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The impact of the unconventional monetary policy in bank's profitability

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BUSINESS
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Resumo

Na presente dissertação, recorrendo à utilização da taxa de juro sombra, estudamos como as políticas monetárias não convencionais afetaram as componentes de rentabilidade dos bancos. A dissertação está dividida em três capítulos que representam três estudos independentes, mas relacionados. No primeiro estudo analisamos o impacto da política monetária do Banco Central Europeu (BCE) na rentabilidade dos bancos de 2008 a 2019. Para isso, dividimos a amostra em dois subperíodos para isolar os efeitos do Quantitative Easing (QE): primeiro trimestre de 2008 até ao terceiro trimestre de 2014 e quarto trimestre de 2014 até ao quarto trimestre de 2019. Os resultados, sugerem que as políticas monetárias não convencionais, após a implementação do QE, afetaram as componentes de rentabilidade dos bancos. No entanto, o retorno global dos bancos não parece ser beneficiado ou prejudicado pelas medidas não convencionais implementadas pelo BCE.

No segundo estudo exploramos o impacto das políticas monetárias ao longo da distribuição da rentabilidade dos bancos usando um método de regressão de quantis, desta vez para o sistema bancário dos EUA durante 2008-2019. Os resultados indicam que as políticas monetárias não convencionais beneficiaram o retorno global médio dos bancos. Além disso, os resultados sugerem que as políticas monetárias não convencionais têm impactos desiguais, ao longo dos quantis, nas componentes de rentabilidade dos bancos americanos, ou seja, nas componentes relacionadas com juros, não juros e também nas provisões.

No terceiro e último estudo analisamos igualmente o sistema bancário dos EUA, mas o periodo de analise refere-se unicamente ao primeiro trimestre de 2009 até ao segundo trimestre de 2014. Neste estudo investigamos a dinâmica entre as componentes de rentabilidade bancária. Com base no modelo de Auto-Regressão de Vetores para Painéis, e estimação com o Método Generalizado dos Momentos, calculamos as funções impulso-resposta das componentes de rentabilidade dos bancos. Os resultados sugerem que os bancos mitigaram as perdas nas componentes de juros por meio da componente que não está relacionada com os juros e provisões, sendo que a componente de provisão desempenha o papel principal de compensação.

Palavras-Chave: Política Monetária Não Convencional; Taxa de Juro Sombra; Rentabilidade dos Bancos; Política Monetária Expansionista

Códigos JEL: E43, E52, G01, G21, G28.

Abstract

This thesis studies, using the shadow rate, how unconventional monetary policies have affected the profitability components of banks, and is divided into three main chapters representing three independent but related studies. The first study analyzes the impact of the European Central Bank's (ECB) monetary policy measures on bank profitability from 2008 to 2019. To this end, we divide the sample into two subperiods to isolate the effects of Quantitative Easing (QE): Q1 2008 to Q3 2014 and Q4 2014 to Q4 2019. The findings, suggest that unconventional monetary policies, upon the implementation of QE, affected bank profitability components. However, the bank's overall return does not seem to be benefited or harmed by the non-standard measures implemented by the ECB.

The second study explores the impact of monetary policies across the distribution of bank profitability in the U.S. banking system during 2008–2019 using a quantile regression method. The results indicate that UMP benefited the average bank's overall return. Furthermore, the results suggest that unconventional monetary policies have uneven impacts, across the quantiles, on the U.S. banks' profitability components, i.e., interest, non-interest, and provisioning.

The third and last study also analyzes the U.S. banking system but only for the period Q1 2009 to Q2 2014. This study investigates the dynamics between bank profitability components. Based on the Panel Vector Autoregression using the Generalized Method of Moments estimator, we compute the impulse response functions for the bank profitability components. Our findings suggest that banks have attenuated losses in interest components through non-interest and provisioning components, with the provisioning components playing the major role of compensation.

Keywords: Unconventional Monetary Policy; Shadow Rate; Banks' Profitability; Expansionary Monetary Policy.

JEL codes: E43, E52, G01, G21, G28.

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1. Introduction

This thesis contributes to one of the most debatable topics in macrofinance in recent years, which is the impact of unconventional monetary policy on bank profitability. We believe this topic is of the utmost importance for two main reasons. On the one hand, the banking sector plays a key role in the monetary policy transmission mechanism. On the other hand, a sound and profitable banking sector can better withstand adverse shocks and contribute to the financial system's stability. Only with an efficient relationship between monetary policy and bank performance it is possible to have an adequate monetary transmission from the banking system to the real economy, thus allowing central banks to achieve their goals.

The thesis begins by recognizing that traditional monetary policy variables hinder to quantify the general orientation of monetary policy in the new environment. Once this limitation is recognized, the shadow rate is introduced as a possible solution. Unlike the observed short-term interest rate, the shadow rates, first introduced by Black (1995), are not limited to 0% or zero-lower bound, which means that this interest rate proxy tends to better summarize the (conventional and unconventional) monetary policies actions than the traditional interest rates. To the best of our knowledge, this thesis is the first to use the shadow rates to analyze the impact of unconventional monetary policy on bank profitability. Additionally, we create and introduce a new proxy for unconventional monetary policy (UMP) that results from the difference between Wu and Xia's (2016) shadow rate and the 3-month Overnight Interest Swap, which we call the UMP Deviation. This proxy will be used throughout the thesis. In short, the UMP deviation reflects the impulse or additional impact that unconventional measures generated on interest rates, which is not possible to obtain using the traditional monetary policy instruments.

The thesis is divided into three main chapters representing three independent but related studies. Because each of the chapters is an independent study, repetition of concepts may be inevitable. It is also to be expected that notation may differ between chapters. In addition to this introduction and the chapters referred below, the final chapter presents concluding remarks and expected directions for future research.

Our first study, presented in Chapter 2, is entitled "What we can only see in the shadows: Unconventional Monetary Policies and European Bank Profitability". This study assesses the effects of the European Central Bank's monetary policy actions on bank profitability from 2008 to 2019. To this end, using a Difference Generalized Method of Moments (GMM) dynamic panel estimator, we estimate the effect of unconventional monetary policy on the components of banks' net profitability and describe the relationships obtained. Moreover, we note that much of the literature has used a short period of effective UMP implementation, which may disregard the full extent of unconventional monetary policies. Thus, our analysis considers a longer period of analysis compared to the literature and we divide the sample into two subperiods, Q1 2008 to Q3 2014 and Q4 2014 to 2019, to isolate the effects of Quantitative Easing (QE). Our key findings suggest that unconventional monetary policies, upon the implementation of quantitative easing, impacted bank profitability components. Nevertheless, ECB's unconventional monetary policy does not seem to benefit or harm bank's overall return.

The second study, presented in Chapter 3, is entitled "An Uneven Policy: The Impact of the U.S. Unconventional Monetary Policy on Bank Profitability across Quantiles". This study investigates the relationship between monetary policies and the net components of bank profitability across the distribution of bank profitability using a quantile regression method for the U.S. banking system during 2008–2019. In contrast to standard mean regression methods, quantile regression can report the entire conditional distribution of bank profitability and allows us to assess how our unconventional monetary policy variables affect banks at each quantile, with an emphasis being the least and the most profitable banks. The characteristics of the banks that generate profits above or below the conditional mean are often substantially different and most likely respond differently to changes in the main determinants. Therefore, regulators and policy makers need to understand what happens at the two extremes of the profitability distribution, given the heterogeneity of the applied monetary measures. Thus, the goal of this study is to understand if the different conditional quantiles of bank profitability (10%, 25%, 50%, 75%, and 90%) respond differently upon the implementation of unconventional monetary policies by the U.S. Fed. Our results suggest that UMP increased the average bank's overall return. Moreover, the results indicate that unconventional monetary policies have uneven impacts, across the quantiles, on the U.S. banks' profitability components, i.e., interest, non-interest, and provisioning.

Finally, the third and last study, in Chapter 4, is entitled "Bank's Sailing Strategy through Unconventional Tides: The Dynamics of U.S. Bank Profitability Components". This study focuses on the analysis of the dynamics between the components of bank profitability, rather than analyzing the components individually. The objective is to understand how banks mitigated their losses in interest income, during the period of the U.S. Fed unconventional monetary policies implementation, from the first quarter of 2009 to the second quarter of 2014. To this end, impulse response functions for the bank profitability components are computed from the estimation of a Panel Vector Autoregression using the Generalized Method of Moments. The key findings indicate that banks have mitigated losses in interest components through non-interest and provisioning components, with the provisioning components playing the largest role of compensation.

2. What we can only see in the shadows: Unconventional Monetary Policies and European Bank Profitability

Synopsis: Our study analyses the impact of European Central Bank's (ECB) policy measures on bank's profitability from 2008 to 2019. We decide to divide it into two subperiods, Q1 2008 to Q3 2014 and Q4 2014 to 2019 to isolate the effects of Quantitative Easing (QE). We create a new proxy for unconventional monetary policy (UMP) that results from the difference of Wu and Xia's (2016) shadow rate and the 3-months Euro Overnight Interest Swap, as reference, which we call the UMP Deviation. In short, the UMP deviation reflects the impulse or additional impact that unconventional measures generated to interest rates, which is not possible to obtain only with the traditional monetary policy instruments. Our findings suggest unconventional monetary policies, upon the implementation of QE, affected the bank profitability components, reinforcing the fall of Net Interest Income (NII), guiding to an increase of the Net Non-Interest Income (NNOII) and leading to a decrease of Loan Loss Provision (LLP). Yet, bank's overall return does not seem to be damaged or benefited by the non-standard measures implemented by the ECB.

2.1. Motivation

The recent European economic history was marked by the Global Financial Crisis around 2007-2009, which led to a recession that turned into a sovereign debt crisis in the euro area. This crisis has raised serious concerns about credit and insolvency risks among debt issuers (Brana et al., 2019). As a result, the European Central Bank (ECB) was compelled to implement monetary policies to address the weak macroeconomic performance and support financial intermediaries (Freixas et al., 2011). The effectiveness of the monetary policies implemented by central banks is directly linked to the transmission mechanisms, i.e., the capacity of those measures to be transmitted to the real economy. Regarding monetary transmission, the banking sector plays a fundamental role (Kashyap and Stein, 1994; Bernanke and Gertler, 1995). Therefore, understanding the interactions between monetary policy and bank profitability is critical, as it may condition the transmission of monetary policy.

Given the diversity and complexity of the measures applied by the ECB, their impact on banks' profitability may need to be clarified. For example, Quantitative Easing (QE) can impact banks' profitability in three ways. First, by facilitating the rise in bond prices, subsequent banks holding these bonds strengthen their balance sheets. Second, QE reduces long-term yields and term spreads, which leads to declines in the loan-to-deposit ratio spread, making it more difficult for banks to generate net interest income on new loans. Finally, QE improves economic prospects, which should help banks exposed to the economy find new credit opportunities and reduce problems with non-performing loans.

The net effect of unconventional monetary policy (UMP) on banks' profitability remains not fully understood. Therefore, what is the overall effect on the components that make up the profitability of banks - Net Interest Income (NII), Net Non-Interest Income (NNOII) and Loan Loss Provision (LLP)? Did QE change the impact of monetary policy on bank profitability components?

The literature has provided important insights into the trade-off between accommodative monetary measures and bank profitability. Recent studies suggest an adverse impact of unconventional monetary policies on net interest margins (Alessandri and Nelson, 2015 or Campmas, 2020). However, the overall effect of UMP on the banks' profitability is not consensual. While some authors defend that low rates not only adversely affect the net interest margins but also the bank profitability (Claessens et al., 2018), others argue that accommodative monetary policies are not associated with lower bank profits (Altavilla et al., 2018). We argue that the lack of consensus in the literature may derive from three shortcomings that require additional research.

First, along with assessing the impact of unconventional monetary policies on banks' profitability, the diversity of these policies hinders quantifying the general orientation of monetary policy in the new environment. Generally, previous studies have used short-term interest rates and the slope of sovereign yield curves to measure the impact of monetary policies on the components of bank performance (e.g., Borio et al., 2017; Campmas, 2020; Altavilla et al., 2018; Lopez et al., 2020; García-Cruz, 2020). In fact, these variables have shown reliability during the period of conventional monetary policy. However, during most of the period of UMP, the short-term interest rate became stable and approximately constant, therefore losing the ability to represent the monetary policy instruments implemented by the ECB.

Second, consequently, several authors have developed proxies that attempt to incorporate the information of unconventional monetary policies (e.g., shadow rate term structure model (SRTSM), and, consequently, shadow rates). However, empirical studies that use those proxies focused on macroeconomic problems, such as inflation shocks, output, transmission mechanisms, unemployment or gross domestic product (Ellington, 2022; Mouabbi and Sahuc, 2019; Wu and Zhang; 2019a; 2019b; Bernanke, 2020). The value of those proxies is yet to be tested on the estimation of the microeconomic issues, such as bank profitability.

Third, several studies have analyzed the impact of unconventional monetary policies on banks' profitability using a short period of effective implementation. Interest rates became negative after June 2014, and Asset Purchase Programmes started in March 2015. Despite that, Borio et al. (2017) end their sample in 2014, Campmas (2020) in 2015, Altavilla et al. (2018) in Q2 2016, and Lopez et al., (2020) and García-Cruz (2020) in 2017. By ending their samples until two years after, these studies may disregard the full implications of unconventional monetary policies, such as the interaction of negative interest rates and QE. Hence, this time constraint may lead to two problems. On the one hand, the studies mix their estimations in periods of conventional monetary policies, which may bias the results and the interpretation of the effects of UMP. On the other hand, the studies cannot effectively separate the periods of pre and post-UMP effects on bank profitability.

To answer these shortcomings, we focus on the euro area, as it contains a substantial number of countries and bank heterogeneity. Moreover, we use the period between the first quarter of 2008 and the fourth quarter of 2019, which comprises crisis and recovery periods and, more importantly, pre- and post-QE regimes. We also keep the traditional monetary policy variables (the short-term interest rate and the slope of sovereign yield curves) but add the shadow rate to the empirical analysis. Because shadow rates are unlimited to the zero lower bound, they offer an interest rate proxy that tends to capture better UMP actions than the traditional interest rates on topics such as monetary transmission, risk-taking, and output, among others (Urbschat, 2020). However, as this proxy does not isolate the effects of UMP, we develop a variable that removes the effect of conventional monetary policy from the shadow rate, keeping the information of unconventional monetary policies. In short, we create the unconventional monetary policy (UMP) deviation that measures the additional impact that unconventional measures generate on interest rates. Moreover, given the relevance of asset purchase programs within unconventional monetary policies, we study with particular attention and detail the pre- and post-QE regimes on the overall and individual bank profitability components. For that purpose, we split the data between Q1 2008- Q3 2014 and Q4 2014 - Q4 2019, i.e., pre- and post-QE, respectively. For the sake of completeness, besides the Wu and Xia's (2016) shadow rate, our research employs two additional rates, the Krippner (2013) and Rezende et al., (2023) shadow rates.

We mainly contribute to the strands of literature on bank profitability and shadow rates in four different directions. The first two contributions are related to the fact that, to the best of our knowledge, we are the first to use shadow rates to analyze the impact of UMP on bank performance. These two contributions are achieved by creating a proxy, the UMP deviation, which isolates the impulse of non-standard monetary measures within the shadow rate and allows the use of traditional monetary instruments used in the previous literature.

On the one hand, we take advantage of this proxy to analyze microeconomic problems, specifically the performance of banks. As such, we investigate the insights that the shadow rate can bring to the behavior of firms, in our particular case the banking sector, in making decisions about allocating limited resources. On the other hand, since these shadow rates tend to account better for the strength of the non-standard measures than the traditional interest rates (Urbschat, 2020), we also contribute to a better understanding of the relationship between monetary policy and banks' profitability. By doing so, we complement the existing literature with additional effects, summarized in the shadow rate, of non-standard ECB measures that may not be captured so far. We expect to recognize the quality of the shadow rate on the abovementioned topics.

The third and fourth contribution are consequence of enlarging the period UMP under analysis and splitting the regimes for an accurate examination of UMP effects on bank's profitability. To this end, we revisit and re-estimate the impact of monetary policy on the profitability of ECB-supervised banks with a more extensive period of UMP (six years of scope). This more extensive period allows us to consider the interaction of low interest rates and QE and capture the effects of the banks' actions to adapt to the environment of low interest rates and flattened yields. We argue that both aspects may be essential to understand better the impact of unconventional monetary policies on the banks' profitability.

Finally, studying the relationship between monetary policy and bank profitability in a pre-and post-implementation period of QE allows us to perceive the importance of this unconventional monetary measure in the banking system.

We highlight three key results. First, we find significant relationships between the UMP deviation and the banks' profitability components, suggesting that unconventional monetary policies have affected profitability elements. Second, we do not find significance between the UMP deviation and bank's Return on Assets (ROA), suggesting offsetting effects between the bank profitability components. Third, our findings suggest that unconventional monetary measures had no or very scarce effects on bank profitability components before QE took place. However, upon the implementation of QE, we find that unconventional monetary measures affected banks' profitability. Specifically, ECB's unconventional monetary policies, upon the implementation of the QE, reinforced the fall of NII, guided to an increase of NNOII and lead to the reduction of LLP.

In summary, UMP did not seem to have affected overall bank profitability, suggesting that banks may have adapted to the new monetary environment implemented by the ECB. Moreover, without the overall banks' profitability being compromised, our evidence suggests that ECB goals and strategy may not be constrained by the relationship between the bank's gains and monetary policies applied.

The remainder of the study is organized as follows. Section 2.2 reviews the literature on the relationship between the monetary policy and bank profitability. In Section 2.3, we introduce the methodology employed and we describe our data in Section 2.4. Section 2.5 discusses the results. In Section 2.6, we evaluate the robustness of our results based on different shadow rates. Section 2.7 concludes.

2.2. Literature Review

This study relates two strands of literature. The first and main strand of literature focuses on the use of shadow rates to account for UMP. Assessing the impact of unconventional monetary policies on bank profitability, but not only, has become a major challenge because interest rates lost efficiency as the main monetary policy instrument when it becomes approximately constant. In other words, UMP has increased the arsenal of instruments with, for example, the implementation of asset purchase programs and forward guidance which made interest rates cease to be, by themselves, representative of monetary policy. After the perception of this challenge, several studies proposed the shadow rate – first introduced by Black (1995) – as a solution to represent monetary policy as a whole because, unlike the observed short-term interest rate, the shadow rates are not limited to 0% or zero-lower bound (Wu and Xia, 2016; Krippner, 2013; Kim and Singleton, 2012).

Our study mainly focuses on the Wu and Xia's shadow rate that proposes a simple analytical representation for bond prices in the multifactor shadow rate term structure model (SRTSM). It provides an excellent approximation and is extremely tractable for analysis and empirical implementation. It can be applied directly to discrete-time data to gain immediate insights into the nature of the SRTSM's predictions. This proxy proposed by Wu and Xia (2016) offers an excellent empirical description of the recent behavior of interest rates, compared to other models such as the Gaussian affine term structure model. Moreover, it is relevant to mention that Wu and Xia's shadow rate is a simple factor-augmented vector autoregression (FAVAR), exhibiting similar dynamic correlations with macro variables of interest. This result gives us a tool for measuring the effects of monetary policy at the zero lower bound (ZLB) and offers an important insight into the empirical macro literature where people use the effective policy rate in vector autoregressive (VAR) models to study the relationship between monetary policy and the macroeconomy (Wu and Xia, 2016).

Nevertheless, the literature on shadow-rate models for the euro area is still relatively scarce. Pericoli and Taboga (2015) and Damjanović and Masten (2016) analyze the usefulness of the shadow rate as a stance indicator, assuming a zero lower bound for their models. Notwithstanding, Urbschat (2020) suggests that shadow rates tend to assess the unconventional monetary policies better than traditional interest rates. Since the appearance of the shadow rate term structure model (SRTSM), which proved to be helpful for both measuring the effects of policy and describing the relations between different yields, several studies have analyzed how the shadow rates can be applied to study the impact of UMP in several aspects of the economy. On the one hand, several theoretical studies have introduced the shadow rates to overcome problems in macroeconomic models caused by the ZLB (Wu and Zhang, 2019a; Wu and Zhang 2019b; Ellington, 2022; Bernanke, 2020). On the other hand, a considerable amount of empirical research, which compares shadow rates with traditional interest rates, support that these proxies provide better interest rate fit. This better fit means that shadow rates tend to capture financial market participants' views regarding the prospective path of the short-term interest rate and forecast estimation of the future monetary policy, on topics such as, monetary transmission, risk-taking, output, among others. Bauer and Rudebusch (2016), based on empirical work using Wu and Xia (2016) shadow rate, suggest that it is possible to obtain forecasts of the future monetary policy liftoff from the ZLB that are closer to survey expectations. Mouabbi and Sahuc (2019), based on DSGE models in which the policy rate is replaced by a shadow rate, suggest that without unconventional measures the euro area would have suffered a substantial loss of output during the Great Recession and during the period of deflation from mid-2015 to early 2017. Finally, Neuenkirch and Nöckel (2018) augment a standard vector autoregressive (VAR) monetary policy transmission model for the euro area, in which they establish the effects of conventional monetary policy shocks with the help of the main refinancing rate (MRR) and a mixture of conventional and UMP shocks with the utilization of the shadow rate (Wu and Xia, 2016).

