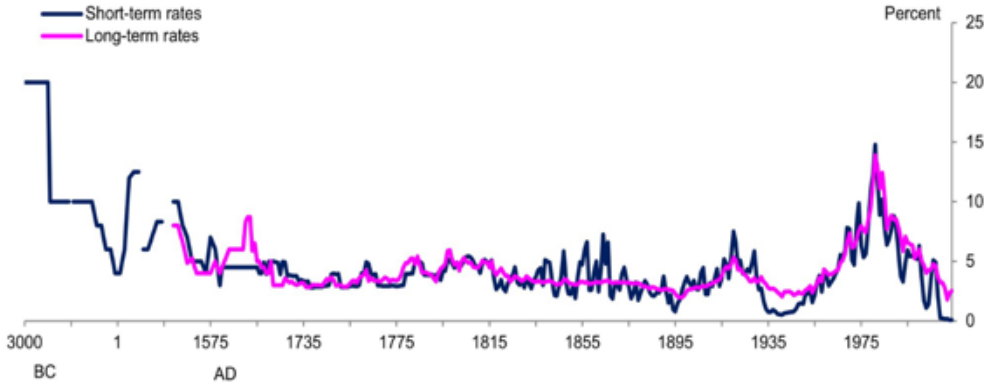

Figure 1. Historical Short- and Long-Term Interest Rates[1]
Source: Bank of England, Global Financial Data, Homer and Sylla

The history shows that real negative interest rates, calculated as a difference between nominal interest rates and inflation, were widely observed before. The most notable example is the US, which experienced high inflation and accommodative monetary policy in 1974-77 following the stock market crash caused by OPEC oil price shock. In the UK, short-term interest rates were also in negative territory during this period as country was affected by the secondary banking crisis of 1973–75 (Barro, Sala-i-Martin 1990).

For a long time, economists around the world thought that the nominal interest rate could not go into the negative territory because households and companies might rush to convert their deposits into cash in order to avoid loss of value.

[1] www.bankofengland.co.uk/publications/Pages/speeches/default.aspx

As the result, five central banks introduced the policy negative nominal rates for commercial banks funds held on deposits at the central bank: the European Central Bank, the National Bank of Denmark, the Swiss National Bank, the Bank of Sweden and the Bank of Japan. This means that commercial banks now should pay a small fee to hold their excess reserves at central banks. The main objective of these decisions is to promote bank lending, which stimulates economic growth, and fights against low inflation and the increasing threat of deflation. Negative interest rates encourage banks to lend more money to households and companies, rather than hold it at the central bank. In this way, business can invest more, using even lower rates.

Sweden was the first country that implemented negative interest rates (Figure 2). On the 8th of July 2009, the central bank lowered deposit (an overnight rate of interest banks receive when they deposit their funds at the Riksbank) rate from 0% to -0.25%. However, negative rates for the main policy rate – repo rate (a seven-day rate at which banks can borrow or deposit funds at the Riksbank) – was only introduced in late February 2015. Therefore, some argue that Denmark was effectively the first country to apply negative rates to commercial banks in 2012. From April to September 2014 the DNB temporarily discontinued the NIRP as economic prospects improved.

The last country that introduced NIRP was Japan in February 2016. The central bank established target rate for uncollateralized overnight call rate applied to the policy-rate balance held at the BoJ from 0 to -0.1%, while keeping the main policy rate in positive territory. Detailed data for current rates and date of NIRP introduction can be found in the Appendix A, Table 6.

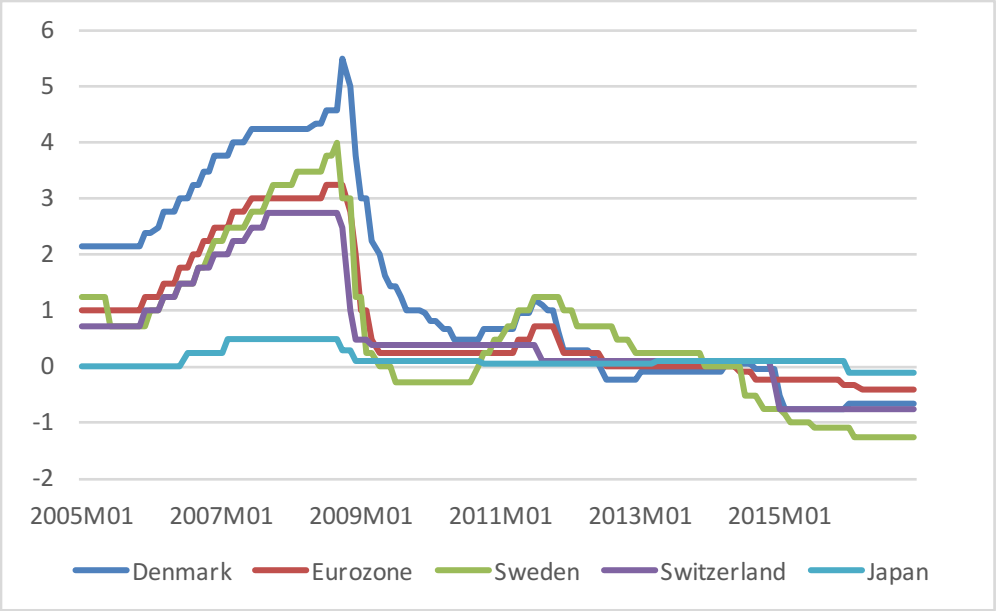

Figure 2. Central bank's policy interest rates from January 2005 to December 2016, %
Source: National central banks

In Denmark and Switzerland, the introduction of NIRP was driven by the desire to prevent high capital inflows into the country in order to decrease currency appreciation impact. On the other hand, Sweden and the ECB introduced NIRP to combat slow growth after the severe recession and prolonged period of inflation below 2% target level.

Until January 2012, banks within common euro area had to hold a minimum of 2% of their deposit liabilities at the ECB in for of required reserves. Since then, this threshold has been lowered to 1%. The total reserve requirements for Eurozone banks reached 120 billion euro in March 2017 (Figure 3). Despite the implementation of negative interest rates the total value of excess reserves reached 840 billion euro. The main reason for this additional liquidity is caused by quantitative easing. According to this program, the ECB purchased the large amount of ABS and MBS in order to support banking system.