Their results suggest that banks react aggressively to an expansionary monetary policy shock by lowering their lending standards. Hence, for a risk-taking channel of monetary policy transmission in the euro area that works through the relaxation of lending standards for borrowers. However, the banks' efforts to keep their lending margins stable are not successful as the research detect a significant compression.

Turning to the second strand of literature, it focuses on the impact of UMP on bank's performance. There is broad consensus that interest rate increases allow banks to widen their margins by increasing the spread between deposit and loan (e.g., Demirguç-Kunt and Huizinga, 1999; Borio et al., 2017; Claessens et al., 2018). Whether these higher spreads end up translating into higher profits, however, it is ambiguous. The reason for this issue is because banks adjust their retail spreads, balance sheets, and risk profiles in response to interest rate changes endogenously (Borio and Zhu, 2012; Hannan and Berger, 1991; Jiménez et al., 2014). Furthermore, banks' lending decisions following policy changes are strongly influenced by their own monetary policy exposure (Gomez et al., 2021). Overall, the contractionary effects of monetary policy on the economy may increase loan losses and reduce the demand for loans, offsetting the beneficial effects of increasing the spread. Lastly, the way and intensity regarding the profitability of monetary policy is an empirical interrogation, which has proved difficult to respond due to the endogeneity of monetary policy and the lack of bank data beyond the recent cycles, during which changes in interest rates often occurred in response to profitability shocks that hit the banking sector. Understanding the interactions between monetary policy and the bank's behavior and profitability is decisive in informing future policies (Zimmermann, 2019). Before the implementation of unconventional monetary policies, several studies suggest a positive relationship between the level of interest rates and bank profitability (Alessandri and Nelson, 2015; Genay and Podjasek, 2014; Borio and Gambacorta, 2017; Busch and Memmel, 2017). Monetary policy tightening (expansion) leads to an increase (decrease) in the spread between lending and deposit rates, with a consequent increase (decrease) of net interest margins (Zimmermann, 2019). But, certainly, banks may mitigate the negative effect of falling interest rates by raising lending volumes, lowering interest expenses (Scheiber et al., 2016), increasing loan spreads (Sääskilahti, 2018), lowering risk provisioning (Albertazzi and Gambacorta, 2009; Borio et al., 2017), setting higher fees (Turk, 2016), taking more risk (Heider et al., 2019), or hedging interest risk (Chaudron, 2018). How banks adjust the previous levers of their lending policies, upon the implemented non-standard measures, will ultimately determine how negative rates affect the overall bank's profitability. Besides decreasing the policy rates, central banks have also at their disposal additional tools to control the economic environment. These tools are the QE and forward guidance, which can offer a substitute for an interest rate policy when it is constrained by the lower limit (Karadi and Nakov, 2021; Antolín-Díaz et al., 2021; Swanson, 2018). Regarding our topic in analysis – bank's profitability – Demertzis and Wolff (2016), based on the historical evolution of government bond term spreads (10-year yields - 1-year yields) and loan deposit rate spread over new credit, suggest that banks profitability is affected by QE in three ways: (1) QE increases bond prices; consequently, banks holding these bonds see their balance sheets strengthened; (2) QE reduces long-term yields and therefore reduces spreads term, which leads to declines in the loan-to-deposit ratio spread, making it harder for banks to generate net interest income on new loans; (3) QE improves economic prospects, which should help banks exposed to the economy to find new credit opportunities and should reduce problems with non-performing loans. Similar effects to QE can be found in forward guidance, namely decreasing long-term yields. Wu and Xia (2020) suggest that forward guidance became a significant part of the unconventional monetary policies and was the reason the curved shape was pushed even further after the implementation of the negative interest rate policy. The above-mentioned literature warns and provides caution to how non-standard measures can affect bank profitability. However, the literature is not consensual on a broad number of related topics. For example, authors such as Claessens et al. (2018) or Campmas (2020) suggest that monetary policy's main instrument adversely affects bank income, whereas Lopez et al. (2020) find little overall impact of negative nominal rates on bank profitability, compared with low positive rates, even, for some sub-samples, weak evidence of positive impacts. Another example includes Abadi et al. (Forthcoming) and Rognlie (2016) which argue that there is nothing special about moderate negative interest rates per se. On the other hand, Eggertsson et al. (2017) and Demiralp et al. (2021) find that the standard mechanisms of monetary policy cease to function at negative interest rates due to several frictions, such as the extension of more loans, holding more non-domestic government bonds or relying less on wholesale funding. Moreover, recent research focuses on prolonged low interest rates for too long: for example, Altavilla et al. (2018) and García-Cruz et al. (2020) suggest the presence of negative effects on bank profitability if the low interest rates continue, which is connected with the existence of a reversal rate (Abadi et al., Forthcoming; Pariès et al., 2020).

2.3. Methodology

This section begins with a discussion of the dependent variables. It then proceeds to present the independent variables we select and construct. Afterwards, this section concludes by describing the econometric methodology.

2.3.1. Dependent Variables

We choose to assess four dependent variables: NII, NNOII, LLP and ROA. First, banks take deposits from consumers and businesses and pay interest on some accounts. In turn, banks take the deposits and either invest those funds in securities or lend to companies and consumers. Since banks receive interest on their loans, their profits are derived from the spread between the rate they earn or receive from borrowers and the rate they pay for the deposits. In this way, and syntactically, we describe the interest components impact on the overall bank performance.

Second, besides the interest components, banks also earn income from the revenue fees they charge for their products and services, including wealth management advice, checking account fees, overdraft fees, ATM fees, and credit card interests and fees; this latest description represents the non-interest components. Third, LLP involves a degree of judgment, representing the management's best assessment of the appropriate loss to be provisioned. LLP ultimately reduces the bank's net income and profit. Lastly, the sum of interest, non-interest and LLP generate the final net income of banks.

For consistency purposes, all dependent variables are relative to the total assets; this way, the variables have a comparable magnitude to ROA. Similar approaches were employed by Altavilla et al. (2018), Lopez et al. (2020) and Campmas (2020). Figure 2.1 summarizes the bank's earning flows.

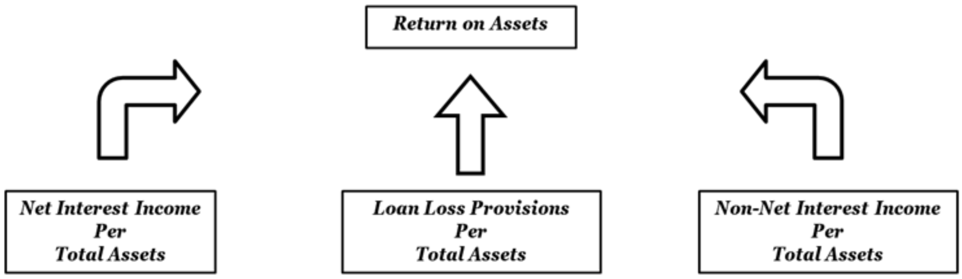


Figure 2.1: Bank's Earning Components.

2.3.2. Independent Variables

We divide the independent variables into three large categories: monetary policy, market and macroeconomic variables, and bank-specific variables. Among the first group of variables, we present the unconventional monetary policy (UMP) deviation – our main contribution to the literature –, which intends to provide additional information on unconventional measures that are not captured in the standard monetary policy variables to explain bank profitability.

2.3.2.1. Monetary Policy

Unconventional monetary policy (UMP) deviation

Unconventional monetary policies are characterized by non-standard measures, along with low or negative interest rates. Within the euro area, there were the following seven unconventional monetary policies also mentioned in Figure 2.2. First, in autumn 2008, the ECB implemented fixed-rate full allotment auctions, providing unlimited credit to banks at a fixed interest rate. Second, in May 2010, the ECB launched the purchased debt securities (Securities Markets Programme). Third, in December 2011, the ECB carried out the very long-term refinancing operations (VLTROs). Fourth, in August 2012, the ECB announced conditional Outright Monetary Transactions (OMT), which acted as a powerful circuit breaker against self-reinforcing fears in sovereign bond markets. This program was never implemented. Fifth, in July 2013, the ECB implemented forward guidance, which means communicating how the ECB expects its policy measures to evolve in the future and what conditions would warrant a change in the policy stance. Sixth, in mid-2014, the ECB announced the asset purchase programme (APP), involving private and public sector securities, to put downward pressure on the term structure of interest rates. This measure was implemented in the fourth quarter of 2014. Lastly, in June 2014, the ECB reduced the Deposit Facility rate to negative territory, which is a rate that banks may use to make overnight deposits with the Eurosystem and implemented the Targeted Longer-Term Refinancing Operations (TLTROs) designed to support bank lending to businesses and households.

Given the diversity and constant increase of measures applied by the ECB, interest rates lost importance as the main monetary policy instrument. Consequently, assessing the impact of unconventional monetary policies or summarizing the general stance of monetary policy in this new environment has become a major challenge. Upon this challenge, several studies proposed the so-called shadow rate – first introduced by Black (1995) – as a solution to represent monetary policy as a whole because, unlike the observed short-term interest rate, the shadow rates are not limited to 0% or hit zero-lower bound (Wu and Xia, 2016; Krippner, 2013; Kim and Singleton, 2012).

Since the shadow rate represents the general stance of monetary policy, it does not isolate the effects of UMP. Hence, to capture the isolated effects of non-standard measures, we develop a variable that removes the effect of conventional monetary policy from the shadow rate. As such, we define the UMP deviation as:

$$UMP_t = SR_t - OIS_t, \tag{2.1}$$

where SR_t stands for the Wu and Xia's shadow rate, and OIS_t represents the 3-months overnight index swap at quarter t. An overnight index swap (OIS) is a term interest rate swap (IRS) where periodic fixed payments are linked to a certain fixed rate, while periodic floating payments are linked to a floating rate calculated from a daily compound overnight rate during the floating coupon period. In an environment with sufficient liquidity and without market variations, the interest rate on time bank deposits must have a close relationship with the expectation of overnight rates composed in the same horizon, as implied by the expectation hypothesis (Linzert and Abbassi, 2012). More importantly, we choose the 3-months OIS as the short-term interest rate to be consistent with the Taylor Rule that uses 3-months OIS as a proxy for the monetary policy instrument.

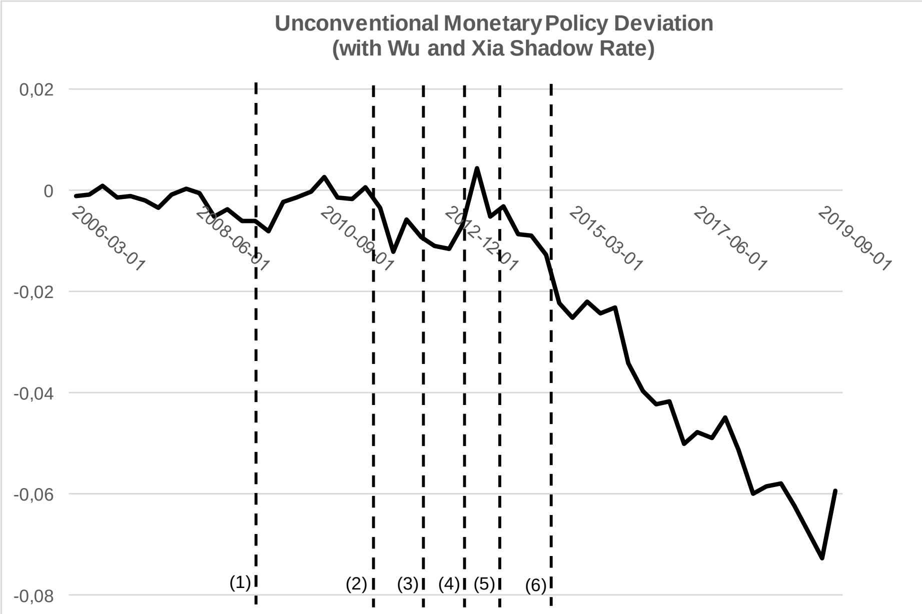
We decide to use the shadow rate calculated by Wu and Xia (2016) as our primary shadow rate measure as this is the most widely used and tested upon the existing literature regarding the impact of unconventional monetary policies (e.g., Avdjiev et al., 2020).[1]

The basic idea of the Wu and Xia (2016) methodology, based on a Factor-Augmented Vector Autoregression by Bernanke et al. (2005), is to compactly summarize the high-dimensional rich information contained in a large set of economic variables using few latent factors to obtain lower-dimensional data while preserving as much of the data's variation as possible. From 97 macro variables loadings, more than one third of the variables have an R^2 above 60%, confirming a three-factor structure. Besides the policy rate, the research focuses on the following five macroeconomic variables: industrial production, consumer price index, capacity utilization, unemployment rate and housing starts. Those macroeconomic variables represent the three factors resulting from having the highest loadings. The final intuition is to condense even further the information of the three latent factors in one variable – the so-called shadow rate – that arises from the stemming of a term structure model, which co-moves strongly with the Federal funds rate or ECB policy rate when there is no binding ZLB constraint, (Debortoli et al., 2020). Thus, monetary policymakers flatten the policy rates, but the shadow rates continue to decrease by capturing the increase of liquidity on the market caused by, for example, QE and the influence of Forward Guidance upon economic expectations. Since the appearance of the shadow rate, several studies have analyzed how they can be applied to study the impact of UMP in several aspects of the economy. In particular, several theoretical studies have introduced the shadow rates to overcome problems in macroeconomic models caused by the ZLB (Wu and Zhang, 2019a; Wu and Zhang 2019b; Bernanke, 2020; Ellington, 2022).

Figure 2.2 plots the evolution of the UMP Deviation variable. As we can observe below, the intensification of unconventional monetary policies leads to the further decline of our proxy.

To facilitate the interpretation of this variable, we divide the timeline into periods using the ECB's announcements of the UMP measures.

[1] Different studies may estimate different values for the shadow rate related to different model assumptions or approaches. For that reason and for robustness purposes, we perform, as well, the same estimations using the shadow rates estimated by Krippner (2013) and Rezende et al., (2023). The results are in the robustness section.



Announced Events	
(1)	Fixed-Rate Full Allotment
(2)	Securities Markets Programme
(3)	Very Long-Term Refinancing Operations (VLTROs)
(4)	Outright Monetary Transactions
(5)	Forward Guidance
(6)	Asset Purchase Programme and Targeted Longer-term Refinancing Operations

Figure 2.2: Evolution of the UMP Deviation - Difference between Shadow Rate and 3-Month Overnight Index Swap. Events (1) to (6) announced by ECB between Q1 2006 until Q4 2019.

As shown in Figure 2.2, after the implementation of unconventional measures – Fixed-Rate Full Allotment, Securities Markets Programme, Very Long-Term Refinancing Operations (VLTROs) and Outright Monetary Transactions – the shadow rate began to differ from the short-term interest rate. However, this discrepancy between the rates becomes more pronounced only after 2013, as the shadow rate becomes increasingly negative and the short-term interest rate stabilizes. This period is accompanied by the implementation of the forward guidance, the Asset Purchase Program, and the Targeted Long-Term Refinancing Operations. Due to this stylized fact (linked to the implementation of the QE) the empirical part is divided into two subperiods to better estimate the effects that may have been cause to banks' profitability.

Short-term interest rate

Following Altavilla et al. (2018), among others, the three-month overnight index swap is used as a proxy for short-term interest rates. As there is an effective lower limit for the deposit interest rate, it may not be possible to transfer the reduction to the deposit interest rate; thus, the NII is reduced (Zimmermann, 2019). Hence, we expect a positive relationship between the level of interest rates and NII. The effect of falling interest rates on banks' overall profitability will depend on whether the negative effect on the net interest margin is offset by other positive effects coming from NNOII or LLP. For example, banks can adopt mitigation strategies to reduce the impact of falls in interest rates, such as raising lending volumes, lowering interest expenses (Scheiber et al., 2016), increasing loan spreads (Sääskilahti, 2018), lowering risk provisioning (Albertazzi and Gambacorta, 2009; Borio et al., 2017), setting higher fees (Turk, 2016), taking more risk (Albertazzi et al., 2016; Heider et al., 2019), or hedging interest risk Chaudron (2018). No less important is to reinforce the notion that the same relationship remains valid even when interest rates are set in very low or negative territory (Altavilla et al., 2018; García-Cruz, 2020). Figure 2.3 plots the evolution of the 3-months Overnight Index Swap (OIS) for the ECB scope.

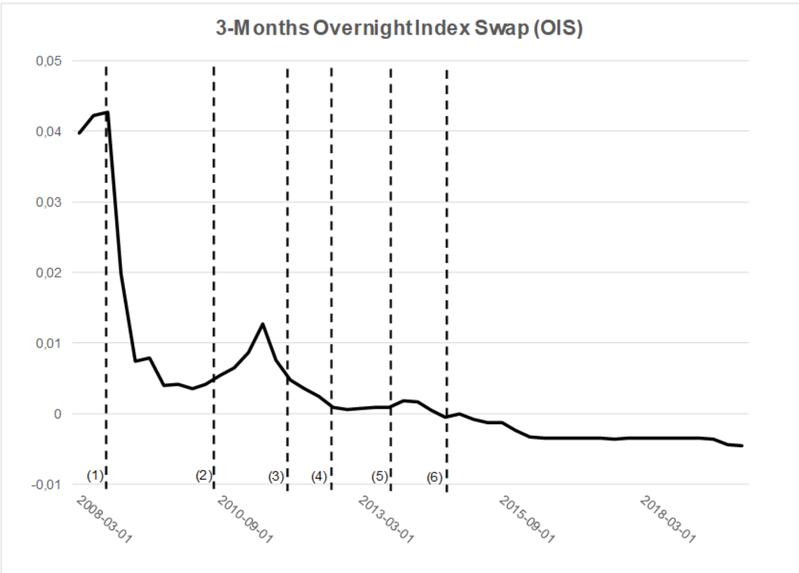


Figure 2.3: Evolution of the 3-Months Overnight Index Swap (OIS), data from Q1 2008 until Q4 2019.

Slope of the Yield Curve

We represent the slope of the yield curve using the difference between the interest rate of a ten-year sovereign bond and a two-year sovereign bond, again following Altavilla et al. (2018), among others. Analogously to the case of interest rates, the expected relationship between the slope of the interest curve and the net interest margin is positive. Like in the case of the short-term interest rate, the effect of the slope of the yield curve on the bank's overall profitability will depend on whether the effect on net interest margin is offset by other adverse effects. Figure 2.4 plots the evolution of the Slope of the Sovereign Yield Curve for the ECB countries under analysis.

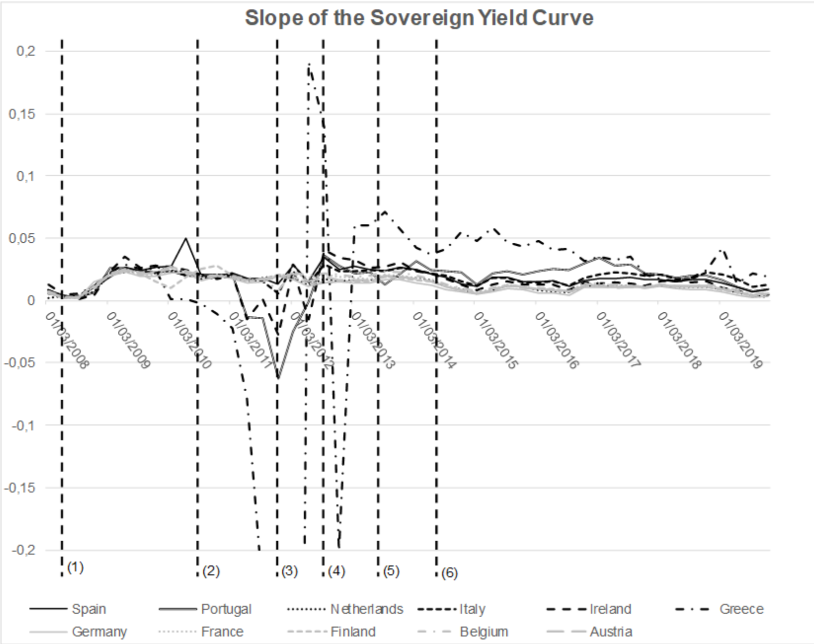


Figure 2.4: Evolution of the Slope of the Sovereign Yield Curve, data for Austria, Belgium, Finland France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain, from Q1 2008 until Q4 2019.

2.3.2.2. Market and Macroeconomic Variables

The literature tends to include market and macroeconomic variables to control environmental exposure (e.g., Borio et al., 2017; Altavilla et al., 2018; García-Cruz, 2020). In this category, we include the GDP growth, inflation, expected GDP growth and inflation and VIX, a market volatility index.

First, the annual GDP growth rate is included to control the business cycle (Demirguç-Kunt and Huizinga 1999; Bikker and Hu, 2002; Albertazzi and Gambacorta, 2009). Second, the literature considers inflation as a determinant because it plays a decisive role in the interest rate structure and controls consumer prices (Campmas, 2020; Martins et al., 2019; Altavilla et al., 2018). Third, the inclusion of expected inflation and economic growth aims to offset the effects of other factors that simultaneously affect the monetary policy stance and the profitability components of banks (Altavilla et al., 2018; Athanasoglou et al., 2008). For example, a compression in ROA could reflect any news expected to undermine economic conditions, which, in turn, would also lead to a fall in interest rates due to the central bank's reaction, which incorporates this news. More specifically, and according to economic theory and central bank practice (see, e.g., Bernanke and Gertler, 1995), monetary policy reacts (is endogenous) to the current and expected overall economic and financial conditions. Finally, VIX is a real-time market index that measures market risk and investors' sentiments (Altavilla et al., 2018). The latter variable is included based on Kumar et al. (2023), which argue that the monetary policy's interaction on stock market volatility impacts leverage and economic activity.

2.3.2.3. Bank-specific variables

<u>5 Years default probability</u>

5-Years Default probability is a forward-looking measure of borrower risk. We use it as a risk score assigned to the issuer, based on the Bloomberg issuer default risk model generated probability of default over the next five years. The model includes the following inputs: Share Price, Market Cap, Price Volatility (1-year), Short-term Debt, Long-term Debt, Total Debt, Loan Loss Reserve, Non-Performing Loans, and Effective Net Income. The proxy employed is similar to the expected default probability used by Altavilla et al. (2018), which attempt to measure borrower risk.

<u>Bank's Non-Performing Loans (NPL)</u>

Non-performing Loans are the value of non-performing loans divided by the total value of assets (including non-performing loans before deducting specific LLP). It measures the bank's loan portfolio quality, where higher economic growth is, in principle, also associated with less defaulted loans in banks' loan portfolios, providing an additional impetus to lend with lower spreads (Matthys et al., 2020). Non-performing loans can be assumed as a proxy for credit risk (Altavilla et al., 2018). Ekinci (2016) assesses the effect of credit risk through an industrial index.

<u>Capital Adequacy Ratio</u>

The Capital Adequacy Ratio (CAR) sets standards for banks, looking at their ability to pay liabilities and respond to credit and operational risks. A bank with a good CAR has sufficient capital to absorb potential losses. Thus, it is less at risk of becoming insolvent and losing depositors' money. Altavilla et al. (2018) use a similar ratio called Tier1 capital ratio.

Efficiency Ratio

Furthermore, the cost-to-income ratio is characterized as operational costs (like administrative costs, staff compensations and property costs) as a level of the income produced before provisions. According to Pasiouras and Kosmidou (2007), this ratio is used to gauge the effect of proficiency on the bank's productivity. As indicated by Dietrich and Wanzenried (2011, 2014) and Berglund and Mäkinen (2019), we anticipate that higher cost/revenue ratios should have a negative relationship with the bank's profitability (Martins et al., 2019 and Altavilla et al. 2018).

Table 2.1 summarizes the variables, previous studies that employ those variables, and the expected effect on bank profitability.

Table 2.1: Independent Variables source and expected impact on ROA.

	Literature	**Expectations - Bank Profitability**
Monetary Policy Instruments		
Short-term interest rate	Altavilla et al. (2018). Campmas (2020), Alessandri and Nelson (2015), Borio et al. (2017), Cruz-García et al. (2019), Angori et al. (2019), and Claessens et al. (2018)	+
Slope of the Yield Curve	Altavilla et al. (2018), Cruz-García (2019), Campmas (2020), Aydemir and Ovenc (2016), Borio et al. (2017), Angori et al. (2019), and Claessens et al. (2018).	+/-
Unconventional Monetary Policy Deviation	New to the Literature. Authors Calculations.	+/-
Macroeconomic		
Cboe Volatility Index, or VIX	Altavilla et al. (2018)	+
GDP Growth	Altavilla et al. (2018) Demirguç-Kunt and Huizinga, (1999), and Albertazzi and Gambacorta, (2009)	+
Inflation	Altavilla et al. (2018), and Martins, et al. (2019)	+
Expected GDP Growth	Altavilla et al. (2018)	+
Expected Inflation	Altavilla et al. (2018)	+
Bank-specific		
5 Years default probability	Altavilla et al. (2018)	-
Bank's Non-Performing Loans (NPL)	Altavilla et al. (2018), and Matthys et al. (2020)	-
Capital Adequacy Ratio	Altavilla et al. (2018)	+
Efficiency Ratio	Altavilla et al. (2018) and Dietrich and Wanzenried (2011, 2014), and Berglund and Mäkinen (2019)	+

Notes: Independent Variables with respective expected effects on bank's profitability, based on previous literature related to the topic.

2.3.3. Econometric Methodology

In our methodology, we followed the previous literature, as Altavilla et al. (2018) or García-Cruz (2020), employing a dynamic model which includes the lag dependent variable in the list of regressors to analyze each component of the bank's profitability. In addition, bank-specific fixed effects are specified for each estimation performed.

The Ordinary Least Square (OLS) estimation method may initially result in inconsistent estimates, as the lagged dependent variable is correlated with the error term due to the presence of time-invariant fixed effects, as described by Nickell (1981). Nickell (1981) shows that the OLS estimation in a dynamic panel model with fixed effects may lead to biased results under a fixed (small) number of time periods and a large number of cross-sections (banks, in our case). However, as the time dimension of our dataset is relatively long (the full sample covers 48 time periods), this effect should be negligible (Altavilla et al., 2018).

Nevertheless, we adopt an estimation approach with a one-step difference Generalized Method of Moments (GMM) dynamic panel estimator developed by Arellano and Bond (1991), which accounts for the "individual effects" that arise due to the bank's heterogeneity upon their characteristics. We decide not to control for "time variability" as the UMP Deviation variable is a singleton for each quarter. This estimation method tackles two potential sources of endogeneity, which come from including the lagged dependent variable and from explanatory variables, using the lagged variables at levels as instruments. For our estimations we use only one lag for the instruments.

The consistency of the GMM estimator depends both on the assumption that the error-term has no serial correlation and on the validity of the instruments utilized. For that purpose, we test if the differential of the error-term is correlated in the second-order series to evaluate the first assumption. Regarding the second assumption, the one-step Sargan test, commonly used for validity purposes, requires homoscedastic error-term to have an asymptotic chi-square distribution. In the presence of heteroscedasticity, this test tends to over-reject the null hypothesis (Arellano and Bond, 1991). In the context of banking data, the assumption of homoscedastic error term may be inadequate (e.g., Altavilla et al., 2018; García-Cruz, 2020). In the absence of a test statistic under heterogeneity we decide not to report the Sargan test.

We use two baseline models to achieve our goals and analyze the research problem. On the first baseline model, we consider the monetary policy measures and the market and macroeconomic variables. The second model adds bank-specific variables to the first baseline model. To sum up, the first baseline model will foresee two dimensions, the European Union level and Country level effects. On the second baseline model, beside the previous dimensions, will also shed the light for the bank-specific characteristics in order to control the individual effects. Given the shortage of bank-specific observations on our database, we prefer to have a first baseline reduced model that brings consistency to the results obtained from the extended second baseline model.

1.

$$Y_{ijt} = \alpha_i + \beta_1 Y_{ijt-1} + \beta_2 UMP_t + \beta_3 OIS_t + \beta_4 Dif.Sovereign\,Yield_{jt} + \beta_5 VIX_t + \beta_5 GDP\,Growth_{jt} + \beta_6 Inflation_{jt} + \beta_7 GDP\,Expected\,Growth_{jt} + \beta_8 Expected\,Inflation_{jt} + \varepsilon_{ijt} \quad (2.2)$$

2.

$$Y_{ijt} = \alpha_i + \beta_1 Y_{ijt-1} + \beta_2 UMP_t + \beta_3 OIS_t + \beta_4 Dif.Sovereign\,Yield_{jt} + \beta_5 VIX_t + \beta_5 GDP\,Growth_{jt} + \beta_6 Inflation_{jt} + \beta_7 GDP\,Expected\,Growth_{jt} + \beta_8 Expected\,Inflation_{jt} + \beta_9 5\,Year\,Default\,Probability_{ijt} + \beta_{10} Non - Performing\,Loans_{ijt} + \beta_{11} Capital\,Adequacy\,Ratio_{ijt} + \beta_{12} Efficiency\,Ratio_{ijt} + \varepsilon_{ijt} \quad (2.3)$$

where Y_{ijt} is the dependent variable (i.e., NII, NNOII, LLP or ROA) of bank i operating in country j at time t; α_i are bank fixed effects; β are the coefficients associated with the independent variables previously described, and finally ε represents the error-term.

Lastly, besides estimating our model with all observations, we also estimate our model in two specific regime subsamples: the first subsample goes from Q1 2008 until Q3 2014 (pre-QE), and the second from Q4 2014 to Q4 2019 (post-QE). The rationale for this exercise is related to the QE period. As stated earlier, the asset purchase programme started in the fourth quarter of 2014. According to Figure 2.2, the UMP deviation variable plunged precisely after that date. Without, however, disregarding the unconventional measures previously carried out, it is in our opinion of greater relevance to study in more detail the period in which this discrepancy between the shadow rate and short-term interest rate became sharply divergent and what impact this event caused to bank's performance components.

2.4. Data

In this section, we describe the accounting data, i.e. bank-level, country-level and time-level data, for a cross-section of European banks which we use to analyze the impact of monetary policy on bank profitability. Our scope is attached to the ECB's monetary policy, so we include the following countries on our sample of analysis: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain.

We rely on different datasets with different degrees of granularity, which compress data sources such as Bloomberg, Refinitiv Eikon and DataStream, Moody's Bank Focus, and the Eurostat. Moreover, the analysis is carried out on a quarterly frequency between Q1 2008 and Q4 2019, which implies that the Global Financial crisis occurred within our period of analysis. Therefore, the analyzed time span covers the period in which many countries, with a single monetary policy, implemented expansionary fiscal measures to cope with the financial crisis. Data availability explains differences in some empirical specifications to other studies.

A small number of variables, both dependent and independent variables, have suffered transformations. The dependent variables have been submitted to a process of Winsorise, which is the transformation of statistics by limiting extreme values, to deal with outliers and avoid misleading results. On our data we limit 5th percentile and the 95th percentile. For variables in which it was not possible to obtain only quarterly data, linearization was carried out in order to transform the semiannual data into quarterly base frequency. In Appendix A we summarize the information previously described about the units, periodicity, data level, sources and data transformations to each of our variables employed.

Tables 2.2 and 2.3 summarize the descriptive statistics of our dependent and independent variables, respectively.

Table 2.2: Descriptive Statistics - Dependent Variables

	Obs.	**Mean**	**Stand. Dev.**	**25th percentile**	**Median**	**75th percentile**	**Max**	**Min**
Bank Performance Variables:								
Return on Assets	5194	0.0049	0.0078	0.0014	0.0043	0.0079	0.0234	-0.0097
Net Interest Income per Total Assets	3967	0.0038	0.0031	0.0021	0.0034	0.0045	0.0695	0.0012
Net Non-Interest Income per Total Assets	3807	-0.0015	0.0016	-0.0023	-0.0011	-0.0004	0.0009	-0.0055
Loan Loss Provision per Total Assets	3639	0.0011	0.0012	0.0002	0.0006	0.0016	0.0040	-0.0002

Notes: Data are at quarterly frequency covering the period Q1 2008–Q4 2019.

Table 2.3: Descriptive Statistics - Independent Variables

	Obs.	Mean	Stand. Dev.	25th percentile	Median	75th percentile	Max	Min
Monetary Policy Variables:								
Short-term interest rate	48	0.0035	0.0110	-0.0035	0.0007	0.0044	0.0426	-0.0045
UMP Deviation (Wu and Xia)	48	-0.0226	0.0229	-0.0435	-0.0112	-0.0035	0.0043	-0.0727
UMP Deviation (Rezende)	48	-0.0036	0.0036	-0.0061	-0.0049	-0.0010	0.0080	-0.0082
UMP Deviation (Krippner)	48	-0.0118	0.0090	-0.0180	-0.0113	-0.0028	0.0015	-0.0348
Slope of the Yield Curve	48	0.0140	0.0408	0.0103	0.0157	0.0208	0.1910	-1.3505
Market and Macroeconomic Variables:								
VIX Index	48	0.1535	0.0588	0.1202	0.1342	0.1657	0.3331	0.0805
GDP Growth	528	0.0075	0.0532	-0.0039	0.0109	0.0227	1.3182	-0.2364
Inflation	528	0.0144	0.0110	0.0060	0.0140	0.0220	0.0500	-0.0250
Expected GDP Growth	528	0.0144	0.0053	0.0120	0.0145	0.0165	0.0370	-0.0100
Expected Inflation	528	0.0159	0.0085	0.0100	0.0150	0.0210	0.0500	-0.0260
Bank-Specific Variables:								
5 Years Default Probability	6554	0.0327	0.0572	0.0177	0.0244	0.0326	1.0000	0.0008
Bank's Non-Performing Loans (NPL)	3431	0.0786	0.0873	0.0262	0.0491	0.0967	1.0000	-0.0342
Capital Adequacy Ratio	2715	0.0937	0.0392	0.0640	0.0817	0.1190	0.2675	-0.0185
Efficiency Ratio	3808	0.8310	1.1212	0.5881	0.6992	0.8520	30.4461	-6.6679

Notes: Data are at quarterly frequency covering the period Q1 2008–Q4 2019. Short-term rate is the three-month OIS, slope of the yield curve is the difference between 10- and 2-year sovereign yields. Expected real GDP growth is the 3 to 5-year-ahead expectation.

Tables 2.2 and 2.3 show measures of central tendency and the 25th and 75th percentiles, which allows having a perception of the empirical distribution of our data. Based on the tables above, we observe a wide variation in the data over the sample through the distribution across percentiles. This variation is visible for all groups of variables, from monetary policy, market and macroeconomic to bank-specific. For example, the VIX index's interquartile range goes from around 12% to 16,5%, while the Bank's Non-Performing Loans ratio's range goes from 2.6% to 9.6%. Another example of the variation is the high volatility of monetary variables, Short-term interest rate has 1,1% of standard deviation, UMP Deviation (Wu and Xia) and Slope of the Yield Curve have 2,29% and 4,1% of standard deviation, respectively.

2.5. Results

2.5.1. Full sample (2008-2019)

The estimates of our specifications of Equations (2.2) and (2.3) for the full sample are reported in Table 2.4. The statistical significance is assessed using heteroscedasticity-robust standard errors on all regressions. Our results are clustered at the bank level, and all estimations are tested if the error-term differential is correlated in the second-order series.

Table 2.4 has eight columns, two for each dependent variable. Each pair of columns present the estimation results for the baseline models represented in equation (2.2) (without bank-specific variables) and equation (2.3) (with bank-specific variables). Our analyses will be presented throughout the dependent variables of interest, following separate subsections.

Table 2.4: Profitability components and monetary policy, period Q1 2008–Q4 2019, Wu and Xia's shadow rate.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.0732	0.3060***	0.4380***	0.2150**	0.3710***	0.2820***	0.9600***	0.8480***
	(0.0595)	(0.0568)	(0.0839)	(0.1010)	(0.1080)	(0.0783)	(0.0642)	(0.1170)
Monetary Policy Variables								
Short-term Interest Rate	-0.0115	0.0022	-0.0128**	-0.0034	0.0047	-0.0042	0.0407**	0.0374
	(0.0210)	(0.0081)	(0.0064)	(0.0098)	(0.0052)	(0.0051)	(0.0195)	(0.0248)
UMP Deviation	0.0122**	0.0147**	-0.0061	-0.0179**	0.0090***	0.0169***	0.0144	0.0192
	(0.0056)	(0.0071)	(0.0051)	(0.0081)	(0.0026)	(0.0036)	(0.0093)	(0.0137)
Yield Slope	0.0000	-0.0004	0.0005	-0.0049	0.0000	0.0000	0.0013*	-0.0038
	(0.0003)	(0.0007)	(0.0005)	(0.0033)	(0.0001)	(0.0007)	(0.0007)	(0.0038)
Market & Macroeconomic Variables								
VIX Index	0.0018***	0.0016***	-0.0017***	-0.00233***	0.0000	0.0001	0.0000	-0.0006
	(0.0007)	(0.0006)	(0.0004)	(0.0006)	(0.0003)	(0.0004)	(0.0007)	(0.0016)
GDP Growth	0.0003	0.0000	-0.0001	-0.0001	0.0004*	0.000	0.0009	0.0008**
	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0007)	(0.0003)
Inflation	0.0010	-0.0238**	-0.0028	0.0000	0.0099**	0.0092**	-0.0306**	0.0049
	(0.0127)	(0.0116)	(0.0071)	(0.0118)	(0.0040)	(0.0043)	(0.0147)	(0.0236)
Expected GDP Growth	0.0699	-0.0146	0.0321**	-0.0256	-0.0267***	-0.0497***	0.0860**	0.1110
	(0.0572)	(0.0278)	(0.0128)	(0.0268)	(0.0087)	(0.0118)	(0.0386)	(0.0745)
Expected Inflation	-0.0022	0.0161	0.0002	0.0080	-0.0112**	-0.0114***	-0.0352	-0.0698**
	(0.0273)	(0.0150)	(0.0093)	(0.0152)	(0.0045)	(0.0043)	(0.0215)	(0.0328)

(continues)

Table 2.4: Profitability components and monetary policy, period Q1 2008–Q4 2019, Wu and Xia's shadow rate. ***(continued)***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Bank-Specific Variables								
5 Year Default Probability		-0.0009		-0.0011		-0.0050**		0.0088
		(0.0017)		(0.0046)		(0.0020)		(0.0140)
Non-Performing Loan Ratio		-0.0075		-0.0023		0.0021		-0.0059
		(0.0084)		(0.0040)		(0.0019)		(0.0126)
Capital Adequacy Ratio		-0.0006		-0.0090***		0.0005		-0.0179**
		(0.0021)		(0.0030)		(0.0025)		(0.0082)
Efficiency Ratio		0.0000		-0.0006**		0.0000		-0.0005**
		(0.0000)		(0.0003)		(0.0000)		(0.0002)
Constant	0.0026***	0.0039***	-0.0012***	0.0005	0.0013***	0.0021***	0.0000	0.0029*
	(0.0008)	(0.0012)	(0.0003)	(0.0008)	(0.0002)	(0.0004)	(0.0005)	(0.0017)
Observations	3,622	1,248	3,483	1,249	3,338	1,216	4,802	1,234
Number of key_banks	126	56	122	54	116	54	147	55
Arellano-Bond test for AR(1) in first differences [p-value]	0.0623	0.1217	0.0000	0.0000	0.0000	0.0008	0.0000	0.0052
Arellano-Bond test for AR(2) in first differences [p-value]	0.5635	0.2803	0.8026	0.1057	0.1588	0.5512	0.1212	0.2272

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q1 2008–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation with a one-step difference Generalized Method of Moments (GMM) dynamic panel estimator developed by Arellano and Bond (1991). UMP deviation is computed based on Wu and Xia's shadow rate.

2.5.1.1. Net Interest Income

In columns (1) and (2), representing the bank's NII, we find a significant positive relationship between the UMP deviation and the NII variable. Since the intensification of the unconventional monetary policies measures led to the decrease of the UMP deviation, this result suggests that unconventional monetary policies tend to decrease banks' net income on interest components. This result is in line with the theoretical literature, which argues that the implementation of unconventional monetary policy - such as fixed-rate full-allotment auctions, QE, and VLTROs - has made it more difficult for banks to generate NII on new loans (by example, Andreeva and García-Pousada, 2021; Demertzis and Wolff, 2016; Kanga and Levieuge, 2020).