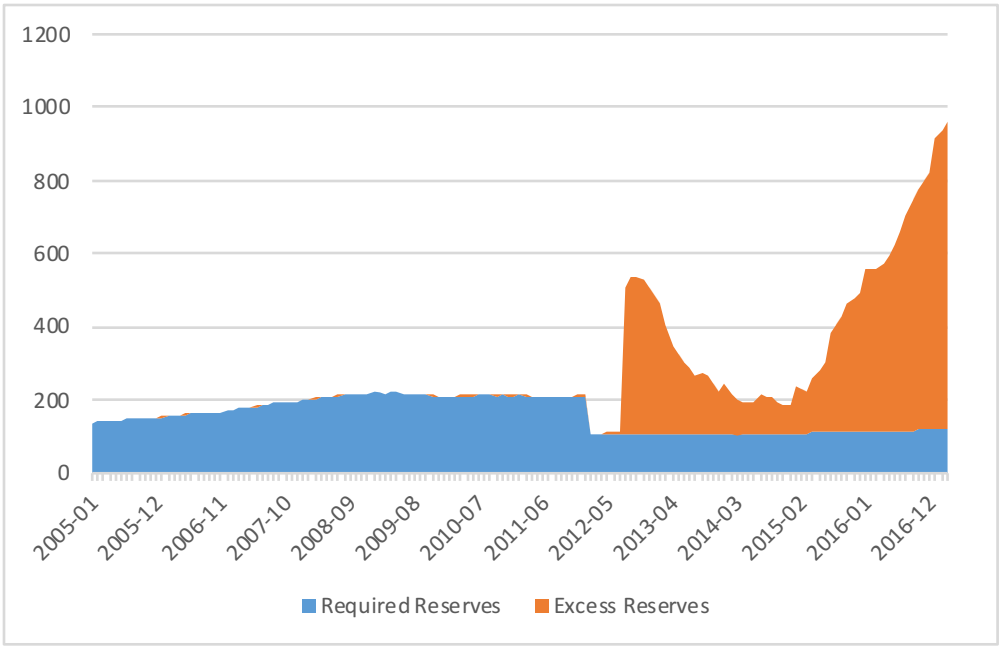

Figure 3. Total required and excess reserves held by depository institutions at the ECB, billions euro
Source: ECB[2]

In the United States the scale of central bank's policy was even more pronounced. At its peak in 2013 the monthly amount of bonds' purchasing reached $85 billion (compared to 60 billion euro in Eurozone). The majority of this liquidity went back to the Federal Reserve in the form of excess reserves (Figure 4). In August 2014 the total value of excess reserves was 31 times higher than required reserves. However, unlike the Eurozone, the US banks' holdings were not restricted by negative rates. Therefore, they put aside substantially higher amount of assets than their European counterparts.

[2] https://www.ecb.europa.eu/mopo/implement/mr/html/index.en.html

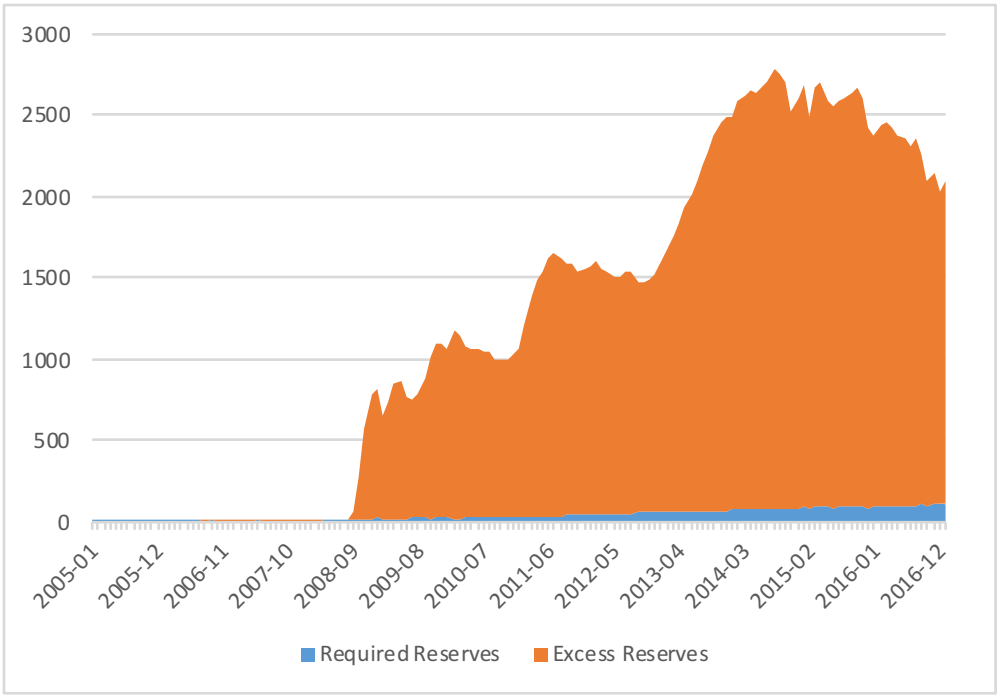

Figure 4. Total required and excess reserves held by depository institutions at the Fed, billions USD
Source: Federal Reserve Economic Data[3]

Today, many developed bond markets in the world are within the scope of the nominal negative interest rates. According to Tradeweb data, there were $9 trillion outstanding bonds with sub-zero yields at the end of 2016 despite tighter monetary policy in the US[4]. This phenomenon spreads not only to short-term rates but also to medium- and long-term yields on bonds with maturity up to 10 years, meaning investors are paying to lend to those governments (Figure 5). Almost 48% of bonds with negative rates originated in Japan and 12% in France and Germany.

[3] https://fred.stlouisfed.org/series/EXCSRESNS

[4] https://www.ft.com/content/9253b220-bb03-11e6-8b45-b8b81dd5d080

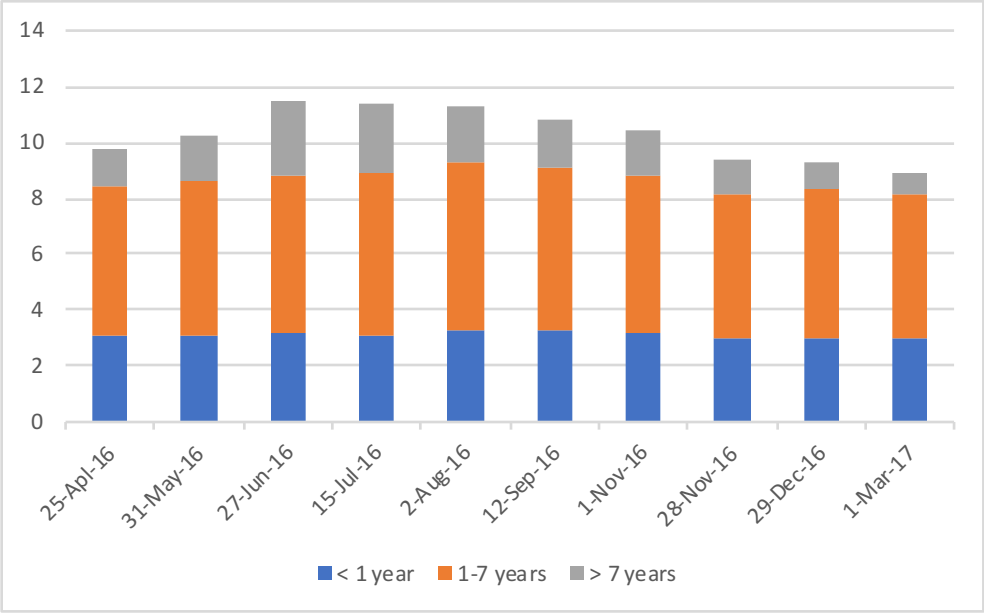

Figure 5. Negative yielding debt by maturity, trillions USD
Source: Bloomberg

The long-term effect of changes in market interest rates on banks' profitability is not obvious. Profitability can either decrease or increase as a result of lower lending rates and funding costs. In addition to this, we should consider the changes in commission income and lending volumes. Such an ambiguous outcome raises important questions about the effectiveness and possible consequences of expansionary monetary policy.