Regarding market and macroeconomic variables, we find a significant and positive relationship between stock market volatility – represented by the VIX index – and NII. Although few authors investigate the relationship between stock market volatility and bank performance, Albertazzi and Gambacorta (2009) also report a positive relationship between stock market volatility and bank NII. After all, when the markets are more volatile, investors expect higher returns to accept the risk. Only for column (2), that is, for the model containing bank-specific variables, we notice a negative relationship between inflation and NII. Several studies, such as Dietrich and Wanzenried (2014), report a positive relationship, whereas Goddard et al. (2013) indicate an insignificant relationship. In fact, during more favorable economic conditions, banks are more likely to increase their loans and improve pricing terms to expand their market share. Nevertheless, Angori et al. (2019), with a study within the euro area for a period of crisis and post-crisis, obtain a negative relationship between inflation and NII. This result can be explained because interest rates on liabilities adjust to inflation faster than those on assets, leading to a negative relationship between inflation and NII (Maudos and Solís, 2009). Finally, we do not find a significant relationship between bank-specific variables and NII.

2.5.1.2. Net Non-Interest Income

The NNOII, expressed in columns (3) and (4), has a significant negative relationship with the UMP deviation. As unconventional monetary policies reduce NII, banks are expected to balance their profits by increasing the non-interest components.

Regarding the short-term interest rate, presented in column (3), we find a significant negative relationship with the NNOII when considering the model without bank-specific variables. The reason for the negative relationship between short-term interest rates and NNOII is also linked to banks' interest income, which may have been impacted by the low interest rate environment. Kok et al. (2019) also find a negative and significant relationship between the short-term interest rate and the non-interest components. Through losses achieved by reducing interest components, banks will seek to offset these losses by increasing service charges (e.g., Hauribrich and Young, 2019). A similar understanding of this event is reported by Lopez et al. (2020), who suggest that the impact of low nominal interest rates is offset, to a certain degree, by increases in fees, commissions, trading assets and derivative activities, among other non-interest components.

Regarding the market and macroeconomic variables, we find a negative relationship between the stock market's volatility and the NNOII. When volatility decreases, investors' expected return decreases and banks' NII will decrease; to offset these losses, banks may compensate by increasing non-interest net income. Albertazzi and Gambacorta (2009) find an inverse relationship. However, their data reflects a period from 1981 to 2003 and includes banks in the United Kingdom, United States, and OECD. This information is important because, in this period, banks were constantly increasing their interest and non-interest income as the economy improved, which is not in line with our period under review. For the model without bank data, we find a positive relationship between expected GDP growth and non-interest income. This result suggests that banks expect their customers to have higher incomes and are more willing to pay for, for example, more fees or commissions. Altavilla et al. (2018) find the same positive relationship between non-interest income and expected GDP.

Concerning the variables specific to banks, two variables have significance and a negative relationship: the capital adequacy ratio and the efficiency ratio. Before analyzing the relationship of both variables with NNOII, it is important to remember that non-interest income allows banks to diversify their income structure better and become more resilient to the general economic conditions that affect their credit portfolio. Furthermore, a larger share of non-interest income makes them less dependent on maturity transformation and interest rate risk (Kohler, 2014). In light of the above mention, a higher capital adequacy ratio is associated with less risky banks, as they can better withstand negative impacts on their portfolios. In other words, the increase in Tier 1 and Tier 2 capital (or decrease Risk-Weighted Assets) leads to a reduction in bank's fees or commissions. Overall, if a bank is well capitalized does not need to seek more non-interest income to become more stable. A similar analogy can be drawn for the efficiency ratio: as banks increase cost-efficiency in their revenue management, they do not need to increase fees or commissions to balance their profits. Hahm (2008) argues that high-cost income ratios tend to exhibit higher non-interest income. However, this analysis is carried out for OECD countries between 1992 and 2006. During our period of analysis, banks lost significantly in the interest components; it is possible that due to this event, banks adopted a combination of increasing revenues from NNOII and improving its cost-effectiveness.

2.5.1.3. Loan Loss Provisions

In columns (5) and (6), representing the bank's LLP, we find a significant positive relationship with the UMP deviation. The mentioned impact is that existing loans become more viable with unconventional monetary policies and need fewer provisions (Borio et al., 2017). Furthermore, unconventional monetary policies may improve economic prospects, which help banks exposed to the economy find new credit opportunities and should reduce problems with non-performing loans.

Regarding market and macroeconomic variables, inflation and expected inflation present interesting results to be explored, as both are significant, but with inverse relationships. The expected impact of unconventional monetary policies by the ECB was to increase inflation to 2%, and these measures by the UMP would have as their ultimate goal the improvement of macroeconomic conditions and, consequently, a relaxation of provisions. However, we know that inflation did not grow as expected by the implemented policies. Abreu and Azevedo (2021) claim that economic forecast has consistently higher inflation rates than current ones (the so-called "missing inflation puzzle", Constâncio, 2015; IMF, 2016), The authors suggest that traditional economic models that report inflation and economic activity may have difficulty capturing the main forces driving inflation. According to this interpretation, the results suggest that loss provisions may have been adjusted based on expectations rather than current inflation. The same analogy can also be seen within GDP growth. GDP growth for the model without bank specifications is positive relative to loan provisions but expected GDP growth for both models is negatively related.

Besides inflation and GDP Growth, we also find a significant relationship between their expectations and the bank's provisioning. As perceived by Altavilla et al. (2018), the endogeneity of macroeconomic variables, such as inflation and GDP growth, needs to be controlled. Monetary policy is endogenous (reacts) to the macroeconomic environment (current and expected); not including these variables in the specification would generate an omitted variable bias.

Bank-specific variables provide a warning: the reduction in LLP is associated with an increase in the probability of default over the 5-year horizon, which means that the risk of banks' collapse is increasing although the macroeconomic has improved. Under normal conditions, the higher expected probability of default will lead to higher provisions. However, due to significant losses in NII, banks may borrow riskier to recoup losses, avoiding provisioning given better macro conditions. Kandrac and Schlusche (2021) argue that the creation of Fed reserves leads to greater growth in total credit and greater risk-taking, the same happening within the scope of the ECB.

2.5.1.4. Return on Assets

Finally, columns (7) and (8) express the results for the return on bank assets. The model without bank-specific variables, column (7), shows a significant positive relationship between the short-term interest rate and the slope of the yield with the ROA. In conventional periods of monetary policy, higher interest rates and higher sovereign yields lead to higher returns for banks (similar results are found in Altavilla et al., 2018). Low short-term interest rates often come simultaneously with a flatter and lower yield curve, which reduces banks' ROA (García-Cruz, 2020). Much of the literature that includes the effect of monetary policy on bank profitability confirm a positive relationship between the level of interest rates and bank profitability (in the short-term, Genay and Podjasek, 2014; Busch and Memmel, 2017 - in the medium to long term - ; Weistroffer et al., 2013; Alessandri and Nelson, 2015; Sääskilahti, 2018; Borio et al., 2017; Claessens et al., 2018; Cruz-García et al., 2020; Angori et al., 2019; Aydemir and Ovenc, 201; among others). Although our UMP deviation variable is not statistically significant for estimating the return on bank assets, we emphasize that the UMP deviation is significant for the components that make up the ROA. That is, the UMP is significant for interest and non-interest income components and provisioning that counterbalance each other out.

Our results suggest that GDP growth, inflation, and its expectations, influence banks' ROA in a way consistent with theory: the ROA tends to improve with increasing GDP growth or expected GDP growth, while it tends to decrease when inflation or expected inflation increases. These results can be seen in both models, with and without bank-specific variables.

The bank-specific variables present two significant variables, and both are negatively related, which are the capital adequacy ratio and the efficiency ratio. First, these results mean that increasing Tier 1 and Tier 2 capital (or decreasing risk-weighted assets) reduce risk-taking and expected returns. Second, reducing cost-to-income ratios tend to lead to higher returns.

2.5.2. QE's structural break (split samples Q1 2008- Q3 2014 and Q4 2014 – Q4 2019)

In this analysis, we look at two subsamples associated with two specific regimes. The first subperiod is from the first quarter of 2008 to the third quarter of 2014, which includes unconventional monetary policies such as fixed-rate full-allotment auctions, the Securities Markets Programme, Very Long-Term Refinancing Operations (VLTROs), Outright Monetary Transactions, and Forward Guidance. The second subperiod is from the fourth quarter of 2014 to the fourth quarter of 2019, which corresponds to the implementation of the Asset Purchase Programme and Targeted Longer-term Refinancing Operations, thus related to the implementation of QE.

QE increases the money supply by purchasing assets with newly created bank reserves to provide more liquidity to banks. Ultimately, this will further lower interest rates and allow banks to lend on easier terms. Viewing our proxy called UMP Deviation calculated as the difference between the Wu and Xia (2016) shadow rate and the overnight interest swap rate, we see that after the announcement of QE, the Wu and Xia's shadow rate diverged significantly from the short-term interest rate. Without, however, disregarding the unconventional measures previously carried out, it is in our opinion of greater relevance to study in more detail the period in which this discrepancy between the Wu and Xia (2016) shadow rate and the short-term interest rate became strongly divergent and what is the impact of this event caused to the performance components of the bank.

2.5.2.1. Pre-QE regime (Q1 2008- Q3 2014)

In this subsection, we study the subperiod from the first quarter of 2008 to the third quarter of 2014, indicated in Table 2.5. This analysis follows the same structure as above.

Table 2.5: Profitability components and monetary policy, period Q1 2008–Q3 2014, Wu and Xia's shadow rate.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.0715	0.3250***	0.5060***	0.1160	0.2430	0.00365	0.9730***	0.8570***
	(0.0596)	(0.0411)	(0.0891)	(0.1060)	(0.1900)	(0.2230)	(0.0747)	(0.1200)
Monetary Policy Variables								
Short-term Interest Rate	-0.0210	0.0004	-0.0118*	-0.0029	0.0014	-0.0040	0.0441**	0.0139
	(0.0291)	(0.0068)	(0.0072)	(0.0118)	(0.0054)	(0.0080)	(0.0223)	(0.0310)
UMP Deviation	0.0068	0.0275	0.0167*	-0.0048	-0.0005	0.0067	0.0237	0.0056
	(0.0098)	(0.0172)	(0.0092)	(0.0177)	(0.0058)	(0.0105)	(0.0186)	(0.0274)
Yield Slope	0.0000	-0.0008	0.0004	-0.0053	0.0000	0.00030	0.0014**	-0.0044
	(0.0003)	(0.0008)	(0.0005)	(0.0036)	(0.0001)	(0.0004)	(0.0007)	(0.0051)
Market & Macroeconomic Variables								
VIX Index	0.0017	0.0010*	-0.0009*	-0.0021**	0.00046*	0.0011**	0.0007	-0.0013
	(0.0011)	(0.0006)	(0.0005)	(0.0010)	(0.0003)	(0.0004)	(0.0010)	(0.0020)
GDP Growth	0.0017	-0.0012	-0.0002	0.0017	0.0016**	-0.0001	0.0011	-0.0002
	(0.0014)	(0.0009)	(0.0010)	(0.0012)	(0.0007)	(0.0008)	(0.0030)	(0.0012)
Inflation	0.0072	-0.0289*	0.0133*	0.0124	0.0123**	-0.0009	-0.0426**	-0.0307
	(0.0145)	(0.0159)	(0.0073)	(0.0142)	(0.0049)	(0.0084)	(0.0190)	(0.0281)
Expected GDP Growth	0.0911	-0.0206	0.0525***	-0.0201	-0.0264**	-0.0569***	0.0750*	0.1340**
	(0.0804)	(0.0357)	(0.0163)	(0.0402)	(0.0106)	(0.0185)	(0.0400)	(0.0556)
Expected Inflation	0.0011	0.0224	-0.0213**	-0.0106	-0.0096	-0.0116	-0.0386	-0.0064
	(0.0360)	(0.0186)	(0.0102)	(0.0205)	(0.0060)	(0.0076)	(0.0285)	(0.0438)

(continues)

Table 2.5: Profitability components and monetary policy, period Q1 2008–Q3 2014, Wu and Xia's shadow rate. ***(continued)***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Bank-Specific Variables								
5 Year Default Probability		-0.0004		-0.0019		-0.0036***		-0.0048
		(0.0022)		(0.0073)		(0.0013)		(0.0193)
Non-Performing Loan Ratio		-0.0078		-0.0140		-0.0007		0.0129
		(0.0054)		(0.0129)		(0.0048)		(0.0156)
Capital Adequacy Ratio		-0.0020		-0.0039		-0.0028		-0.0068
		(0.0030)		(0.0041)		(0.0035)		(0.0112)
Efficiency Ratio		0.0000		-0.0006**		0.0000		-0.0005*
		(0.0001)		(0.0003)		(0.0000)		(0.0003)
Constant	0.0023**	0.0040***	-0.0010***	0.0009	0.0013***	0.0028***	0.0002	-0.0004
	(0.0011)	(0.0010)	(0.0003)	(0.0014)	(0.0004)	(0.0006)	(0.0005)	(0.0019)
Observations	1,720	460	1,624	453	1,612	460	2,543	456
Number of key_banks	102	36	90	30	95	36	131	35
Arellano-Bond test for AR(1) in first differences [p-value]	0.0814	0.1840	0.0000	0.0014	0.0000	0.0210	0.0001	0.0403
Arellano-Bond test for AR(2) in first differences [p-value]	0.2289	0.2980	0.6280	0.5341	0.0257	0.2456	0.1858	0.0909

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q1 2008–Q3 2014. Standard errors clustered at bank level in parentheses. Estimation with a one-step difference Generalized Method of Moments (GMM) dynamic panel estimator developed by Arellano and Bond (1991). UMP deviation is computed based on Wu and Xia's shadow rate.

Regarding the NII, the monetary policy variables do not explain NII. Comparing with the results for the full sample, these results imply that the positive relationship mentioned above may be caused by QE or by the combination of all UMP measures applied by the ECB. We test these hypotheses in the following subsection. Regarding market and macroeconomic variables, these results are consistent with the full sample analysis whereas for the bank-specific variables we do not find significant results to be reported.

For the NNOII, our results are consistent with the analysis for the complete sample, except for two variables. First, the relationship between UMP deviation and NNOII is still significant, but this time it is positive. Overall, this positive relationship suggests that banks were decreasing non-interest-related components as unconventional monetary policies were implemented. Hence, banks did not find it necessary to adjust NNOII to balance losses in interest income during the period from Q1 2008 to Q3 2014. Second, the capital adequacy ratio is insignificant in explaining NNOII during this subperiod.

Similar to the results on NNOII, the results on LLP are consistent with the full sample, except in two variables. First, we do not find a significant relationship between the UMP deviation and LLP. This situation may be related to the unconventional measures adopted from the 1^{st} quarter of 2008 to the 3^{rd} quarter of 2014, which were insufficient to improve the macroeconomic conditions, and banks did not reduce provisioning. Second, we do not find any significant relationship between expected inflation and the provision for loan losses.

Finally, regarding the banks' ROA, our results show that the UMP deviation remains insignificant, also because the UMP deviation is found to be insignificant to explain the profit components. This result suggests that the measures applied by unconventional monetary policies neither reinforced nor mitigated the fall in bank profitability. Lastly, expected inflation and GDP growth lose significance in the subperiod analysis from the first quarter of 2008 to the fourth quarter of 2014.

2.5.2.2. Post-QE regime (Q4 2014 - Q4 2019)

We now turn our attention to the sub-period from the fourth quarter of 2014 to the fourth quarter of 2019, when QE was implemented by the ECB. The results are in Table 2.6.

For the NII, and comparing with the estimation for the full sample, we find a significant positive relationship between the deviation of the UMP and the NII (for the model that does not include bank-specific variables). This result contrasts with what we find in the previous subsection, suggesting that the measures implemented after Q3 2014, and not before, may have reduced the components of net interest. Furthermore, we find a significant positive relationship between the sovereign bond yield slope and NII in both models. English (2002) also reported this type of relationship, arguing that bank liabilities are re-priced faster than bank assets or have shorter maturity base rates, leveraging the relationship mentioned. In addition to the aforementioned relationships, we also find a positive significant relationship between the stock volatility index and NII (for the model with bank-specific variables).

Concerning the NNOII, our results reinforce the idea that after the implementation of QE banks decided to increase the non-interest components, as reported by the negative relationship between the Deviations UMP and existing losses on the NII. However, for the subperiod in question, the short-term interest rate has a significant and positive relationship with the dependent variable. The VIX index maintains a significant negative relationship and GDP growth for both models, and inflation, for the model without bank data, has a significant negative relationship with non-interest net income. The main reason for this relationship may be related to the fact that both GDP and inflation did not evolved as expected and therefore banks were forced to obtain more income from non-interest components. The capital adequacy ratio maintains the same relationship, and the efficiency ratio loses importance.

Moving on to the LLP, the UMP deviation has a positive relationship with provision (for the model with bank-specific variables). This result is similar to the analysis of the full sample and suggests that QE drives the improvement of the bank's liquidity, which reduces provisions as fewer defaults are expected. Furthermore, costs associated with LLP tend to increase (decrease) following an upward (downward) shift or a steepening (flattening) of the yield curve. This outcome is in line with Altavilla et al. (2018). However, unlike Altavilla et al. (2018), the short-term interest rate shows a negative and significant relationship with the LLP. This result means that protracted low short-term interest rates alone were deteriorating the perception of the macroeconomy. An interpretation similar to the full-sample analysis can be provided for macroeconomic variables. However, we note that GDP growth loses significance.

Last but not least, regarding the banks' ROA, our results suggest that the UMP Deviation is insignificant in regard to the relationship with the overall ROA, which can be explained by the offsetting effects of QE on the bank's profitability components, NII, NNII and LLP. There is a positive relationship between the short-term interest rate and ROA (for the model without a specific bank), and negative relationship with the slope of the yield on sovereign bonds. Among other authors, Borio et al. (2017) find a positive effect of both the level of short-term interest rates and the slope of the interest curve on bank profitability for a sample of 14 advanced economies. We can confirm this to the short-term interest rate but not the yield slope. The slope of sovereign bond yields decreased considerably among the euro countries studied in this study, in proportion to the QE applied from the fourth quarter of 2014 to the fourth quarter of 2019. Sovereign bond denotes the improvement in the country's confidence and default on bonds, which translate into a negative relationship between the fall in yields and the increase in the profitability of the bank's assets. As mentioned by García-Cruz et al. (2020), the previous literature can mainly find a positive relationship or no relationship between the current expansionary monetary policy and the profitability of banks, which brings an inconclusive effect. Therefore, it confirms that the net impact of lowering interest rates on bank profitability depends on how banks manage the other factors that affect profitability, such as provisions, fees and commissions, the importance of deposits as a source of funding, among others. GDP growth and expected inflation are consistent with the full sample. Inflation and expected GDP growth are meaningless at the moment. Capital adequacy remains significant and negative, but the importance of the efficiency ratio disappears.