In the recent issue of the Financial Stability Review (2015) published by the ECB, a weak bank profitability is named as one of the key risk factors for the euro area banking sector. First, the bank core capital represents the important buffer against unexpected shocks. The inability for banks to accumulate the necessary capital by retaining earnings damages their shock-absorption capability. Second, prolonged period of low profitability could force banks to take additional risks in

order to generate higher returns, which can result in the instability of the financial sector.

Overall, negative interest rates policy is a relatively recent topic, and thus, mainly unstudied. Therefore, the purpose of this research is to bring some additional understanding of the monetary transmission mechanism and determine the ultimate outcome of central bank policies by using a broad cross-country analysis. The main research question of this work is to determine how low and negative interest rates affect banks' profitability and general industry stability in the Eurozone and other major developed countries.

This paper is organized as follows. In the next chapter, we review the relevant literature to understand the effect of NIRP in different countries. In Chapter 3, we examine theoretical framework by considering the main channels through which monetary policy influences banks' profitability. Chapters 4 and 5 focus on the empirical analysis. They describe the data set and present the econometric framework for our study. The conclusion in Chapter 6 highlights our main findings and their implication on the further development of the banking industry.

Chapter 2

LITERATURE REVIEW

In general, the problem of monetary policy influence on the banking system profitability is not a new one. There are numerous research papers, in which authors try to measure the extent of the impact on bank profits through the monetary policy transmission mechanism. Their conclusions greatly depend on the country or region they chose for the analysis and time period under investigation.

For example, in his classic paper Flannery (1980) modeled the response of asset returns and liability costs to market rate changes of 75 US commercial banks (divided into six size categories based on asset position) for the period 1961-1978. As the reference rate, he used the short-term Treasury bill rate with maturity up to one year. He concluded that bank profits are not very responsive to shifts in interest rates, as both revenue and costs changes tend to cancel one another. This finding is confirmed by the historical data that show us that interest rates fluctuations around the mean level do not produce significant changes in the earnings. Moreover, banks with assets under $100 million even benefited from increased profitability in short term because of slower adjustment of liability costs.

In a different study, Flannery (1981) measured the relationship between the market conditions and banks' profitability. He analyzed a random sample of 15 US banks for the period 1959-1978. Similar to our research he used Compustat database as his primary source for balance sheet and income statement inputs. The results show that large banks are sufficiently hedged against interest rate, as they do not have statistically significant long-run effect on the interest margin and net current

operating earnings. This cash flow hedging is achieved by matching the maturity of borrowing and lending[5].

In his third paper, Flannery (1983) extended his analysis to banks with smaller balance sheet values. The bank data were obtained from the Federal Report of Income and Conditions. Overall, the sample includes 60 US banks in the period from 1960 to 1978. His results show that small commercial banks have adequate range of assets and liabilities on their balance sheet to hedge their profit margin against interest rates fluctuations. For 38 out of 60 sample banks maturity mismatch coefficients are statistically insignificant.

A more recent study conducted by Genay and Podjasek (2014) show that in the United States banks were adversely influenced by a narrower net interest margin caused by accommodative monetary policy. However, the direct effects of ultra-low interest rates on banks' bottom line have low economic significance. On the other hand, they found that changes in house prices and unemployment rate historically had a larger effect on banks' profitability than changes in policy rates. For example, a 1% decline in unemployment rate is associated with 9 bp increase in ROA, which is six times larger effect than from the effect of a comparable change in short-term rates. Similarly, 1% increase in house prices produce 5bp decrease in bank profitability. The authors also observed that during longer-term period banks were able to mitigate the effects of interest rates decline on profits by changing their business practices, such as greater revenue allocation to the fee and commission income sources. Lower loan-loss provisions also tend to contribute much support for bank earnings.

[5] On average banks in the sample have duration of assets 1.36 years and duration of liabilities 1.81 years. Although, the matching is not perfect, it is sufficient to reduce balance sheet exposure to rates changes.

Alessandri and Nelson (2014) applied similar analysis for the UK banks over the period 1992 Q1 to 2009 Q3. In addition to the typical banking institutions, they also took data for building societies, small retail entities that are close in nature to the credit unions and cooperative banks. Their estimations are based on the fixed effect and system GMM (generalized method of moments) approaches with both bank-specific variables (e.g. leverage, asset growth) and macroeconomic variables (e.g. Libor volatility, concentration index). In order to identify structural monetary policy shocks they make use of VAR model. The results of the paper confirmed theoretical model that imply that decrease in short rates leads to the reduction in loan rates and extra provisions for credit loss. Overall, a 100 bp decrease in market rates is associated with a decline in the net interest margin of 0.035% and 0.016% for commercial banks and building societies correspondingly.

In Japan, we can observe a completely different situation as they had experienced ultra-low and zero interest rate policy for a longer period than any other country (since the 1990s). A study by the Weistroffer (2013) showed that a prolonged period of low interest rate contributed to declining net interest margin, and thus earnings, in this country. One of the main reasons for this is that Japanese banks are highly exposed to the interest income sources that represents 60% of total revenue. In response to this, the banking industry has taken steps to rebalance its portfolio towards non-interest securities and implemented cost-cutting policy that helped to offset the negative impact from ZIRP. In search for higher yields, Japanese banks also expanded their business by opening branches and representations in growing markets abroad. The other strategy to counter solvency problems was wide consolidation of banking groups within the country.

In contrast, Riskbank's Monetary Policy Report (2016) suggested that low and negative interest rates do not have a negative effect on banks' profitability. They

stated that Swedish banks' proceeds had been high and stable during the interest rate cuts in recent years. The reason for this is the high cost efficiency and low funding costs compared to the European counterparts. During the observed period (2009-2016), the level of cost-to-income ratio of major Swedish banks declined from 51% to 47%. On the other hand, in the rest of Europe this indicator rose from 62% to 74%. Therefore, Swedish banking system looks like exception rather than rule.