Table 2.6: Profitability components and monetary policy, period Q4 2014–Q4 2019, Wu and Xia's shadow rate.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.1620*	0.3300*	0.4040***	0.4440***	0.4940***	0.2680***	0.8590***	0.8530***
	(0.0907)	(0.1930)	(0.1050)	(0.1280)	(0.0954)	(0.0943)	(0.1200)	(0.1790)
Monetary Policy Variables								
Short-term Interest Rate	-0.0223	-0.0694	0.2140***	0.1660**	-0.0773*	-0.1190**	0.1690*	0.1670
	(0.0447)	(0.0714)	(0.0625)	(0.0788)	(0.0403)	(0.0543)	(0.0897)	(0.1520)
UMP Deviation	0.0115**	0.0155	-0.0261***	-0.0247***	0.0055	0.0172***	0.0151	0.0122
	(0.0058)	(0.0110)	(0.0058)	(0.0074)	(0.0040)	(0.0045)	(0.0113)	(0.0183)
Yield Slope	0.0187**	0.0134*	0.0136	0.0002	0.0222***	0.0150*	-0.0735***	-0.0735**
	(0.0078)	(0.0081)	(0.0141)	(0.0117)	(0.0085)	(0.0080)	(0.0216)	(0.0326)
Market & Macroeconomic Variables								
VIX Index	0.0010	0.0022*	-0.0031***	-0.0026***	-0.0007*	-0.0009	0.0003	0.00042
	(0.0008)	(0.0012)	(0.0005)	(0.0007)	(0.0004)	(0.0008)	(0.0014)	(0.0029)
GDP Growth	0.0001	0.0002	-0.0004**	-0.0006**	0.0000	0.0000	0.0008**	0.0016**
	(0.0001)	(0.0003)	(0.0002)	(0.0003)	(0.0001)	(0.0001)	(0.0003)	(0.0007)
Inflation	-0.0037	-0.00267	-0.0390***	-0.0284	0.0088	0.0229***	-0.0017	0.0283
	(0.0155)	(0.0240)	(0.0149)	(0.0224)	(0.0098)	(0.0088)	(0.0214)	(0.0285)
Expected GDP Growth	0.0043	0.0005	-0.0336	-0.0589*	-0.0425**	-0.0848***	0.2000**	0.3070
	(0.0291)	(0.0344)	(0.0215)	(0.0301)	(0.0171)	(0.0251)	(0.0831)	(0.2370)
Expected Inflation	-0.0063	-0.0107	0.0316**	0.0427**	-0.0280***	-0.0221*	-0.0325	-0.1160**
	(0.0102)	(0.0206)	(0.0156)	(0.0201)	(0.0083)	(0.0117)	(0.0285)	(0.0491)

(continues)

Table 2.6: Profitability components and monetary policy, period Q4 2014–Q4 2019, Wu and Xia's shadow rate. *(continued)*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Bank-Specific Variables								
5 Year Default Probability		-0.0013		0.0037		-0.0041		0.0198
		(0.0032)		(0.0041)		(0.0026)		(0.016)
Non-Performing Loan Ratio		-0.0089		0.0029		0.0038*		-0.0123
		(0.0108)		(0.0037)		(0.0022)		(0.0173)
Capital Adequacy Ratio		-0.0036		-0.0080**		0.0033		-0.0267*
		(0.0033)		(0.0040)		(0.0034)		(0.0152)
Efficiency Ratio		-0.00016		-0.0007		-0.0004***		-0.0002
		(0.0001)		(0.0006)		(0.0001)		(0.0003)
Constant	0.0031***	0.0039**	-0.0006	0.0007	0.0012***	0.0022***	0.0000	0.0022
	(0.0006)	(0.0017)	(0.0005)	(0.0008)	(0.0004)	(0.0007)	(0.0014)	(0.0034)
Observations	1,732	730	1,701	738	1,576	700	2,036	723
Number of key_banks	112	52	107	51	100	49	129	51
Arellano-Bond test for AR(1) in first differences [p-value]	0.0480	0.2706	0.0000	0.0011	0.0000	0.0065	0.0000	0.0146
Arellano-Bond test for AR(2) in first differences [p-value]	0.0755	0.8258	0.5881	0.3611	0.9792	0.8810	0.0378	0.8778

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q4 2014–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation with a one-step difference Generalized Method of Moments (GMM) dynamic panel estimator developed by Arellano and Bond (1991). UMP deviation is computed based on Wu and Xia's shadow rate.

2.5.2.3. QE's structural change: Overall Results on Unconventional Monetary Policy

Based on our previous results in subchapters 2.5.2.1 and 2.5.2.2., we can conjecture that the measures applied by the ECB during the period from Q1 2008 to Q3 2014 did not act as a recovery indenture on the bank's performance indicators.

Nevertheless, during the period of Q4 2014 to Q4 2019, the measures applied allowed banks to reduce provisions, given the lower expectations of default, despite boosting losses on the NII component. In addition to the reduction in provisions, banks also increased NNOII, which offset the losses in the interest component. However, it is not clear, as shown in tables 2.5 to 2.6, based on the UMP deviation, whether unconventional monetary policies directly influenced banks profitability. In other words, and based on our previous estimations, the unconventional monetary policies did not impact the overall bank profitability, advocating those banks may have adjusted their strategies and structure to account the monetary policies implemented by the ECB.

Additionally, without the overall banks' profitability being significantly affected, it is not possible to affirm that ECB intentions and strategy is limited by the relationship between bank's gains and monetary policies applied, which means that ECB still has space to intensify the measurements applied if economic conditions are not yet those desired, without the condition of damaging the banking system.

2.5.3. Krippner (2013) and Rezende et al., (2023) Shadow Rates

As stated in the Methodology section, we use the shadow rate calculated by Wu and Xia (2016) as our primary shadow rate definition, in detriment to other shadow rates, as this is the best known, most widely used, and tested in the existing literature regarding the impact of unconventional monetary policies (e.g., Avdjiev et al., 2020; Mavroeidis, 2021). For the sake of completeness, we perform a similar analysis, focusing on the full sample and the subsample from Q4 2014 until Q4 2019, for the shadow rates estimated by Krippner (2013) and Rezende et al. (2023) which have different assumptions and modelling approaches.

Krippner (2013) propose an approximation for the instantaneous forward rate in continuous time similar to Wu and Xia (2016), adding a call option feature to derive the solution. An important difference between Wu and Xia (2016) and Krippner (2013) calculations is the fact that Wu and Xia (2016) shadow rate results from a shadow/lower-bound term structure model (SLM) with three factors instead of just two factors, as calculated by Krippner (2013). In this sense, Krippner (2015) criticizes Wu and Xia's (2016) shadow rate of not being robust due to the excessive sensitivity to their proxy. According to the author, Wu and Xia (2016)'s computations leads to a tenuous and/or insignificant interpretation of policy measures concerning levels and changes in shadow rate. Krippner (2015) argues that the shadow rate estimated from the two-factor shadow/low limit term structure model is relatively robust in dynamics and profile and correlates well with UMP events. In addition, the two-factor shadow rate is suitable for policy monitoring and quantitative analysis, but depending on the application, robustness checks with different lower limit specifications and samples appropriate for the given application economics should be employed.

Rezende et al., (2023) develop another shadow rate by presenting an additional feature of particular relevance. Krippner (2013) and Wu and Xia (2016) shadow rates result from Black's (1995) mechanism, which is when the observed short-term rate is at its lower bound, and longer-term rates are sufficiently constrained. These shadow rates capture movements in the whole yield curve and decouple from the short-term rate, being commonly interpreted as a measure of the overall stance of monetary policy at the lower bound. Rezende et al., (2023) estimate a shadow rate through a discrete-time gaussian dynamic affine term structure model, that measures the overall stance of monetary policy when the lower bound is not necessarily binding. The particular feature of this specification is that it does not impose any lower bound constraint on nominal interest rates. This feature allows the shadow rate to measure the interest rate effects of UMP at any point in time, being particularly useful for estimating the overall stance of monetary policy prior and during the lower bound period, as well as in the post UMP environment. The biggest advantage of this approach is not requiring a lower bound environment. As such, the shadow rate from Rezende et al., (2023) is particularly convenient from an estimation point of view, as the literature has emphasized that typical shadow rate estimates seem to be highly sensitive to the assumed numerical value for the lower bound (Bauer and Rudebusch, 2016).

Figure 2.5 shows the difference between the UMP deviations using the three different shadow rates. The difference is more pronounced in the second regime, where we perceive that the magnitudes are further apart. It is verified that the UMP Deviations calculated from the Rezende shadow rate are more stable and that the UMP Deviations calculated from the Krippner shadow rate show a momentary growth around 2017, unlike the UMP deviation calculated from the shadow rate of Wu and Xia. These differences can motivate the difference between the results that we will see later.

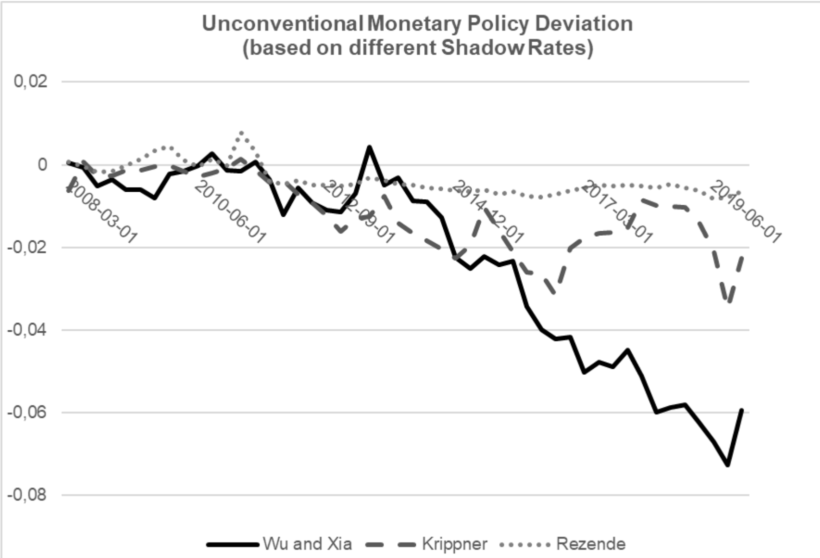


Figure 2.5: Unconventional Monetary Policy Deviation: Shadow Rates calculated with Wu and Xia (2016), Krippner (2013) and Rezende et al., (2023), and 3-Month Overnight Index Swap. Data from Q1 2008 until Q4 2019.

Tables 2.7 to 2.10 summarize the estimation results for the full sample (2008-2019) and subsample (Q4 2014 - Q4 2019) for the four dependent variables under analysis. Table 2.7 has estimates with a baseline model without bank-specific variables whereas Table 2.8 is for the baseline model containing bank-specific variables. Both tables consider the unconventional deviation of monetary policy calculated with the Krippner (2013) shadow rate. Tables 2.9 and 2.10 are the same but with the Rezende et al., (2023) shadow rate. Again, the independent variables are categorized into the usual three categories (Monetary Policy, Market and Macroeconomics, and Bank-specific variables) but we only present the estimates of our monetary policy variables given the purpose of our investigation and to facilitate the interpretation of the main results.

Table 2.7: Profitability components and monetary policy, Krippner's shadow rate, without bank-specific controls.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.1800*	0.0847	0.4560***	0.4600***	0.5220***	0.4220***	0.9200***	0.9810***
	(0.0987)	(0.0599)	(0.1040)	(0.0859)	(0.0837)	(0.1050)	(0.1240)	(0.0615)
Monetary Policy Variables								
Short-term Interest Rate	0.0292	-0.0089	0.0849	-0.0137**	-0.0532	0.0054	0.2020**	0.0400**
	(0.0414)	(0.0204)	(0.0706)	(0.0062)	(0.0403)	(0.0051)	(0.0913)	(0.0194)
UMP Deviation	0.0015	0.0034	-0.0019	0.0039	-0.0001	-0.0048	0.0116	0.0017
	(0.0067)	(0.0071)	(0.0061)	(0.0040)	(0.0038)	(0.0034)	(0.0126)	(0.0096)
Yield Slope	0.0234***	0.0000	0.0061	0.0005	0.0240**	0.0001	-0.0829***	0.0012*
	(0.0074)	(0.0003)	(0.0167)	(0.0005)	(0.0097)	(0.0001)	(0.0220)	(0.0007)
Constant	0.0026***	0.0024***	0.0007	-0.0009***	0.0008***	0.0009***	-0.0006	-0.0002
	(0.0005)	(0.0009)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0014)	(0.0006)

(continues)

Table 2.7: Profitability components and monetary policy, Krippner's shadow rate, without bank-specific controls. ***(continued)***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Market & Macroeconomic Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Specific Variables	No	No	No	No	No	No	No	No
Observations	1,732	3,622	1,701	3,483	1,576	3,338	2,036	4,802
Number of key_banks	112	126	107	122	100	116	129	147
Arellano-Bond test for AR(1) in first differences [p-value]	0.0480	0.0608	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Arellano-Bond test for AR(2) in first differences [p-value]	0.0802	0.2861	0.5728	0.8855	0.8950	0.1027	0.0365	0.1253

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Market & Macroeconomic variables includes: VIX Index, GDP Growth, Inflation and Expected GDP Growth Expected Inflation. Bank-specific variables include: 5 Year Default Probability, Non-Performing Loan Ratio, Capital Adequacy Ratio and Efficiency Ratio. Data are at quarterly frequency covering an unbalanced sample for the full period Q1 2008–Q4 2019, but also subperiod Q4 2014–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation with a one-step difference Generalized Method of Moments (GMM) dynamic panel estimator developed by Arellano and Bond (1991). The table only contains estimations for the baseline model without bank-specific variables. Unconventional Monetary Policy deviation is computed based on Krippner's shadow rate.

Table 2.8: Profitability components and monetary policy, Krippner's shadow rate, with bank-specific controls.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.3440**	0.3290***	0.4910***	0.2580***	0.3580***	0.3740***	0.8630***	0.8840***
	(0.1630)	(0.0557)	(0.1200)	(0.0967)	(0.0922)	(0.0822)	(0.1800)	(0.1200)
Monetary Policy Variables								
Short-term Interest Rate	0.0561	0.0081	0.0085	-0.0076	-0.0479	-0.0003	0.3060	0.0378
	(0.0394)	(0.0075)	(0.0848)	(0.0097)	(0.0548)	(0.0051)	(0.2070)	(0.0246)
UMP Deviation	-0.0067	0.0025	0.0057	0.0067	0.0004	-0.0026	-0.0132	-0.0176
	(0.0105)	(0.0074)	(0.0090)	(0.0080)	(0.0044)	(0.0045)	(0.0250)	(0.0150)
Yield Slope	0.0247**	0.0000	-0.0115	-0.0055	0.0198**	0.0002	-0.0595*	-0.0034
	(0.0117)	(0.0007)	(0.0128)	(0.0034)	(0.0083)	(0.0007)	(0.0326)	(0.0039)
Constant	0.0027**	0.0034***	0.0023***	0.0015**	0.0011*	0.0013***	0.0010	0.0016
	(0.0012)	(0.0010)	(0.0007)	(0.0007)	(0.0006)	(0.0003)	(0.0036)	(0.0017)

(continues)

Table 2.8: Profitability components and monetary policy, Krippner's shadow rate, with bank-specific controls. *(continued)*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Market & Macroeconomic Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Specific Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	730	1,248	738	1,249	700	1,216	723	1,234
Number of key_banks	52	56	51	54	49	54	51	55
Arellano-Bond test for AR(1) in first differences [p-value]	0.2413	0.1141	0.0007	0.0000	0.0066	0.0007	0.0141	0.0046
Arellano-Bond test for AR(2) in first differences [p-value]	0.8252	0.2714	0.3386	0.1474	0.9193	0.3591	0.8729	0.2420

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Market & Macroeconomic variables includes: VIX Index, GDP Growth, Inflation and Expected GDP Growth Expected Inflation. Bank-specific variables include: 5 Year Default Probability, Non-Performing Loan Ratio, Capital Adequacy Ratio and Efficiency Ratio. Data are at quarterly frequency covering an unbalanced sample for the full period Q1 2008–Q4 2019, but also subperiod Q4 2014–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation with a one-step difference Generalized Method of Moments (GMM) dynamic panel estimator developed by Arellano and Bond (1991). The table only contains estimations for the baseline model with bank-specific variables. Unconventional Monetary Policy deviation is computed based on Krippner's shadow rate.

Table 2.9: Profitability components and monetary policy, Rezende's shadow rate, without bank-specific controls.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.1980*	0.0807	0.4610***	0.4580***	0.5150***	0.4240***	0.9030***	0.9720***
	(0.1050)	(0.0612)	(0.1060)	(0.0851)	(0.0864)	(0.1010)	(0.1260)	(0.0618)
Monetary Policy Variables								
Short-term Interest Rate	0.0166	-0.0100	0.1130**	-0.0140**	-0.0551	0.0057	0.2350***	0.0410**
	(0.0354)	(0.0205)	(0.0573)	(0.0062)	(0.0367)	(0.0051)	(0.0771)	(0.0195)
UMP Deviation	0.0347	0.0167	-0.1430***	0.0077	0.0208	-0.0099	0.2090***	0.0000
	(0.0487)	(0.0167)	(0.0350)	(0.0084)	(0.0252)	(0.0105)	(0.0732)	(0.0295)
Yield Slope	0.0194***	0.0000	0.0165	0.0005	0.0228***	0.0001	-0.0884***	0.0012*
	(0.0070)	(0.0003)	(0.0140)	(0.0005)	(0.0084)	(0.0001)	(0.0206)	(0.0007)
Constant	0.0027***	0.0023***	-0.0006	-0.0010***	0.0011***	0.0010***	0.0013	-0.0002
	(0.0006)	(0.0008)	(0.0004)	(0.0002)	(0.0004)	(0.0002)	(0.0015)	(0.0005)

(continues)

Table 2.9: Profitability components and monetary policy, Rezende's shadow rate, without bank-specific controls. *(continued)*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Market & Macroeconomic Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Specific Variables	No	No	No	No	No	No	No	No
Observations	1,732	3,622	1,701	3,483	1,576	3,338	2,036	4,802
Number of key_banks	112	126	107	122	100	116	129	147
Arellano-Bond test for AR(1) in first differences [p-value]	0.0499	0.0598	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Arellano-Bond test for AR(2) in first differences [p-value]	0.0895	0.3345	0.7120	0.8556	0.9156	0.1045	0.0345	0.1175

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Market & Macroeconomic variables includes: VIX Index, GDP Growth, Inflation and Expected GDP Growth Expected Inflation. Bank-specific variables include: 5 Year Default Probability, Non-Performing Loan Ratio, Capital Adequacy Ratio and Efficiency Ratio. Data are at quarterly frequency covering an unbalanced sample for the full period Q1 2008–Q4 2019, but also subperiod Q4 2014–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation with a one-step difference Generalized Method of Moments (GMM) dynamic panel estimator developed by Arellano and Bond (1991). The table only contains estimations for the baseline model without bank-specific variables. Unconventional Monetary Policy deviation is computed based on Rezende's shadow rate.

Table 2.10: Profitability components and monetary policy, Rezende's shadow rate, with bank-specific controls.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.4170***	0.3500***	0.5040***	0.2490***	0.3490***	0.3690***	0.8480***	0.8860***
	(0.1110)	(0.0584)	(0.1220)	(0.0938)	(0.0967)	(0.0822)	(0.1800)	(0.1200)
Monetary Policy Variables								
Short-term Interest Rate	-0.0013	0.0071	0.0668	-0.0082	-0.0614	0.0000	0.2590	0.0391
	(0.0381)	(0.0076)	(0.0675)	(0.0097)	(0.0489)	(0.0051)	(0.1730)	(0.0244)
UMP Deviation	0.0252	-0.0223	-0.0999***	-0.0011	0.0761**	0.0012	0.0862	-0.0305
	(0.0805)	(0.0335)	(0.0377)	(0.0157)	(0.0370)	(0.0160)	(0.1110)	(0.0278)
Yield Slope	0.0144**	0.0003	0.0019	-0.0054	0.0151**	0.0002	-0.0767**	-0.0034
	(0.0064)	(0.0008)	(0.0110)	(0.0034)	(0.0070)	(0.0006)	(0.0303)	(0.0038)
Constant	0.0031**	0.0032***	0.0010	0.0013**	0.0018***	0.0014***	0.0026	0.0021
	(0.0013)	(0.0011)	(0.0008)	(0.0006)	(0.0006)	(0.0003)	(0.0039)	(0.0015)

(continues)

Table 2.10: Profitability components and monetary policy, Rezende's shadow rate, with bank-specific controls. ***(continued)***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**	**Q4 2014 - Q4 2019**	**Q1 2008 - Q4 2019**
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Market & Macroeconomic Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Specific Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	730	1,248	738	1,249	700	1,216	723	1,234
Number of key_banks	52	56	51	54	49	54	51	55
Arellano-Bond test for AR(1) in first differences [p-value]	0.1602	0.1149	0.0005	0.0000	0.0061	0.0000	0.0142	0.0044
Arellano-Bond test for AR(2) in first differences [p-value]	0.7513	0.2793	0.4595	0.1360	0.9000	0.8556	0.8796	0.2388

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Market & Macroeconomic variables includes: VIX Index, GDP Growth, Inflation and Expected GDP Growth Expected Inflation. Bank-specific variables include: 5 Year Default Probability, Non-Performing Loan Ratio, Capital Adequacy Ratio and Efficiency Ratio. Data are at quarterly frequency covering an unbalanced sample for the full period Q1 2008–Q4 2019, but also subperiod Q4 2014–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation with a one-step difference Generalized Method of Moments (GMM) dynamic panel estimator developed by Arellano and Bond (1991). The table only contains estimations for the baseline model with bank-specific variables. Unconventional Monetary Policy deviation is computed based on Rezende's shadow rate.

For our specific problem and our sample, the shadow rate of Wu and Xia (2016) fits well with the objective, as we do not obtain tenuous and/or insignificant quantitative results. However, as we can observe from Tables 2.7 and 2.8, our results using Krippner (2013)'s shadow rate contrast with the results previously obtained. Here, we do not obtain significant results on the relationship between monetary policies and the bank's performance components. Furthermore, the UMP deviation calculated with the Krippner (2013) shadow rate does not provide any significant relationship with the banks' profitability components of our analysis.

The shadow rate from Rezende et al., (2023) presents similar results to the ones obtained with Wu and Xia (2016) when we consider the sub-period of assessment Q4 2014 to Q4 2019 and for the net non-interest rate and LLP. However, this shadow rate lacks to provide consistent results on the full sample analysis, as we can see in Tables 2.9 and 2.10. Furthermore, for the subsample Q4 2014 until Q4 2019, the UMP deviation presents a positive relationship with the ROA, but not for the overall full sample. It is fair to say that the significance of our sample is not as strong as for the shadow rate of Wu and Xia (2016).

In general, Rezende et al, (2023) also has consistent results compared to Wu and Xia (2016) but less significant. Krippner (2013) shadow rate does not show significant results. Notwithstanding the aforementioned, it is of major importance to consider Wu and Xia (2016) warning that different model choices influence the values of the shadow rate. The calculation of the shadow rate ends up being more or less accurate for the problem under analysis, depending on the adopted specifications. Nevertheless, we achieve interesting results from Wu and Xia (2016) shadow rate that point to economic conclusions already discussed and mentioned in the literature.

2.6. Robustness

This section presents additional analysis carried out to check the robustness of the results presented in the main part of the study. More specifically, we assess the estimators of the UMP deviation variable using different estimation techniques.

Tables 2.11 and 2.12 replicate the results reported in Tables 2.4 and 2.6, respectively, using the Ordinary Least Squares (OLS) regression with bank-level fixed effects, instead of using the one-step difference Generalized Method of Moments (GMM) dynamic panel estimator. The results of both approaches are relatively similar regarding the UMP deviation variable, meaning that the endogeneity issue, which comes from adding the lagged dependent variable and the explanatory variables, is apparently not that significant and the estimation bias may be residual for at least that specify covariate.

Table 2.11: Profitability components and monetary policy, period Q1 2008–Q4 2019, Wu and Xia's shadow rate, OLS fixed effects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.2770**	0.5630***	0.5170***	0.3490***	0.5970***	0.5690***	0.7730***	0.7910***
	(0.1250)	(0.0588)	(0.0433)	(0.0456)	(0.0394)	(0.0386)	(0.0187)	(0.0375)
Monetary Policy Variables								
Short-term Interest Rate	0.0015	-0.0058	0.0012	0.0048	0.0093***	0.0021	0.0187*	-0.0029
	(0.0087)	(0.0049)	(0.0033)	(0.0045)	(0.0023)	(0.0025)	(0.0108)	(0.0095)
UMP Deviation	0.0094***	0.0036**	0.0000	-0.0014	0.0019*	0.0061***	0.0005	0.0045
	(0.0035)	(0.0018)	(0.0010)	(0.0017)	(0.0011)	(0.0019)	(0.0028)	(0.0040)
Yield Slope	-0.0004	-0.0013**	0.0009***	-0.0019	0.0003***	-0.0002	0.0009	-0.0012
	(0.0003)	(0.0005)	(0.0003)	(0.0014)	(0.0000)	(0.0004)	(0.0006)	(0.0015)
Market & Macroeconomic Variables								
VIX Index	0.0014**	0.0008	-0.0012***	-0.0015***	0.0003	0.0004	-0.0023***	-0.0021
	(0.0007)	(0.0006)	(0.0004)	(0.0006)	(0.0002)	(0.0004)	(0.0007)	(0.0013)
GDP Growth	0.0004	0.0002	-0.0004	0.0000	0.0000	-0.0003*	0.0023**	0.0018***
	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0001)	(0.0002)	(0.0010)	(0.0005)
Inflation	0.0062	-0.0039	-0.0037	0.0008	0.0011	0.0066**	-0.0190**	-0.0121
	(0.0062)	(0.0058)	(0.0050)	(0.0079)	(0.0025)	(0.0027)	(0.0091)	(0.0117)
Expected GDP Growth	0.0229	0.0091	0.0041	-0.0040	-0.0291***	-0.0280***	0.0544***	0.0717***
	(0.0211)	(0.0086)	(0.0060)	(0.0113)	(0.0041)	(0.0052)	(0.0165)	(0.0235)
Expected Inflation	0.0003	0.0078	-0.0014	-0.0108	-0.0052	-0.0075*	-0.0004	-0.0141
	(0.0160)	(0.0085)	(0.0086)	(0.0115)	(0.0032)	(0.0042)	(0.0131)	(0.0169)

(continues)

Table 2.11: Profitability components and monetary policy, period Q1 2008–Q4 2019, Wu and Xia's shadow rate, OLS fixed effects. ***(continued)***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Bank-Specific Variables								
5 Year Default Probability		-0.0043**		0.0005		-0.0016		-0.0098*
		(0.0021)		(0.0022)		(0.0017)		(0.0054)
Non-Performing Loan Ratio		-0.0025		0.0006		0.0007		-0.0023
		(0.0016)		(0.0007)		(0.0005)		(0.0023)
Capital Adequacy Ratio		-0.0031		0.0016		0.0004		0.0049
		(0.0025)		(0.0017)		(0.0013)		(0.0041)
Efficiency Ratio		-0.0001		-0.0006***		0.0000		-0.0004
		(0.0000)		(0.0002)		(0.0000)		(0.0003)
Constant	0.0023***	0.0022***	-0.0005***	-0.0004	0.0009***	0.0011***	0.0008***	0.0006
	(0.0003)	(0.0005)	(0.0001)	(0.0003)	(0.0000)	(0.0002)	(0.0003)	(0.0007)
Observations	3,776	1,362	3,628	1,36	3,471	1,325	4,981	1,364
Number of key_banks	129	57	126	57	118	56	149	56
R-squared	0.097	0.352	0.286	0.245	0.536	0.557	0.660	0.761

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q1 2008–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation is Ordinary Least Squares (OLS) with fixed effects. UMP deviation is computed based on Wu and Xia's shadow rate.

Table 2.12: Profitability components and monetary policy, period Q4 2014–Q4 2019, Wu and Xia's shadow rate, OLS fixed effects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.4120***	0.3300**	0.4580***	0.3220***	0.5460***	0.4710***	0.7370***	0.6990***
	(0.1140)	(0.1250)	(0.0615)	(0.0640)	(0.0514)	(0.0659)	(0.0237)	(0.0405)
Monetary Policy Variables								
Short-term Interest Rate	-0.0533	-0.1180	0.2340***	0.2490***	-0.0498*	-0.1150**	0.0474	0.0310
	(0.0377)	(0.0795)	(0.0409)	(0.0558)	(0.0266)	(0.0433)	(0.0730)	(0.1380)
UMP Deviation	0.0104**	0.0129	-0.0117***	-0.0163***	0.0047*	0.0090**	0.0116	0.0015
	(0.0041)	(0.0088)	(0.0037)	(0.0055)	(0.0027)	(0.0038)	(0.0073)	(0.0137)
Yield Slope	0.0027	-0.0031	-0.0076	-0.0054	0.0040	0.0094	-0.0561***	-0.0446***
	(0.0054)	(0.0028)	(0.0066)	(0.0041)	(0.0046)	(0.0068)	(0.0123)	(0.0164)
Market & Macroeconomic Variables								
VIX Index	0.0017*	0.0028*	-0.0030***	-0.0027***	-0.0001	-0.0003	0.0007	0.0016
	(0.0009)	(0.0016)	(0.0005)	(0.0007)	(0.0004)	(0.0006)	(0.0013)	(0.0027)
GDP Growth	0.0000	0.0002	-0.0003	-0.0003	0.0000	0.0000	0.0002	0.0014***
	(0.0001)	(0.0003)	(0.0003)	(0.0002)	(0.0000)	(0.0001)	(0.0008)	(0.0004)
Inflation	0.0022	-0.0026	-0.0316***	-0.0205	0.0095*	0.0158**	0.0044	0.0473*
	(0.0054)	(0.0071)	(0.0092)	(0.0143)	(0.0054)	(0.0077)	(0.0157)	(0.0254)
Expected GDP Growth	-0.0101	-0.0050	-0.0035	-0.0009	-0.0291***	-0.0548***	0.1040***	0.2060***
	(0.0161)	(0.0136)	(0.0113)	(0.0157)	(0.0103)	(0.0173)	(0.0353)	(0.0619)
Expected Inflation	0.0079	0.0318*	0.0322***	0.0164	-0.0148**	-0.0160	0.0291	-0.0555*
	(0.0137)	(0.0168)	(0.0118)	(0.0156)	(0.0069)	(0.0125)	(0.0184)	(0.0281)

(continues)

Table 2.12: Profitability components and monetary policy, period Q4 2014–Q4 2019, Wu and Xia's shadow rate, OLS fixed effects. ***(continued)***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Bank-Specific Variables								
5 Year Default Probability		-0.0051		-0.0009		-0.0016		-0.0088
		(0.0049)		(0.0019)		(0.0025)		(0.0092)
Non-Performing Loan Ratio		-0.0029		0.0036**		0.0030***		-0.0014
		(0.0046)		(0.0017)		(0.0011)		(0.0046)
Capital Adequacy Ratio		-0.0032		0.0015		-0.0013		0.0008
		(0.0027)		(0.0023)		(0.0030)		(0.0061)
Efficiency Ratio		-0.0002		-0.0005*		-0.0003***		-0.0002
		(0.0001)		(0.0003)		(0.0000)		(0.0002)
Constant	0.0022***	0.0028***	0.0000	-0.0006	0.0009***	0.0015***	0.0007	-0.0011
	(0.0007)	(0.0010)	(0.0003)	(0.0003)	(0.0002)	(0.0004)	(0.0006)	(0.0011)
Observations	1,861	803	1,820	808	1,684	767	2,179	810
Number of key_banks	113	54	109	54	100	52	130	53
R-squared	0.220	0.103	0.234	0.212	0.343	0.387	0.578	0.606

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q4 2014–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation is Ordinary Least Squares (OLS) with fixed effects. UMP deviation is computed based on Wu and Xia's shadow rate.

Tables 2.13 and 2.14 also replicate the results reported in Tables 2.4 and 2.6, respectively, but this time using the two-step System Generalized Method of Moments (GMM) dynamic panel estimator developed by Blundell and Bond (1998) and applied by García-Cruz (2020). System GMM augments the GMM's set of instruments by simultaneously including the differences and levels, the two equations being distinctly instrumented. The two-step estimator is asymptotically more efficient than the one-step estimator. However, as the UMP deviation is a pure time-series variable, the time-variance bias of banks response is not expected. In terms of the UMP deviation variable, the results show some similarities, which suggests that the System GMM does not significantly invalidate the previous main results obtained.

Table 2.13: Profitability components and monetary policy, period Q1 2008–Q4 2019, Wu and Xia's shadow rate, System GMM two-step.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.1200	0.4910***	0.4180***	0.2580***	0.5420***	0.3870***	0.9610***	0.9620***
	(0.0787)	(0.1870)	(0.0580)	(0.0427)	(0.0797)	(0.0676)	(0.0361)	(0.0720)
Monetary Policy Variables								
Short-term Interest Rate	0.0147	0.0151	-0.0137**	-0.0040	0.0115***	0.0034	0.0112	-0.0143
	(0.0095)	(0.0145)	(0.0070)	(0.0059)	(0.0044)	(0.0033)	(0.0140)	(0.0132)
UMP Deviation	0.0176***	0.0008	0.0009	-0.0090***	0.0053	0.0094***	0.0050	0.0126*
	(0.0061)	(0.0027)	(0.0034)	(0.0030)	(0.0034)	(0.0023)	(0.0083)	(0.0075)
Yield Slope	0.0002	0.0004	0.0008	-0.0042**	0.0002	0.0008**	0.0012*	-0.0079
	(0.0003)	(0.0023)	(0.0005)	(0.0020)	(0.0002)	(0.0004)	(0.0007)	(0.0068)
Market & Macroeconomic Variables								
VIX Index	0.0027***	0.0022**	-0.0015***	-0.0024***	0.0007***	0.0008***	-0.0017**	-0.0023*
	(0.0006)	(0.0011)	(0.0005)	(0.0005)	(0.0003)	(0.0003)	(0.0008)	(0.0013)
GDP Growth	0.0006	0.0000	-0.0003	-0.0003	0.0005	-0.0001	0.0015*	0.0012*
	(0.0006)	(0.0005)	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0009)	(0.0006)
Inflation	-0.0059	-0.0275**	0.0079	-0.0003	0.0036	0.0122***	-0.0412*	-0.0173
	(0.0073)	(0.0121)	(0.0072)	(0.0119)	(0.0046)	(0.0042)	(0.0215)	(0.0237)
Expected GDP Growth	0.0190	-0.0273	0.0395***	0.0002	-0.0390***	-0.0555***	0.0902**	0.0737
	(0.0584)	(0.0569)	(0.0115)	(0.0198)	(0.0085)	(0.0081)	(0.0357)	(0.0538)
Expected Inflation	-0.0128	0.0201	-0.0151	-0.0035	-0.0078*	-0.0167***	-0.0136	-0.0358
	(0.0149)	(0.0176)	(0.0107)	(0.0142)	(0.0044)	(0.0040)	(0.0292)	(0.0267)

(continues)

Table 2.13: Profitability components and monetary policy, period Q1 2008–Q4 2019, Wu and Xia's shadow rate, System GMM two-step. *(continued)*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	Net Interest Income	Net Interest Income	Net Non-Interest Income	Net Non-Interest Income	Loan Loss Provision	Loan Loss Provision	Return on Assets	Return on Assets
Bank-Specific Variables								
5 Year Default Probability		-0.0032		-0.0047		-0.0040**		0.0014
		(0.0039)		(0.0030)		(0.0020)		(0.0113)
Non-Performing Loan Ratio		0.0020		-0.0018*		0.0044***		-0.0030
		(0.0025)		(0.0011)		(0.0006)		(0.0034)
Capital Adequacy Ratio		0.0024		-0.0080***		0.0015		-0.0118**
		(0.0085)		(0.0021)		(0.0021)		(0.0059)
Efficiency Ratio		-0.0002		-0.0007***		0.0000		-0.0007*
		(0.0003)		(0.0002)		(0.0000)		(0.0003)
Constant	0.0033***	0.0019*	-0.0011***	0.0007*	0.0011***	0.0015***	0.0000	0.0024*
	(0.0006)	(0.0011)	(0.0002)	(0.0004)	(0.0002)	(0.0003)	(0.0005)	(0.0013)
Observations	3,776	1,362	3,628	1,360	3,471	1,325	4,981	1,364
Number of key_banks	129	57	126	57	118	56	149	56
Arellano-Bond test for AR(1) in first differences [p-value]	0.1132	0.1407	0.0000	0.0019	0.0003	0.0065	0.0000	0.0212
Arellano-Bond test for AR(2) in first differences [p-value]	0.6024	0.2456	0.7785	0.1519	0.1554	0.4434	0.1257	0.2451

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q1 2008–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation with a two-step system Generalized Method of Moments (GMM) dynamic panel estimator developed by Blundell and Bond (1998). Two lags of dependent variable for use as instruments. UMP deviation is computed based on Wu and Xia's shadow rate.

Table 2.14: Profitability components and monetary policy, period Q4 2014–Q4 2019, Wu and Xia's shadow rate, System GMM two-step.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Dependent Variable Lag	0.6160***	0.5320***	0.4100***	0.4340***	0.6570***	0.3630***	0.9290***	0.9740***
	(0.1530)	(0.1130)	(0.0772)	(0.0981)	(0.0880)	(0.1310)	(0.0608)	(0.0861)
Monetary Policy Variables								
Short-term Interest Rate	-0.0976	-0.1270*	0.2130***	0.1870*	-0.0666	-0.1130*	0.1340*	0.2680**
	(0.0726)	(0.0698)	(0.0557)	(0.1000)	(0.0406)	(0.0625)	(0.0691)	(0.1230)
UMP Deviation	0.0037	0.0035	-0.0246***	-0.0206***	-0.0004	0.0135*	0.0108	0.0191
	(0.0046)	(0.0060)	(0.0058)	(0.0068)	(0.0062)	(0.0069)	(0.0086)	(0.0149)
Yield Slope	0.0108	-0.0009	0.0092	0.0009	0.0329***	0.0231***	-0.0481**	-0.0475*
	(0.0141)	(0.0087)	(0.0134)	(0.0135)	(0.0076)	(0.0080)	(0.0206)	(0.0267)
Market & Macroeconomic Variables								
VIX Index	0.0023**	0.0043	-0.0033***	-0.0027***	-0.0004	-0.0009	-0.0003	-0.0005
	(0.0010)	(0.0027)	(0.0006)	(0.0009)	(0.0004)	(0.0008)	(0.0009)	(0.0040)
GDP Growth	0.0000	0.0000	-0.0007**	-0.0007*	0.0000	-0.0002	0.0008***	0.0017**
	(0.0000)	(0.0003)	(0.0003)	(0.0004)	(0.0001)	(0.0002)	(0.0003)	(0.0008)
Inflation	0.0101	0.0181	-0.0343**	-0.0388**	0.0080	0.0316***	0.0035	0.0237
	(0.0108)	(0.0185)	(0.0143)	(0.0198)	(0.0084)	(0.0096)	(0.0162)	(0.0511)
Expected GDP Growth	-0.0144	-0.0544**	-0.0559**	-0.0517*	-0.0572***	-0.0961***	0.0858	0.0470
	(0.0337)	(0.0226)	(0.0232)	(0.0291)	(0.0169)	(0.0151)	(0.0696)	(0.0793)
Expected Inflation	-0.0155	-0.0091	0.0357**	0.0507**	-0.0324***	-0.0325***	-0.0220	-0.0469
	(0.0123)	(0.0195)	(0.0170)	(0.0217)	(0.0085)	(0.0117)	(0.0241)	(0.0475)

(continues)

Table 2.14: Profitability components and monetary policy, period Q4 2014–Q4 2019, Wu and Xia's shadow rate, System GMM two-step. *(continued)*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Bank-Specific Variables								
5 Year Default Probability		-0.0034		0.0011		-0.0045		0.0139
		(0.0055)		(0.0032)		(0.0032)		(0.0131)
Non-Performing Loan Ratio		0.0064**		0.0015		0.0042***		-0.0075
		(0.0031)		(0.0030)		(0.0012)		(0.0061)
Capital Adequacy Ratio		-0.0009		-0.0068		0.0046		-0.0057
		(0.0054)		(0.0047)		(0.0040)		(0.0116)
Efficiency Ratio		-0.0002		-0.0006		-0.0003***		-0.0003
		(0.0002)		(0.0006)		(0.0000)		(0.0003)
Constant	0.0011	0.0015**	-0.0001	0.0008	0.0009**	0.0019**	0.0007	0.0032*
	(0.0008)	(0.0006)	(0.0004)	(0.0009)	(0.0004)	(0.0008)	(0.0011)	(0.0019)
Observations	1,861	803	1,820	808	1,684	767	2,179	810
Number of key_banks	113	54	109	54	100	52	130	53
Arellano-Bond test for AR(1) in first differences [p-value]	0.0172	0.0814	0.0017	0.0047	0.0024	0.0546	0.0010	0.0729
Arellano-Bond test for AR(2) in first differences [p-value]	0.5489	0.6505	0.6654	0.4013	0.7947	0.9816	0.0461	0.8206

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q4 2014–Q4 2019. Standard errors clustered at bank level in parentheses. Estimation with a two-step system Generalized Method of Moments (GMM) dynamic panel estimator developed by Blundell and Bond (1998). Two lags of dependent variable for use as instruments. UMP deviation is computed based on Wu and Xia's shadow rate.

2.7. Summary and Discussion

In this study, we examine the impact of unconventional monetary policies (UMP) on banks' profitability by the introduction of a new variable called UMP deviation in a regression model, which results from the difference between the Wu and Xia (2016) Shadow Rate and the Short-term Interest Rate. To tackle our question, we also split our full sample into two regimes. The first subsample includes all the unconventional monetary policies except the QE, and the second includes all UMP.

The results suggest four robust findings. First, the relationship between UMP deviation and banks' profitability components is significant, on both full and sub-samples under analysis. This suggests that unconventional monetary policies have impacted bank's profitability components.

Second, regarding the pre-and pos- QE regimes, the results obtained suggest that the non-standard monetary measures had no effect on bank profitability components before the QE.

Third, the results obtained with the second subsample, which already includes the QE, suggest that non-standard measures were able to reinforce the decrease of NII and at the same time partially offset the decrease in LLP and the increase in the NNOII.

Fourth, the effect of UMP on banks' overall return is not clear. According to our results, the unconventional monetary policies do not seem to damage or benefit banks regarding their returns. In other words, banks may have been able to adapt to the new environment and monetary transmission mechanisms may have not been compromised. These effects also mean that the banks' profitability should not be at risk of influencing the decisions of the ECB, should it need to intensify the measures applied to date.

Finally, when using the shadow rates from Krippner (2013) or Rezende et al., (2023), our results show a weaker relationship between the UMP deviation and bank profitability components than when using the Wu and Xia (2016)'s shadow rate. As such, further research shall assess how shadow rate computations are performed and how they can be adapted to the research of bank profitability.

Appendix A

Table A.1: Summary of units, frequency, data level, sources and data transformations to each of our variables employed.