Some authors considered broader view on the situation. Borio, Gambacorta and Hofmann (2015) used cross-country data that cover 109 large international banking groups located in 14 advanced economies for the period 1995–2012. This sample represents 70% of global bank assets according to the Banker Magazine Top 1000 banks. In order to control for the unconventional monetary policy effects they used the yield curve slope – difference between 10-year government bond yield and 3-month interbank rate. They found a clear positive relationship between short-term rates and banks returns. Their conclusions confirm that the overall effect on net interest margin is stronger at lower levels of interest rates (50 basis points for 1% change at a rate of 1%) compared to higher level of interest rates (20 basis points at a rate of 6%). In addition, both interest and non-interest income positively respond to the level of the short-term rate and the yield curve slope, and this relationship is concave.

The recent paper by Claessens, Coleman, and Donnelly (2016) investigated the link between interest rates and NIMs for different interest rate environments using cross-country analysis. They considered the sample of 3,418 banks from 47 countries for 2005-2013. Like many other authors, they used annual frequency data provided by Bankscope database. The results confirmed their initial hypothesis that low rates contributed to weaker net interest margins and this effect is higher when

interest rates are low. Specifically, 1% decrease in the short-term rate is corresponding to a 9 bp decrease in net interest margin in countries with high-rate environment (3-month government bond yield above 1.25%) compared to 17 bp decrease in countries with low-rate environment. This difference can be explained by the fact that banks exposed to negative interest rate are usually reluctant to lower deposit rates for customers below zero even when they suffer losses. The authors also concluded that prolonged period of lower profitability decrease banks' ability to cumulate necessary capital to cover potential losses. As the result, they are more susceptible to market shocks and decline in customers' trust that undermine their ability to serve as financial intermediaries.

Indeed, decrease in banks' profitability associated with accommodative monetary policy may lead to less stable banking industry in general. Rajan (2005), a former Governor of the Reserve Bank of India, describes this situation as the "search for yield". In his work he describes the process through which changes in policy rates could affect risk taking. If the central bank policy implies lower interest rates on banks' short-term assets in comparison to the long-term liabilities held on the balance sheet, it may encourage them to switch to more risky assets. In extreme case, a prolonged period of ultra-low interest rate may jeopardize the ability of a financial institution to meet its long-term obligations.

As we can see, there are is no consensus about the effect of monetary policy on banks' profitability. It depends on the distinctive characteristics of each banking system and the general economic environment in which they function. In this paper, we contribute to the literature in there main ways. First, we a take more comprehensive approach by using quarterly frequency for balance sheet and income statement data provided by Compustat. The major limitation of Bankscope (managed by Fitch and Bureau van Dijk) database used by most researches is that

it provides only annual data. This can limit the overall analysis as negative interest rate policy has been implemented by central banks relatively recently. Second, the mix of countries that we use is unique. It helps us better capture the differences between various monetary policy regimes. Finally, we use difference-in-difference model with unbalanced panel data to capture the effect of negative interest rate policy introduced by the central banks. Our sample comprised of 500 banks from 33 countries for the period Q1 2009 – Q4 2016.

Chapter 3

METHODOLOGY

3.1. Theoretical Analysis

As mentioned above, the effect of changes in market interest rates on banks' profitability is not clear in advance (Appendix B, Table 7). In order to determine its magnitude and sign, we should closely analyze the structure of bank's revenue, its main sources and all the costs associated with its business activities.

The main source of earning of commercial banks is net interest income. As we know, the primary role of a banking system is to efficiently allocate resources in the economy through deposits and loans. In such a way, excess financial means are redistributed from one part of a society to where they are needed the most. In the US, for example, net interest income represents up to 64% of total income generated by the banking industry and its share remains relatively stable since the financial crisis 2008-2009 (Figure 6). In comparison, the Eurozone banks generate up to 59% of their income through the interest proceeds.

The difference between the lending rate and the cost of capital funding is called interest margin. Both these rates tend to follow closely the changes in policy rate imposed by the central bank. Therefore, the spread between them is hard to predict as it can either widen or squeeze in response to monetary policy decisions. On the other hand, when we talk about deposit margin (which is the difference between the market rate and the interest on the deposits) we should consider the fact banks are highly reluctant to impose negative interest rates on depositors. As

the result, low and negative interest rates lead to a lower deposit margin, and thus, banks' profitability.

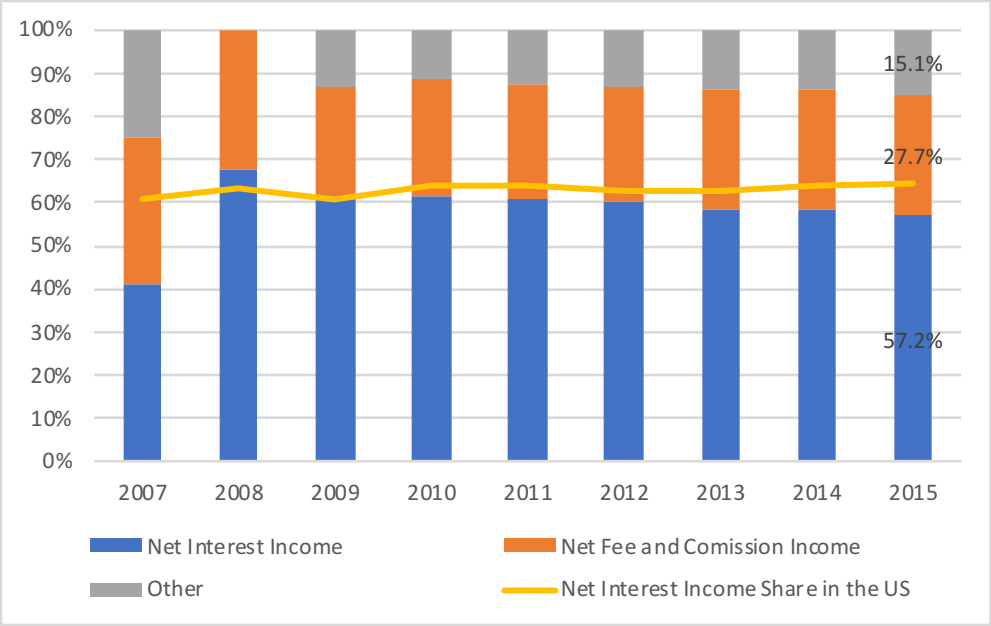

Figure 6. Main income sources of the US and Eurozone banking system[6]
Source: ECB, Fred

The primary goal of implementing ultra-low monetary policy is to stimulate the economy through more affordable loans for consumers and companies. As for banks, the increase in credit volume in conjunction with stable interest margin leads to positive increase in the bottom line. However, the recent paper by Rodnyansky and Darmouni (2016) showed that banks' response to implementation of quantitative easing was not in line with the market expectations. This was caused by banks' unwillingness to reduce their excess holdings at the central banks, even when the rates became negative.