	Units	Frequency	Data Level	Source	Manipulation/Transformations
Dependent Variables					
NII per TA	Hundredth of percent	Quarterly-basis and Semi-annual	Bank-level	Refinitiv Eikon	Winsorise & Linearization from Semi-annual to Quarterly basis
NNOII per TA					
LLP per TA					
ROA				Refinitiv Eikon & Bloomberg	
Independent Variables					
Monetary Policy Instruments					
Short-term interest rate	Hundredth of percent	Quarterly-basis	Time-level	Refinitiv DataStream	-
UMP Deviation (Wu and Xia)					-
UMP Deviation (Rezende)				Authors Data File	-
UMP Deviation (Krippner)					-
Slope of the Yield Curve			Country-level	Refinitiv DataStream	-
Market and Macroeconomic					
VIX Index	Hundredth of percent	Quarterly-basis	Time-level	Bloomberg	-
GDP Growth			Country-level	Eurostat	-
Inflation					-
Expected GDP Growth		Semi-annual		Refinitiv DataStream	Linearization from Semi-annual to Quarterly basis
Expected Inflation		Quarterly-basis			-
Bank-specific					
5 Years default probability	Hundredth of percent	Quarterly-basis	Bank-level	Bloomberg	-
Bank's Non-Performing Loans (NPL)		Semi-annual		Moody's Bank Focus	Linearization from Semi-annual to Quarterly basis
Capital Adequacy Ratio		Quarterly-basis and Semi-annual		Refinitiv DataStream	
Efficiency Ratio					

3. An Uneven Policy: The Impact of the U.S. Unconventional Monetary Policy on Bank Profitability across Quantiles

Synopsis: This study explores the impact of monetary policy along the distribution of bank profitability in the U.S. banking system during 2008–2019, using a quantile regression method. The objective is to understand if the conditional quantiles 10%, 25%, 50%, 75%, and 90% of bank profitability indicators such as Return on Assets (ROA), Net Interest Income (NII), Net Non-Interest Income (NNOII) and Loan Loss Provision (LLP), respond differently upon the implementation of unconventional monetary policies (UMP), such as Quantitative Easing (QE) and Maturity Extension Program (MEP). Our results suggest that UMP increased the average bank's overall ROA. Furthermore, our results also suggest that the UMP implemented by the U.S. Fed have uneven impacts on the U.S. banks' profitability components. These uneven impacts can be seen in three measures of profitability: UMP (i) increased bank's NNOII at their lower quantiles; (ii) decreased provisioning in banks with higher LLP; (iii) increased profitability in banks with lower ROA.

3.1. Motivation

The Global Financial Crisis led to a recession that strangled financial intermediaries, particularly their profitability. To solve the problem of a deep recession at hand, the Federal Reserve (Fed) has implemented unconventional monetary policies (UMP). The success of these measures depends on their capacity to be transmitted to the real economy, which depends on the banking sector (Bernanke and Gertler, 1995; Stein, 2008). It is therefore essential to understand the interactions between monetary policy and bank profitability as this may affect the monetary transmission mechanism (Zimmermann, 2019).

Among others, two factors need to be addressed when analyzing bank's profitability during the implementation of UMP. On the one hand, UMP generate opposite effects within the banks' profitability components (Demertzis and Wolff, 2016). For example, these policies may lead to a decrease in interest rates, which generate losses in the bank's net interest revenues, but at the same time, to a decline in loan defaults by creating a better economic outlook. On the other hand, bank characteristics may define the impact of UMP on each bank's profitability item. For example, does the bank's business model, i.e., whether banks rely more on income from interest or non-interest components or how banks manage their risk appetite, influences the bank's reaction to the new monetary policy regime? Further, how did the Fed's UMP impact U.S. bank profitability? Did these policies create an unequal/unbalanced impact on profitability across the U.S. banks?

Recent literature has studied the impacts of UMP on bank profitability and has obtained ambiguous and unclear results (e.g., Claessens et al., 2018; Altavilla et al., 2018; García-Cruz, 2020; Campmas, 2020). Despite these efforts, this literature uses traditional monetary instruments – short-term interest rate and slope of the sovereign yield curve – which may not broadly capture the effects of UMP. Furthermore, the literature on shadow rates, which is an instrument for accounting for UMP, has been used mainly to study impacts on macroeconomic problems (e.g., Mouabbi and Sahuc, 2019; Ellington, 2022), but not so much regarding bank profitability. Finally, the research on the differentiated reaction across banks focused on the determinants of bank profitability without analyzing in-depth the monetary policies implemented by Central Banks.

To the best of our knowledge, we have identified three gaps in the existing literature to which our article intends to contribute. First, the shadow rate has not been used to study the relationship between UMP and bank profitability in the U.S. Second, the literature does not consider the different monetary policy regimes. Most research addresses time periods that include both conventional and UMP without segregating them into a subsample when obtaining the estimates. The process employed can lead to misleading results due to the contrasting effects of different policies. Third, most research on the impact of UMP on bank profitability focuses on estimates of conditional means without providing insights on whether the effects of monetary policies may differ across banks and along their profitability's distributions.

We fill in the gaps in the previous literature by adopting the following approach. First, regarding the inability to capture the effects of unconventional measures with traditional monetary policy instruments, we use a variable called UMP Deviation. The UMP Deviation was first introduced in Chapter 2 and exploits shadow rate information to capture the effects of UMP. The approach provides additional considerations for how banks' performance components behave after the introduction of non-standard monetary policy measures in the U.S. and for assessing banks' overall returns. To tackle the second gap mentioned above, we decide to analyze the period characterized by the implementation of UMP, i.e., the Large-Scale Asset Purchase Programs (LSAP) and Maturity Extension Programs between Q1 2009 and Q2 2014. The approach helps to understand better and isolate the real impact of UMP on bank profitability. For the third and final gap identified, we apply quantile regression techniques for panel data, based on the methodology of Machado and Santos Silva (2019), to address the heterogeneity of banks' profitability response to non-standard measures implemented by the U.S. Fed.

In contrast to other traditional regression methods, quantile regression can report the entire conditional distribution of bank profitability and allows us to evaluate how our main interest variables affect banks at each quantile, with the emphasis being the lowest and the highest profitable banks. The characteristics of the banks that generate profits above or below the conditional mean are often substantially different and most likely respond differently to changes in the main determinants. Therefore, regulators and policymakers need to understand what happens at both extremes of the profitability distribution, given the heterogeneity of monetary measures applied.

Our main results are as follows. First, our results suggest that UMP improved bank's overall profitability, increasing the average bank's Return on Assets (ROA). Second, our key result indicates that UMP has unequal impacts on the profitability components across U.S. banks. These unequal impacts can be seen across three measures of profitability: UMP (i) increased bank's Net Non-Interest Income at their lower quantiles; (ii) decreased provisioning in banks with higher Loan Loss Provisons; (iii) increased profitability in banks with lower ROA.

The results presented in this study may have relevant policy implications. Because UMP may have unequal impacts across banks profitability distribution, our results imply that policymakers should look beyond the average effects of the policy. Hence, our results may help policymakers rethinking how UMP may be adopted in the future.

The remainder of the study is organized as follows. Section 3.2 presents the literature review with stylized facts on recent developments about the topics of monetary policy and bank profitability. In Section 3.3 we introduce the methodology employed, and we describe our data in Section 3.4. Section 3.5 shows the results and their interpretations based on the employed estimations. In Section 3.6, we evaluate the robustness of our results based on different estimation techniques. Section 3.7 concludes with the final remarks of our study.

3.2. Literature Review

Our study contributes to three strands of literature. First, the main strand of the literature focuses on the impact of monetary policy on bank profitability. The impact of monetary policy measures on banks' profitability remains unclear in the existent literature. During periods of conventional monetary policies, which are characterized by changes on the interest policy rate, there is a broad agreement that increases (decreases) in the interest rate allow banks to widen (narrow) their margins by increasing (decreasing) the deposit to a lending spread (e.g., Demirguç-Kunt and Huizinga, 1999; Borio et al., 2017; Claessens et al., 2018). Consequently, when monetary policy loosens, banks must pass it on to borrowers and expand lending. If interest rates rise, banks must raise them and cut lending. However, whether these higher (lower) spreads translate into higher (lower) profits is diffuse, and several studies have even obtained contradictory results. The lack of a univocal relationship between spreads and profits occurs because banks adjust their retail spreads, balance sheets, and risk profiles (e.g., Hannan and Berger, 1991; Borio and Zhu, 2012; Jiménez et al., 2014). Additionally, and on top of the previously mentioned, banks' lending decisions following policy changes are strongly influenced by their monetary policy exposure, which may differ significantly between banks, depending on the business model and the sectors in which they operate (Gomez et al., 2021).

In short, the effects of interest rates on banks' profits are not clear. However, is the impact of the UMP measures (e.g., QE and MEP) more transparent regarding banks' profitability? Again, based on the literature, the answer is that it is not clear either.

Considering QE, Rodnyansky and Darmouni (2017) using time dummies on each LSAP implementation suggest that, contrary to conventional wisdom, this policy had a differential effect on various types of financial institutions in the economy, rather than "rise with the tide and raise all boats". As per Demertzis and Wolff (2016), QE can impact banks' profitability in three ways. First, QE increases bond prices, strengthening banks' balance sheets. Second, QE reduces long-term yields and therefore reduces term spreads, which leads to declines in the loan-to-deposit ratio spread, making it more difficult for banks to generate net interest income on new loans. Third, QE improves economic prospects, which should help banks exposed to the economy find new credit opportunities and reduce problems with non-performing loans.

Because of these three effects of QE, its overall impact on bank profitability may be ambiguous. On the one hand, such a measure positively affects banking profitability. First, QE provides abundant access to central bank liquidity and reduces the cost of debt with positive consequences for bank financing and borrower creditworthiness, respectively. Second, QE protects bank capital by reducing non-performing loans and provisioning for loan losses (Allen, et al., 2009, 2015; Freixas et al., 2011; Gertler and Karadi, 2011; Kiyotaki and Moore, 2019; Praet, 2016). On the other hand, there can also be disadvantages associated with easing monetary policy (Rajan, 2006; Allen and Rogoff, 2011; Stein, 2012; Carlson et al., 2016; Allen and Carletti, 2015; Stiglitz, 2018), especially when interest rates remain very low for a long time (Maddaloni and Peydró, 2011). These potential disadvantages include reducing net interest income (Alessandri and Nelson, 2015; Borio et al., 2017), which could ultimately hamper monetary policy transmission (Abadi et al., Forthcoming).

The first finding of the literature is the neutrality, in some cases negative, impact of monetary policies on bank profitability. Michail (2019) contradicts Goodhart (2013), arguing that conventional monetary policy may not be able to influence banks' lending behavior through interest rates. Factors that guide the neutrality of banks profitability in relation to monetary policy are linked to funding costs, as suggested by Blanchard et al. (2010) and Michail et al. (2016), and/or due to the effects on different bank's components that tend to largely offset each other, as suggested by Altavilla et al. (2018) and in Chapter 2. The negative relation between monetary policy and banks profitability found on Brana et al. (2019) and Meuleman and Vander Vennet (2020) may result of accommodative monetary conditions being associated with overall lower loan spreads, the increase of a risk-taking approach, and the decline of net interest margins, and consequently bank's profitability.

The second finding is related to the effect of monetary policy on bank profitability, which is highly state dependent, (Zimmermann, 2019). The reason for this effect might be explained by the exposure of banks to loans. Higher exposure to mortgage credit increases the sensitivity of bank profitability to interest rate changes, consequently, banks with a high share of mortgages highly suffer when monetary policy tightens, while banks with a lot of deposits can cushion the contractionary effects. This leads to the possibility that a monetary policy tightening tends to have larger effects on economic activity than a monetary policy loosening (Angrist et al., 2018).

Third and final finding, the impact of monetary policies in banks profitability is conditioned on the country environment and banks' characteristics. Banks with a high level of diversification, regarding assets, and low deposit fundings have a less pronounced relationship between monetary policies and banks profitability (Mamatzakis and Bermpei, 2016). The relationship between bank profitability and interest rates do not only affect bank assets and liabilities, but also volume of activity that the banking sector can attain in a given period, impacting the overall return on funds (Pérez and Ferrer, 2018).

The second strand of literature is related to the use of shadow rates to account for the unconventional monetary policy. When a low-interest rate policy is implemented in conjunction with unconventional monetary policy, assessing the monetary policy stance is a challenge. The shadow rate, first introduced by Black (1995) and later developed by other authors, tends to capture better the UMP than the traditional interest rates (Urbschat, 2020). In addition, this interest rate proxy helps predict fairly well the future level and the realized variance of interest rates (Rostagno et al., 2021). Shadow rate models act as an all-absorbing state, and this feature explains part of the success of the shadow rate model in predicting future short rate realizations at short horizons when rate histories evolve along paths that remain consistently close to the effective lower bound.

Wu and Xia (2016) propose a shadow rate, which allows assessing conventional and UMP and provides interesting highlights about the effect of non-standard measures on several fields of study. Due to a term structure model, the shadow rate co-moves strongly with the Federal Fund Rate when there is no ZLB restriction limit. When the federal fund rate approaches the ZLB, thus transmitting information about monetary policy posture, the shadow rate is negative.

Given these advantageous properties, many authors have used shadow rates in their investigations to understand the effects of monetary policies on macroeconomic topics. Ellington (2022) performs a comprehensive empirical assessment of the evolution of UMP under a binding ZLB constraint for the U.S. economy. Following a demonstration that the Federal funds rate conveys no information regarding monetary policy stance under a binding ZLB constraint, the analysis reveals that one can reconcile economically plausible results using shadow rates. Lopez Buenache (2017) suggests differences in economic performance under contractionary and expansionary policies and supports the recent success of monetary stimuli in boosting real indicators while having little effect on inflation. Rezende et al. (2023) advocate that exchange rates respond more to conventional than unconventional monetary policy. Wang (2019), based on shadow rates, shows that without the unconventional monetary policy, macroeconomic variables would have worse performance than their actual realizations. Mouabbi and Sahuc (2019) provide evidence that, without unconventional measures, the euro area would have suffered a substantial loss of output since the Great Recession and a period of deflation from mid-2015 to early 2017; specifically, year-on-year inflation and GDP growth would have been on average below their actual levels. Finally, Michail (2019) indicates that negative interest rates did not have a significant effect on bank lending growth or inflation in any country. This failure to reject the policy ineffectiveness hypothesis most likely lies in the fact that negative interest rates did not ease the situation for the factors restricting the supply of bank lending, namely bank funding costs and bank performance.

The research around the employment of shadow rates to study the relationship between bank performance and non-standard measures is not extensive. As per Chapter 2, we have created a proxy derived from the Wu and Xia (2016) shadow rate for the ECB scope, providing the impulse or additional impact that unconventional measures generated on interest rates to investigate the relationship between UMP and banks' profitability. Our findings, in Chapter 2, suggest that UMP affected the bank profitability components upon the implementation of QE. However, banks' overall returns do not seem to be damaged or benefited by the non-standard measures.

In the third strand of the literature, our study is also related to studies that employ quantile regression analysis to investigate banking performance. Elekdag et al. (2020) explore the determinants of profitability across large euro area banks using an approach based on conditional profitability distributions and conclude that the most reliable determinants of bank profitability are real GDP growth and the nonperforming loan (NPL) ratio. Le and Nguyen (2020) empirically investigate the impact of capital structure on bank profitability using a quantile regression method in the Vietnamese banking system from 2007 to 2019. Their results suggest that the nonlinear relationship between capitalization and bank profitability is only significant at the 90th quantile. In preceding studies, Wheelock and Wilson (2009) propose a quantile estimator to observe changes in the efficiency and productivity of U.S. banks between 1985 and 2004. They show that larger banks experienced higher efficiency and productivity gains than small banks, with less than 1 billion dollars of total assets, consistent with the presumption that changes in regulation and information technology have favored larger banks. Similarly, Koutsomanoli-Filippaki and Mamatzakis (2011) study the cost efficiency of banks in the European are from 2000 until 2005, finding that efficiency scores are lower, for higher conditional distributions. Focusing on United Kingdom banks, De-Ramon et al., (2019) use quantile regression to assess how competition within the banking industry differentially affects bank-level measures of risk. Their results find that, on average, competition lowers stability, but its effect varies across banks depending on the underlying financial health of the institution. Li (2010) examines the risk-return relationship for listed U.S. banks and finds a positive risk-return relationship for profitable banks and a negative relationship for less profitable banks. The 'V' shape relationship between bank risk and profitability identified by this study could satisfactorily explain the existing risk–return puzzle. Finally, Lang and Forletta (2019) investigate how systemic risk measures affect the ROA of European banks. They show that high levels of cyclical systemic risk led to large downside risks to the bank-level ROA three to five years ahead. Hence, exuberant credit and asset price dynamics tend to increase considerably the likelihood of large future bank losses.

3.3. Methodology

In this section, we start by describing the dependent variables. Next, we present the independent variables. Finally, we conclude the section by introducing the econometric methodology applied in our research.

3.3.1. Dependent Variables

We analyze four dependent variables to assess the impact of unconventional monetary policy measures on banks' profitability. Three of those four variables are the Net Interest Income (NII), Net Non-Interest Income (NNOII) and Loan Loss Provision (LLP). NII is a measure that translates the difference between the gains generated from a bank's interest-bearing assets and losses associated with paying on interest-bearing liabilities. NNOII is the difference between the revenues and expenses of non-interest-bearing components, including deposit and transaction fees, insufficient funds fees, annual fees, monthly account service charges, inactivity fees, check and deposit slip fees, among others. LLP are expenses set aside as an allowance for loans not repaid or uncollected. The provisions cover customer bankruptcy, non-performing loans and/or renegotiated loans which were not expected to be lower than the estimated payment computation. The sum of these three bank profitability components divided by the bank's total assets is an approximation of our fourth dependent variable – the ROA. The ROA is an overall measure of how much profit a bank generates from its assets, translating the general stance of efficiency and productivity in managing its balance sheet. All these measures, upon similar approaches, were used by Alessandri and Nelson (2015), Borio et al. (2017), Altavilla et al. (2018), Angori et al. (2019), Lopez et al. (2020), or García-Cruz, (2020). Figure 3.1 illustrates the developments over time in bank profitability and its main components, as well as their cross-sectional dispersion across quantiles 10% 15%, 25%, 50%, 75%, 85%, and 90%. It is possible to observe in Figure 3.1 a significant dispersion in the profitability components among the various banks under analysis, suggesting the existence of heterogeneity in our sample.

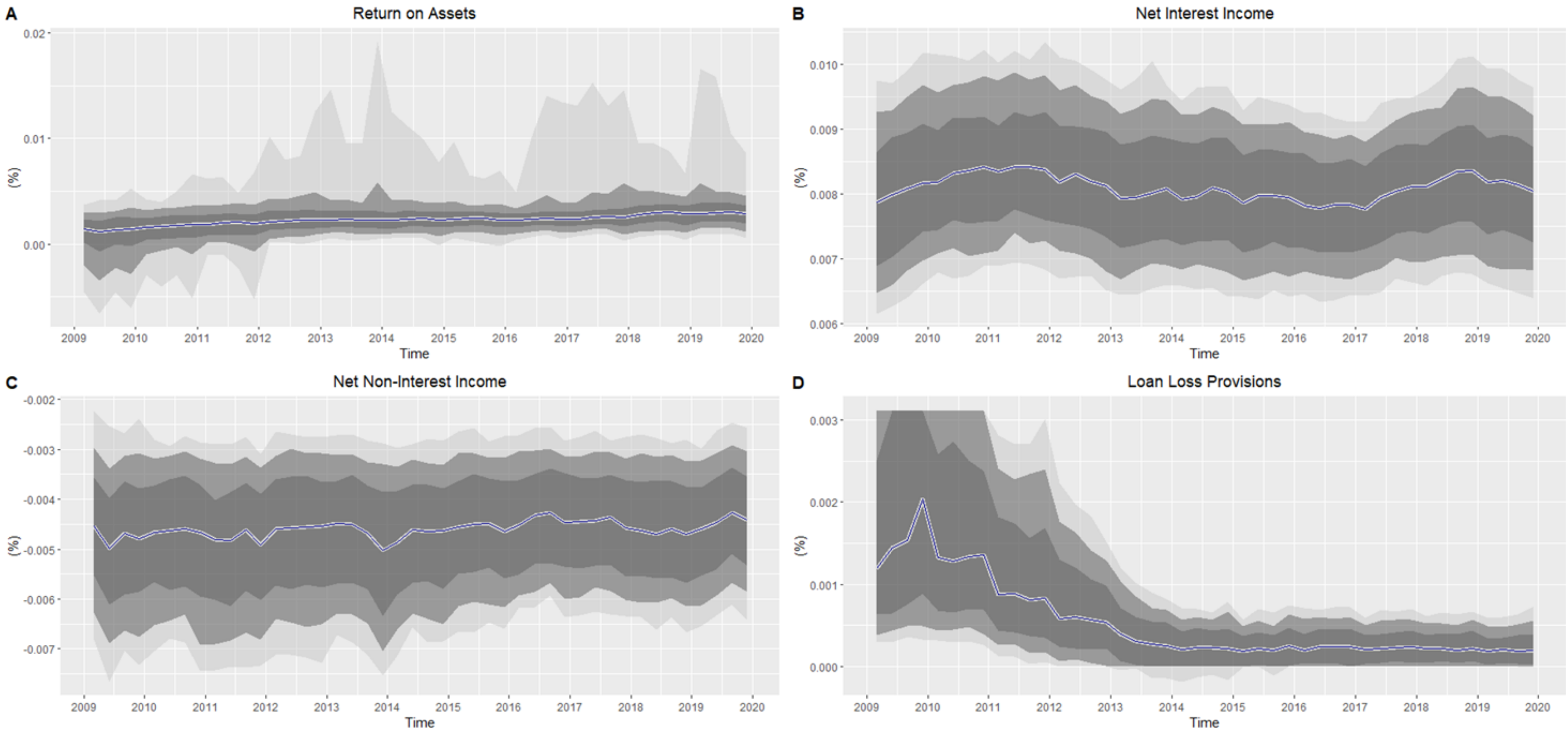


Figure 3.1: Evolution of Banks' Profitability Components during the implementation of Unconventional Monetary Policies – Q1 2009 until Q4 2019.