[6] http://sdw.ecb.europa.eu/browse.do?node=9691144

Decrease in interest rates also tends to increase net commission income. This income is generated by asset management and investment banking services provided by the banks in exchange for fixed payment fee. Demand for these services typically increases when market rates are low.

Also, banks usually hold significant proportion of their assets in the form of debt securities, in particular government bonds. Interest rates and bond prices have an inverse relationship, so when market rate are low the change in the book value of this securities reported as a net result from item at fair value, i.e. valuation profit.

Finally, low interest rates can decrease loss provision, which are used to cover potential loan losses caused by customer defaults. Substantially lower lending rates can improve customers' debt-servicing ability, as a smaller share of income goes to service interest rate payments. As the result, the number of bad loans decrease, which translates into higher profitability.

Based on theoretical analysis we want to test the following three hypothesis. Taking into account country and bank level constraints we expect that:

1) Implementation of the negative interest rate policy has the negative effect on banks' profitability measured by return on assets and ratio of interest income to total assets.
2) There is a positive relationship between changes in short-term interest rates and profitability.
3) There is a positive relationship between interest rate spread (slope of the yield curve) and profitability.

3.2. Empirical Analysis

In our analysis, we make use of the difference-in-difference model with unbalanced panel data. We modified the model employed by Claessens, Coleman, and Donnelly (2016) to capture the effect of negative interest rate policy introduced by the central banks. Also, some minor changes are made by adopting valuable insights about changes in yield slope from Borio, Gambacorta and Hofmann (2015).

As our primary profitability measure we chose return on assets (ROA). According to the Deloitte report it is the best financial indicator of company's health (Hagel et al, 2013). The change in ROA helps to measure how effectively banks employ their assets. However, the net income is tend to be highly volatile across periods as it is capture the overall effect of different factors and decisions by management of the bank. Therefore, as our dependent variable, we also used the ratio of interest income to total assets, which is more stable indicator.

We regress these profitability ratios on the following variables:

$$y_{ijt} = \beta_0 + \beta_1 Treat_{jt} + \beta_2 Post_{jt} + \beta_3 TreatPost_{jt} + \beta_4 STRates_{jt} + \beta_5 Spread_{jt} + \beta_6 GDP_{jt} + \beta_7 Securities_{it} + \beta_8 Deposits_{it} + \beta_9 Equity_{it} + \varepsilon_{ijt}$$

$Treat_{jt}$ – Dummy variable if the observation is in the treatment group (= 1 if country implemented the NIRP). It includes 16 countries: Denmark, Sweden, Switzerland, Japan, and 12 Eurozone members.

$Post_{jt}$ – Post treatment dummy (= 1 after the implementation of the NIRP). All countries within the NIRP introduced their policy in 2014, except for Denmark and Japan.

- Denmark – Q3 2012 (Certificate of Deposit Rate).
- Eurozone – Q3 2014 (Deposit Facility Rate).
- Sweden – Q3 2014 (Repo Rate). In Sweden negative interest rates on repo rate and deposit rate were implemented not in the same year. Thus, we used the former one as it is stated by the Riksbanks as the primary policy rate.
- Switzerland – Q4 2014 (Libor rate for CHF deposits).
- Japan – Q1 2016 (Complementary Deposit Facility Rate).

$TreatPost_{jt}$ – Interaction term between treatment and post-treatment variables, (i.e. treatment states after the intervention). The coefficient near this term will help us to measure the effect of NIRP on banks' profitability. We expect it to be negative.

$STRates_{jt}$ – Average quarterly level of the three-month rate on the government bonds (or closest proxy). This rate is closely follows the changes in monetary policy conducted by the central bank.

$Spread_{jt}$ – Spread between the three-month and ten-year sovereign rates (slope of the yield curve). When the difference between these rates narrows, the yield curve becomes more flatter. Therefore, borrowing in the short-term inter-banking market (repurchase agreement) while investing in longer-term assets, do not allow banks to earn excess returns.

GDP_{jt} – Real GDP growth rate (year-over-year). Good economic performance and upbeat future projections can lead to higher demand for consumer and business loans.

In addition to the exogenous variables, banks profitability is dependent on the change in structure of assets and liabilities. Therefore, in order to capture endogenous effects we use the following bank control variables:

- $Securities_{it}$ – Total securities divided by total assets.
- $Deposits_{it}$ – Deposits divided by total liabilities.
- $Equity_{it}$ – Total equity capital divided by total assets.

The key assumption for the difference-in-difference model is that the outcome in the treatment and control group should follow the same time trend when treatment is absent (i.e. before implementation of the NIRP). This is a reasonable assumption for our model as our sample contains only developed countries. On average, treatment and non-treatment groups have similar trends.

Conventional standard errors can substantially understate the standard deviation of the estimators because variables in each country are not only correlated within the country but also serially correlated. Indeed, after performing the test we found that our data exposed to biased standard errors. In order to correct for both heteroscedasticity and autocorrelation we use clustered standard errors at the country level. Number of OECD countries is sufficiently enough to conduct this error correction technique. However, for our second sample we have only seven countries (G7 club). Therefore we used bootstrap approach to clustering suggested by Cameron and Miller (2007).

In order to check for seasonality we regress our dependent variable on the seasonal dummies, while omitting the intercept. All the coefficients at the quarterly dummies were statistically insignificant at the 90% confidence level (Appendix C, Table 8). Thus, our variable do not experience any apparent seasonality problems, and not require further adjustment.

As literature suggests the problem of endogeneity should not have significant impact on our analysis framework (Borio, 2015). Even if general conditions may have some effect on central banks' decisions regarding the implementation of accommodative or restrictive monetary policy, the profitability of individual banks within the country tend to have less effect on the policy decisions.

Chapter 4

DATA OVERVIEW

4.1. Data source

The input data for our analysis is provided by Compustat Capital IQ, a commercial database maintained by Standard&Poor's, which covers 99% of the world's publicly traded companies. It can be accessed using Wharton Research Data Services (WRDS), a web-based business data research service. Each bank report comes with a detailed consolidated (and unconsolidated) balance sheet, income statement, company and country risk ratings, ownership, and price information.

We consider the quarterly data of 500 major publicly traded banks, representing 33 of 35 countries members of the OECD (Organization for Economic Co-Operation and Development). The sample covers 7 years (28 quarters) from Q1 2009 to Q4 2016, the period spanning from the beginning of the financial crisis. We include both the banks currently operating in the market and the bankrupt ones in order to avoid the selection bias (these banks tend to have lower profitability).

Overall, the total assets value of the banks under analysis is around 60% of consolidated balance sheet of OECD countries. There is no single source for assets data for all countries, therefore we combined information from different providers[7].

[7] https://www.ecb.europa.eu/pub/pdf/other/bankingstructuresreport201410.en.pdf

The yields on 3-month and 10-year government bonds are provided by Fusion Media Website[8]. We converted monthly data into quarterly ones to match other variables. Some countries do not have active markets for 3-month bonds, so we take the best proxy available: Poland – 2-month, Portugal – 6-month yields. Quarterly growth rates of the real GDP (year-over-year change) are collected from the OECD website, which provides data for both OECD countries and selected non-member economies.[9]

4.2. Data description

Our sample consists of 33 countries members of the OECD, 16 of which implemented negative interest rate policy on excess reserves held at the central bank. If we look at the bank level data we have 276 of 500 institutions (55.2% of the sample data) which conduct their primary business within NIR environment. Hence, we have balanced proportion of treatment and control groups (Appendix C, Figure 8).

In order to clear the data, we remove observations which are inconsistent with logical framework (when assets and liabilities have negative sign, deposits are higher than total liabilities of the bank). In addition to this, we eliminate outliers that are different from the mean by six standard deviations.

In Figure 7 you can see the range and median statistics of the short-term yields for each country from our sample. The rate dispersion is large for some countries, as they were highly exposed to the European debt crisis of 2010.

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http://www.helgilibrary.com/indicators/bank-assets-as-of-gdp/

[8] https://www.investing.com/rates-bonds/

[9] https://data.oecd.org/gdp/quarterly-gdp.htm

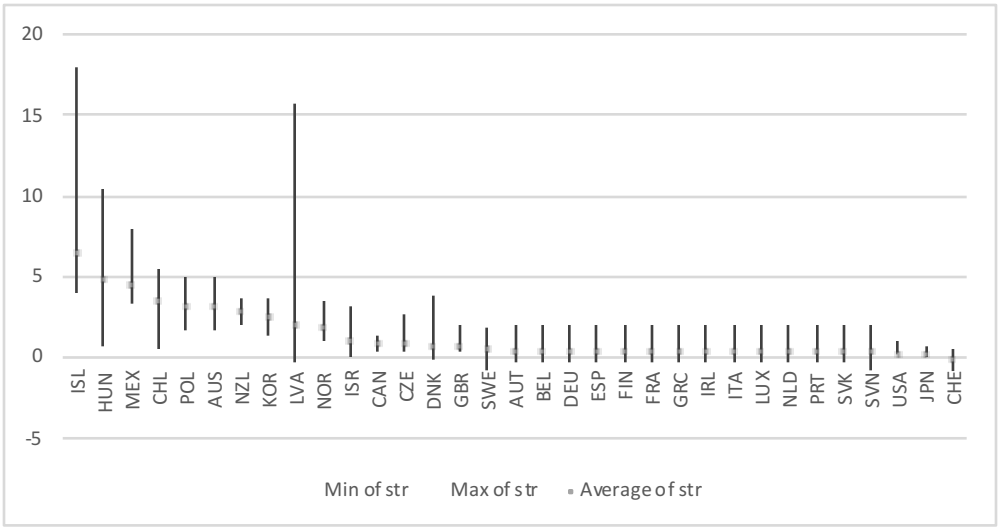

Figure 7. Range of short-term government bond yields and their mean for each country from 2009-2016, %

In Table 1 you can see the aggregate comparison of macro indicators between our two groups. The mean GDP growth of the treatment group is 0.36% compared to 1.62% in the control group. Overall, there is clear relationship between central bank rates and GDP growth over period covered in our analysis. Countries tend to implement stimulative monetary policy in order to counter slow growth rates. Ireland and Greece have the largest and smallest average GDP growth (4.8% and -3.8% correspondingly). Both of them are included in the treatment group.

Table 1. The mean and median statistics for country level controls in terms of treatment and control groups

Treat	Stats	GDP	STRates	LTRates
0	Mean	1.620	1.045	2.832
	P50	1.893	0.377	2.623
	SD	2.038	1.339	1.230
1	Mean	0.365	0.462	2.536
	P50	0.902	0.299	1.716
	SD	3.153	0.726	2.768
Total	Mean	1.207	0.853	2.735
	P50	1.682	0.337	2.426
	SD	2.531	1.205	1.885

Table 2 compares the bank level balance sheet ratios used in our analysis. Overall, there are differences in composition of assets and liabilities that can explain the different profitability levels (ROA of 0.122% vs. -0.001%). Banks in the treatment group have 10% lower proportion of investment securities to assets. In addition to this, they have lower share of deposits in their total liabilities. Therefore, they tend to heavily use market borrowing in the form of corporate bonds and repo agreements that have higher costs then ordinary deposits, thus decreasing the profit margin. Finally, banks in the treatment group have higher leverage ratio 17.1x compared to 9.4x in the control group. In times of market distress (e.g., stock market crash) it can magnify both gains and losses from their business activities.

Table 2. The mean and median statistics for country level controls in terms of treatment and control groups

Treat	Stats	ROA	Securities	Deposits
0	Mean	0.122	18.975	78.995
	P50	0.270	17.260	85.241
	SD	0.503	11.439	17.722
1	Mean	-0.001	17.399	60.471
	P50	0.119	15.945	61.502
	SD	0.920	11.005	27.926
Total	Mean	0.089	18.445	72.820
	P50	0.219	16.828	81.469
	SD	0.132	11.319	23.357

Chapter 5

EMPIRICAL RESULTS

The baseline regression results (table 3) show that implementation of the negative interest rate policy decrease return on assets by 0.118%. This coefficient is both statistically significant (at 95% confidence level) and economically significant compared to the average profitability across banks. The major component that contributed to this drop in ROA is the fact that banks hold significant portion of their reserves (excess reserves) at the central banks. In particular, in Switzerland the deposit rate (3-month Libor rate for CHF deposits held at the SNB) charged by the SNB is currently -0.75%. In this way central banks are taxing deposit institutions for exceeding their reserve requirements. Also, commercial banks incur some technical costs associated with implementation of new IT systems adapted to the unusual business environment.

Table 3. Regression output with estimates and corresponding t-statistics of OECD countries (ROA as dependent variable)

Variable	Coefficient	t-statistics
treat	0.0785	(1.38)
post	0.0066	(0.36)
treatpost	**-0.1180**	**(-2.62)***
strates	**0.0089**	**(0.87)**
spread	**0.0797**	**(6.01)*****
gdp	0.0235	(2.80)**
securities	0.0023	(1.50)
deposits	0.0011	(1.48)
equity	0.0386	(6.88)***
_cons	-0.2060	(-1.85)

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

On the other hand, we do not see any clear relationship between profitability and change in short term rates (3-month government bond yields). This can be partially explained by the fact that banks try to match duration of their assets and liabilities to mitigate interest rate risk. Also, banks rebalance their portfolio beyond core business, because after the financial crisis asset management divisions generated higher returns than loans. Finally, all major global banks implement cost-cutting programs that helped to offset the negative impact from interest rate decrease.

We also found that decrease in the spread between the three-month and ten-year sovereign rates decrease return on assets by 0.08%. When the difference between short- and long-term rates narrows the yield curve becomes more flatter. Therefore, borrowing in the short-term inter-banking market while investing in longer-term assets do not allow banks to earn excess returns.

Good economic performance also contributed to better performance of the banks. In particular, 1% increase in GDP growth rates increase profitability by 0.023%. One of the reasons why this effect is relatively small is because after financial crisis banks are unwilling to increase their lending to consumers and businesses despite better market sentiment. Thus, the overall lending volumes was substantially lower than 10 years ago.

Finally, we found positive relationship between equity-to-total-assets ratio and ROA (0.037%). The logic behind this, is that such banks can obtain their funding at more favorable rates as they are perceived more safe by the counterparts. In repo market, it is not only important to have good collateral, but also possess additional liquidity, which can be used in times of market distress.

Next, we analyzed the impact of negative interest rates on interest income (Table 4). As our dependent variable, we chose the ratio of interest income to total assets. We obtained similar results to our ROA regression output. However, in this case the coefficient near short-term rates is highly significant. This is because we exclude other non-interest income (net gains on trading and derivatives, net fees and commissions, and other operating income) which is less sensitive to interest rate changes. Overall, the share of interest income represents significant share in overall income of the banking systems – between 60% and 70%.

Table 4. Regression output with estimates and corresponding t-statistics of OECD countries (interest income to total assets as dependent variable)

Variable	Coefficient	t-statistics
treat	0.2070	(3.46)**
post	0.1050	(3.62)**
treatpost	**-0.1560**	**(-2.64)***
strates	**0.1410**	**(7.09)*****
spread	**0.0337**	**(3.71)*****
gdp	0.0064	(1.42)
securities	0.0028	(2.27)*
deposits	-0.0027	(-1.98)
equity	0.0197	(4.26)***
_cons	-0.3500	(-3.76)***

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Finally, we narrowed our analysis to G7 group consisting of highly developed countries: Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. In this way, we can construct more homogeneous sample with similar trends. Four out of seven countries implemented negative interest rate policy (France, Italy, and Germany since June 2014; Japan since February 2015). Therefore, our treatment group represents 45% of our sample, while control group 55%. The regression results (Table 5) show that implementation of the negative interest rate policy decreases return on assets by 0.138%. We can also

observe positive effect of real GDP growth and spread between government bonds. Therefore, we can confirm results from our base regression.

Table 5. Regression output with estimates and corresponding t-statistics of G7 countries (ROA as dependent variable)

Variable	Coefficient	t-statistics
treat	0.1240	(1.77)
post	0.0183	(1.24)
treatpost	**-0.1490**	**(-2.82)****
strates	**0.0176**	**(0.47)**
spread	**0.0686**	**(7.04)*****
gdp	0.0296	(3.28)**
securities	0.0031	(1.71)
deposits	0.0011	(1.88)
equity	0.0357	(21.8)***
_cons	-0.2170	(-2.58)**

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Chapter 6

CONCLUSIONS

This study investigates the link between changes in monetary policy and banks' profitability through a difference-in-difference approach with unbalanced panel data. We consider the quarterly data of 500 major publicly traded banks, representing 33 of 35 countries members of OECD. The sample covers 7 years (28 quarters) from Q1 2009 to Q4 2016. We include both the banks currently operating in the market and the bankrupt ones in order to avoid the selection bias. We examine the effect of negative interest rate policy introduced by the central banks on overall profitability, measured by ROA and ratio of interest income to total assets.

We control for both macroeconomic conditions (change in short-term rates, GDP growth, and slope of yield curve) and main bank-specific characteristics. In order to check the robustness of the model we add the analysis of G7 countries that are more similar in their economic development.

We find that implementation of the negative interest rate policy decreases return on assets by 0.111% which is both statistically and economically significant. High level of excess reserves accumulated at the central banks contributed much to this decline. Also, we obtain strong positive relationship between slope of the yield curve and overall profitability.

Finally, our baseline regression did not show clear impact of changes in short-term rates on profitability. This can be explained by the banks' application of asset-liability management that helps to minimize yield risk by matching duration of

assets and liabilities. In addition to this, non-interest sources of income, like commission fees and trading, made net profit less susceptible to interest rate changes.

The negative impact of current interest rate policy on banks' profitability creates some important policy issues. The general objective of NIRP implementation was to stimulate economies that highly suffered from Financial Crisis 2008-2009 and subsequently European Debt Crisis. However, low interest rates hampered bank's ability to effectively conduct monetary policy through transmission mechanism. The demand for new credits did not match the expectations of the policymakers. As the result, small increase in lending did not compensate the decrease of interest margin as more borrowers refinanced their current mortgages at lower costs.

Such an environment has adverse effects on bank's core capital that represents the important buffer against unexpected shocks. The decrease in profitability level leads to bank's inability to accumulate the necessary reserves by retaining earnings. The prolonged period of ultra-low interest rates policy could force banks to take additional risks through investment banking activities in order to generate higher returns. This will further damage their shock-absorption capability and could produce decline in market confidence. Therefore, central banks should consider additional measures that will prevent the rise of financial industry fragility and consequent economic disequilibrium.

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APPENDIX A

Table 6. Central banks with negative interest rate policy

	Current Policy Rate	Date of NIRP Introduction	Comments
Denmark	Certificates of Deposit Rate: -0.65%	July 2012 – April 2014, September 2014	Rate for the deposits that banks placed with the DNB
Eurozone	Deposit Facility Rate: -0.4%	June 2014	Rate that banks may use to make overnight deposits at the ECB
Sweden	Repo Rate: -0.5%	February 2015	Seven-day rate at which banks can borrow or deposit funds at the Riksbank
	Deposit Rate: -1.25	July 2009 – September 2010, July 2014	Overnight rate of interest banks receive when they deposit their funds at the Riksbank
Switzerland	Libor Rate: -0.75	December 2014	3-month Libor rate for CHF deposits held at the SNB. Target range: from -1.25% to -0.25%
Japan	Complementary Deposit Facility Rate: -0.1%	February 2016	Uncollateralized overnight call rate applied to the policy-rate balances held at the BOJ. Target range: from 0 to -0.1%.

Source: National central banks

APPENDIX B

Table 7. The effect of decrease in policy interest rates on profitability

Income Item	Comments	Effect
Net Interest Income		
• Interest Margin	Difference between the lending rate and the interest rate on funding	Varies
• Deposit Margin	Difference between the market rate and the interest on deposits	–
• Increased Volumes	Demand for loans increases at low interest rates	+
Net Commission Income	Demand for capital management and IB services may increase when interest rates are low (higher asset prices)	+
Net Results From Item at Fair Value	Debt securities increase in value when interest rates fall. Valuation profit.	+
Costs (associated with NIR)	Change in IT system, legal and contractual expenses	–
Loan Losses	Lower landing rates improve customers' debt-servicing ability (loss provision)	+
Net Profit		Varies

APPENDIX C

Table 8. Test for seasonality of banks' profitability

Variable	Coefficient	t-statistics
quarter 2	-0.032	(-0.15)
quarter 3	-0.354	(-1.59)
quarter 4	-0.129	(-0.58)
_cons	0.193	(1.23)

* p < 0.05, ** p < 0.01, *** p < 0.001

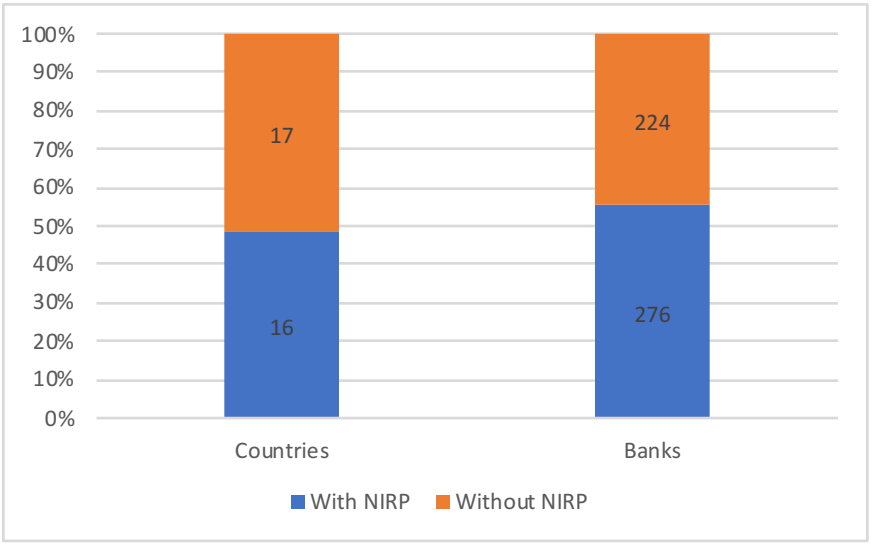

Figure 8. Proportion of countries and banks in treatment and control groups

APPENDIX D

Table 9. Total number of banks and observations by country

Country	Observations	Banks	Share	Country	Observations	Banks	Share
AUS	272	9	2.17	ISR	307	10	2.45
AUT	284	10	2.27	ITA	573	22	4.58
BEL	62	2	0.5	JPN	1,475	72	11.78
CAN	223	7	1.78	KOR	387	22	3.09
CHE	560	20	4.47	LUX	21	1	0.17
CHL	282	9	2.25	LVA	42	2	0.34
CZE	51	2	0.41	MEX	265	10	2.12
DEU	652	25	5.21	NLD	124	4	0.99
DNK	964	42	7.7	NOR	845	28	6.75
ESP	320	15	2.56	NZL	44	2	0.35
FIN	64	2	0.51	POL	519	20	4.14
FRA	663	26	5.29	PRT	167	7	1.33
GBR	534	23	4.26	SVK	133	5	1.06
GRC	234	11	1.87	SVN	86	3	0.69
HUN	31	1	0.25	SWE	173	7	1.38
IRL	133	5	1.06	USA	1,789	74	15.88
ISL	44	2	0.35				

APPENDIX E

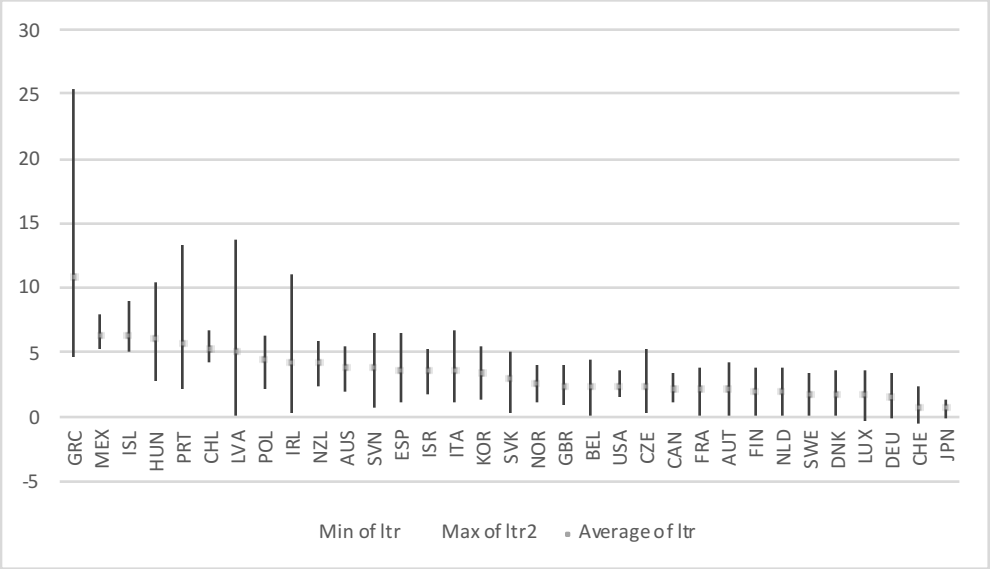

Figure 9. Average annual growth rate in countries with NIRP and without during 2009-2016, %

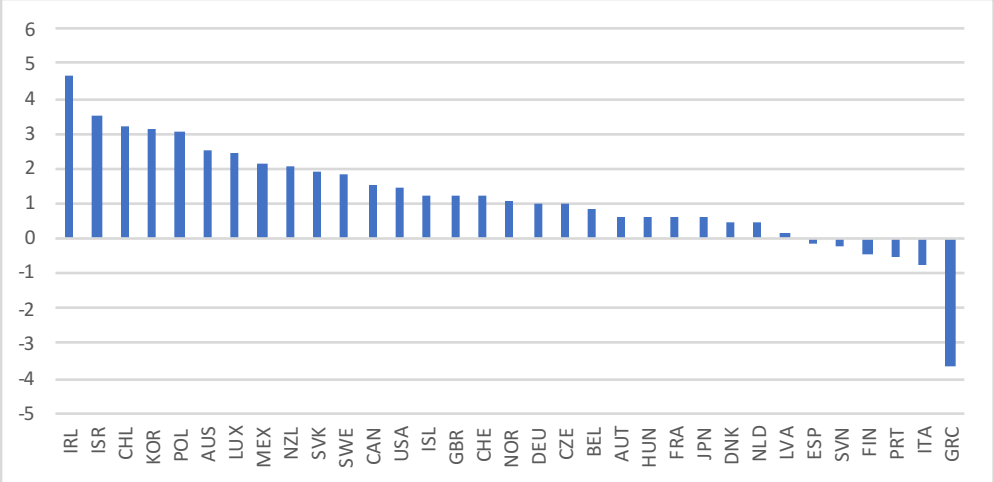

Figure 10. Range of long-term government bond yields and their mean for each country from 2009-2016, %