Notes: Cross sectional dispersion on bank's profitability components. Panel A, B, C and D correspond to ROA, NII, NNOII and LLP, respectively. Blue line refers to the 50% quantile, dark grey band refers to the 25% to 75% quantiles, mid-grey band refers to the 15% to 85% quantiles and, finally, light grey refers to the 10% to 90% quantiles.

3.3.2. Independent Variables

We use three sets of variables to address the problem proposed in our research. The primarily set of variables is the monetary policy variables that describe the monetary policy's evolution in the U.S. In addition to the traditional monetary policy variables, which are widely used in the literature – the short-term interest rate and the slope of the sovereign yield curve – we employ a proxy, called the Unconventional Monetary Policy (UMP) Deviation, to account for the impulses generated by the UMP, specifically QE and maturity extension effects. The remaining two sets of variables are used as control variables. The first set of control variables are the macroeconomic and market variables, providing information about the economic environment, and the second set of control variables is the bank-specific variables, which are well-known to influence bank profitability and have been applied across several empirical studies. Below, we summarize those variables.

3.3.2.1. Monetary Policy Variables

Short-term interest rate: Alessandri and Nelson (2015), Borio et al. (2017), Altavilla et al. (2018), Cruz-García et al. (2019), and Angori et al. (2019) use the short-term interest rate to account the prompt impact of monetary policy measures on the bank profitability. As Altavilla et al. (2018), we use as a proxy for the short-term interest rate the 3-months overnight index swap (OIS). In an environment with sufficient liquidity and without market variations, the interest rate on time bank deposits must have a close relationship with the expectation of overnight rates composed in the same horizon, as implied by the expectation hypothesis (Linzert and Abbassi, 2012). Alessandri and Nelson (2015) argue that a decline in interest rates contributed strongly to compressing bank margins over the period, which is passed through into banks' ROA, as interest expenses fall less than interest income. Figure 3.2 presents the evolution of the U.S. 3-months overnight index swap (OIS).

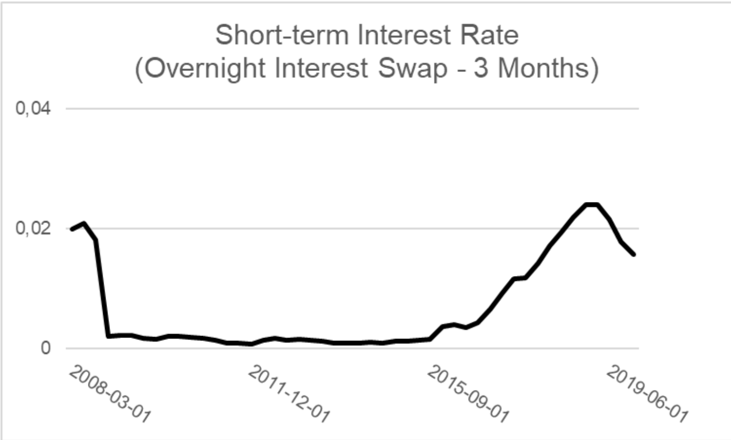


Figure 3.2: Evolution of the U.S. 3-Months Overnight Index Swap (OIS), data from Q1 2008 until Q4 2019.

Slope of the Yield Curve: This variable is the difference between long term market interest rates and short-term market interest rates, translating the expectations of the market environment on a foreseen horizon. Afresh, following Altavilla et al. (2018), we calculate the slope of the yield curve as the difference between the interest rate of a ten-year sovereign bond and a two-year sovereign bond. Cruz-García et al. (2019) advocate that its impact on net interest margin should be positive because a cut in the monetary policy rate shrinks the margin even more. Moreover, since the reassessment of assets is quicker than liabilities, a drop in the rates reduces assets maturity structure and, thus, entails a bigger effect on the interest margin. The overall effect on bank's profitability will depend on whether the negative effect on the NII is counterbalanced by other positive effects. Figure 3.3 plots the evolution of the difference between the interest rate of a ten-year sovereign U.S. bond and a two-year sovereign U.S. bond.

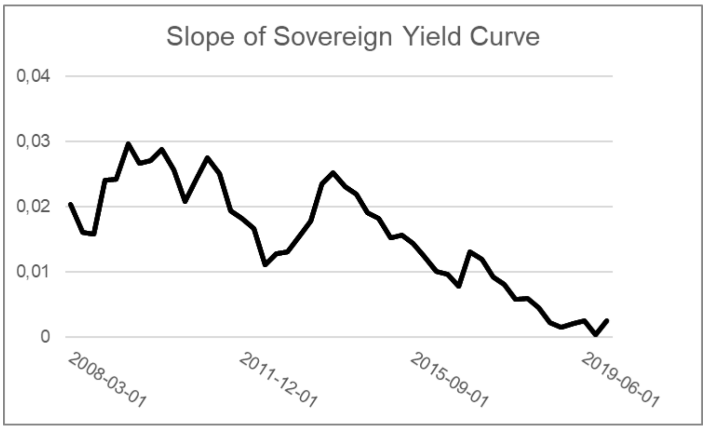


Figure 3.3: Evolution of the U.S. Slope of the Sovereign Yield Curve, from Q1 2008 until Q4 2019.

Unconventional monetary policy (UMP) deviation: Similarly, to the approach of Chapter 2, we make use of Wu and Xia's (2016) shadow rate and compute a proxy to account for and isolate the impulses of non-standard measures, specifically the LSAP and MEP from the U.S. Fed.

The Fed typically uses a short-term interest rate as a policy tool to achieve its macroeconomic objectives, such as employment and inflation. However, during the global financial crisis and the Great Recession of 2007-2009, the U.S. Fed pushed the policy interest rates to zero. Unfortunately, given the severity of the economic slowdown, even this ultra-low interest rate was not enough to revive output and employment growth. Therefore, the U.S. Fed resorted to additional non-standard policy tools to achieve its goals. These non-standard or unconventional monetary policy tools include forward guidance through communication on future short-term interest rates, the purchase of assets, and MEP.

The implementation of the abovementioned UMP by the U.S. Feds changed the economic environment and became a major challenge regarding their effect on several economic and financial topics. As mentioned earlier, short-term interest rates and the slope of the sovereign yield curve have been widely used in the literature to assess the impact of monetary policies on bank performance, but these two variables may not retain the necessary unconventional monetary policy information. However, with the adoption of the shadow rate, which is an implicit interest rate that better consolidates the action of UMP than the short-term interest rate or the sovereign yield curve, the quantification of the dynamics of the new environment may have become more accurate to study. To analyze the problem that we propose, we use the shadow rate calculated by Wu and Xia (2016), as our primary shadow rate source. This shadow rate is the best known, most widely used and tested upon the existing literature regarding the impact of UMP, such as Avdjiev et al. (2020) or Mavroeidis (2021), among others. However, the shadow rate represents the general stance of monetary policy; it does not isolate the effects of unconventional monetary policy. For that reason and because we need to capture the isolated effects of non-standard measures, we develop a variable that removes the effect of conventional monetary policy from the shadow rate. Hence, we define the UMP deviation as:

$$UMP_t = SR_t - OIS_t, \tag{3.1}$$

where SR_t stands for the Wu and Xia's shadow rate, and OIS_t represents the 3-months overnight index swap at quarter t. This approach allows to conserve the exiting traditional monetary policies previously mention. Figure 3.4 plots the evolution of the U.S. UMP deviation variable.

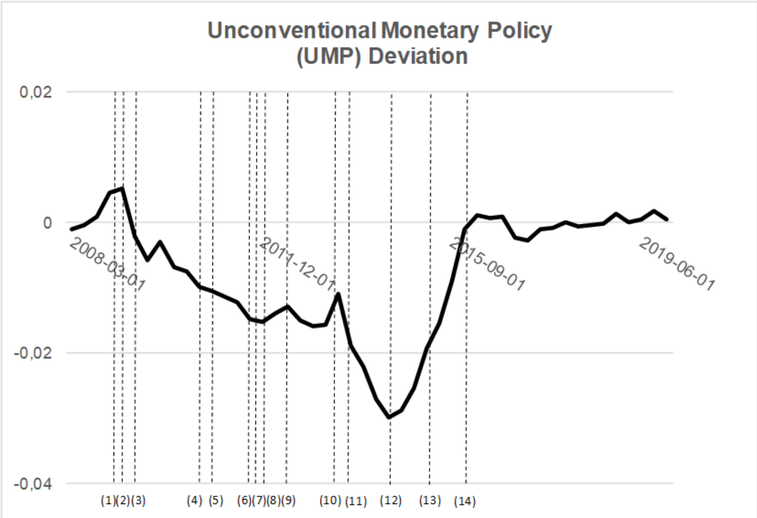


Figure 3.4: Evolution of the U.S. UMP Deviation - Difference between Shadow Rate and 3-Month Overnight Index Swap. Appendixes B and C describe the evolution of the UMP, (1) to (14), during the period of Q1 2008 until Q4 2019.

3.3.2.2. Macroeconomic and Market Variables

Stock Market Volatility, VIX index: A high market volatility in returns should increase lending and deposit rates. Following Ho and Saunders (1981) and Angbazo (1997), the interest rate on loans should be more affected by volatility than that on deposits. Moreover, the VIX index measures market risk and investors' sentiments (Altavilla et al., 2018).

GDP growth: A common practice in the literature is to include GDP growth to control the influence of the economic cycle. As per Demirguç-Kunt and Huizinga (1999), Bikker and Hu (2002), GDP growth has a positive effect on the profitability via lending activity and provisioning.

Inflation: This rate may affect roughly lending and loan pricing if borrowers' real incomes are sticky (Angori et al., 2019). Most empirical studies advocate a positive effect of inflation on bank's profit, but its coefficient is not clear to interpret. As the GDP Growth, we use the Inflation rate to control the business cycle.

Expected Inflation and Expected GDP Growth: The introduction of these variables aims to offset the effects of other factors that simultaneously affect the monetary policy stance and the profitability components of banks (Altavilla et al., 2018; Athanasoglou et al., 2008). According to economic theory and central bank practice, monetary policy reacts (is endogenous) to the current and expected overall economic and financial conditions. In other words, expected changes in the economic environment may lead to a reaction of the U.S. Fed, which incorporates the recent news and take action to control the foreseen conditions. Expected real GDP growth and expected inflation employed on our analysis has a 3 to 5-year-ahead expectation (see, e.g., Bernanke and Gertler, 1995).

3.3.2.3. Bank-specific Variables

5 Years default probability: Following Maudos and De Guevara (2004), Entrop et al. (2015), Altavilla et al. (2018), Cruz-García et al. (2019) and García-Cruz (2020), among others, the credit risk is included as an explanatory variable. 5-Years Default probability is a forward-looking measure of borrower and credit risk provided on the Bloomberg issuer default risk model, which generates a probability of default over the next five years. In principle, the higher the default rate, the larger the provisions banks set aside. The expected effect of credit risk on net interest margin is positive because banks charge an implicit risk premium in those operations with a higher default risk. The expected effect of credit risk on overall profitability will be, however, unclear. Riskier operations are usually the most profitable but are also the most prominent to default.

Non-Performing Loans (NPL) per Total Assets: NPLs are loans that are not repaid both in their principal and/or interest for a period of time above the terms and conditions under the loan contract. Hence, the non-performing loan ratio measures the bank's quality assets (Tseganesh, 2012). On several occasions of insolvency, NPLs have been responsible for banking collapse, because of the extreme accumulation on their balance sheet (Fofack and Fofack, 2005). Furthermore, non-performing loans have a deteriorating impact on bank profits as they decrease interest income and crumble current profits base through provisions, as suggested by Samir and Kamra (2013).

Capital Adequacy Ratio: Barth et al. (2013) argue that capital regulation does clearly impact bank margins. Nevertheless, the literature acknowledges that after a drop in bank profitability, if the equity is sufficiently low and it is too costly to issue new shares, banks reduce lending. Otherwise, banks fail to meet regulatory capital requirements, which is based on the hypothesis of an imperfect market for bank equity: banks cannot easily issue new equity because of the presence of agency costs and tax disadvantages (Myers and Majluf, 1984; Cornett and Tehranian, 1994; Calomiris et al., 1995; Froot and Stein, 1998). Altavilla et al. (2018) use a similar ratio called Tier1 capital ratio.

Efficiency ratio: Also known as cost-to-income ratio, this variable is an operational indicator that translates the cost-effectiveness of management. Hess and Francis (2004) find that there is an inverse correlation between the cost-to-income ratio and the bank's profitability. Furthermore, Sufian and Chong (2008) suggest that poor expense management is the main contributor to low profitability upon finding a significant relationship between efficient expense management and bank performance. Syafri et al. (2012), Almazari (2013), and Martins et al. (2019) also argue that the cost-to-income ratio has a negative impact on profitability.

3.3.3. Econometric Approach

The baseline specifications of our empirical approach are as follows:

1.

$$Y_{it} = \alpha_i + \beta_1 Y_{it-1} + \beta_2 UMP_t + \beta_3 OIS_t + \beta_4 \Delta Sovereign\,Yield_t + \beta_5 VIX_t + \beta_5 GDP\ Growth_t + \beta_6 Inflation_t + \beta_7 GDP\ Expected\ Growth_t + \beta_8 Expected\ Inflation_t + \varepsilon_{it} \quad (3.2)$$

2.

$$Y_{it} = \alpha_i + \beta_1 Y_{it-1} + \beta_2 UMP_t + \beta_3 OIS_t + \beta_4 \Delta Sovereign\,Yield_t + \beta_5 VIX_t + \beta_5 GDP\ Growth_t + \beta_6 Inflation_t + \beta_7 GDP\ Expected\ Growth_t + \beta_8 Expected\ Inflation_t + \beta_9 5\ Year\ Default\ Probability_{it} + \beta_{10} Non - Performing\ Loans_{it} + \beta_{11} Capital\ Adequacy\ Ratio_{it} + \beta_{12} Efficiency\ Ratio_{it} + \varepsilon_{it} \quad (3.3)$$

where Y_{it} is the dependent variable (i.e., NII, NNOII, LLP or ROA) of bank i at time t; α_i are bank fixed effects; β are the coefficients associated with the independent variables previously defined, and finally ε represents the error-term. These specifications are the basis for the benchmark mean regression and quantile regression, which we employ on our research. To facilitate comparability with the existing literature, which uses conditional mean regression, (e.g., for the Eurozone banks, Altavilla et al., 2018; for the Eurozone, U.S., and British banks, García-Cruz, 2020) we begin our analysis by also implementing the conditional mean regression. We will call it our benchmark regression. However, the conditional mean does not give us any information regarding the tails of the profitability components distribution, as such, we employ a quantile regression that addresses the heterogeneity of banks' profitability response to non-standard measures implemented by the U.S. Fed across banks profitability components distribution.

3.3.3.1. Mean Regression with Fixed Effects – Benchmark

As previously explain, before we study the quantile regression model, we set as a benchmark a conditional mean regression, which is the OLS regression with fixed effects. One of the serious disadvantages of the OLS regression is the underestimation or overestimation in heterogeneous distributions (Cade and Noon, 2003). However, the OLS regression with fixed effects provides a perception of the overall expectations for the estimations under quantile regression.

OLS with bank-level fixed effects may also result in inconsistent estimates, as the lagged dependent variable is correlated with the error-term due to the presence of time-invariant fixed effects, as described by Nickell (1981). For our full sample, which compresses 48 periods (Q1 2008 until Q4 2019), as the time dimension is relatively long, this effect should be negligible. However, for the sub-sample, which isolates the Unconventional Monetary Policy regime, that is the QE and MEP, the period spam only accounts for 22 periods (Q1 2009 until Q2 2014). To complement our results obtained with the OLS regression with fixed effects, we perform the same estimations but with the one-step difference Generalized Method of Moments (GMM) dynamic panel estimator.

3.3.3.2. Quantile Regression with Fixed Effects – Panel Data

We adopt the quantile regression with fixed effects for panel data, developed by Machado and Santos Silva (2019). The advantage of the approach employed is that it allows the use of methods that are only valid for estimating conditional means, such as differentiating individual effects in panel data models, while providing information on how regressors affect the entire conditional distribution. The method is flexible enough to allow two important features in our model: individual bank effects and endogenous explanatory variables.

Previously, the estimation of linear regression quantiles for longitudinal data was fundamentally considered by Koenker (2004). To mitigate the effects of the incidental parameters problem[2], Koenker considers a model where the individual effects only cause parallel (location) shifts in the distribution of the response variable (see also Lamarche, 2010; Canay, 2011; Galvão, 2011). That is, the effects are individual-specific, but each one is the same at the entire distribution, $\alpha_i(\tau) \equiv \alpha_i$, for all quantile τ. Machado and Santos Silva (2019) also start by considering a linear specification but allow the individual effects to affect the entire distribution, as in Kato et al. (2012), Galvão and Wang (2015), and Galvão and Kato (2016).

[2] This is typically caused by only having (a small number of) T time observations to estimate each individual effect. As the number of cross-sections n grows, the estimate of individual effects remains random rather than a (fixed) constant. Machado and Santos Silva (2019) claim that problems occur for large n/T (above 10). This problem is mitigated by using the split-panel jackknife bias correction of Dhaene and Jochmans (2015).

Given data $\{(Y_{it}, X'_{it})'\}$ from a panel of n individuals $i = 1, \dots, n$ over T time periods, $t = 1, \dots, T$, consider the estimation of the conditional quantiles $Q_Y\ (\tau \backslash X)$ for a location-scale model of the form:

$$Y_{it} = \alpha_i + X'_{it}\beta + \varepsilon_{it}, \tag{3.4}$$

- Error- term is defined as the following: $\varepsilon_{it} = (\delta_i + Z'_{it}\gamma)U_{it}$;
- $(\beta, \gamma) \in R^{2k}$ and $(\alpha_i, \delta_i), i = 1, \dots, n,$ are unknown parameters;
- X'_{it} is the matrix that contains the independent variables announced previously:

$$X'_{it} = [Y_{it-1}, UMP_t, OIS_t, \Delta Sovereign\ Yield_t, VIX_t, GDP\ Growth_t, Inflation_t,$$
$$GDP\ Expected\ Growth_t, Expected\ Inflation_t, 5\ Year\ Default\ Probability_{it},$$
$$Non\ Performing\ Loans_{it}, Capital\ Adequacy\ Ratio_{it}, Efficiency\ Ratio_{it}];$$

- Z is a k-vector of known differentiable (with probability 1) transformations of the components of X with element l given by:

$$Z_l = Z_l(X), \qquad l = 1, \dots, k;$$
$$P\{(\delta_i + Z'_{it}\gamma) > 0\} = 1;$$

- U_{it} are $i.i.d.$ (across i and t), statistically independent of X_{it} and normalized to satisfy the moment conditions:

$$E(U) = 0 \qquad E(|U|) = 1.$$

The parameters $(\alpha_i, \delta_i), i = 1, \dots, n,$ capture the individual i fixed effects. The model implies that:

$$Q_Y\ (\tau \backslash X_{it}) = (\alpha_i + \delta_i q(\tau)) + X'_{it}\beta + Z'_{it}\gamma q(\tau), \tag{3.5}$$

where the scalar coefficient $\alpha_i(\tau) \equiv \alpha_i + \delta_i q(\tau)$ is the quantile-τ fixed effect for individual i, or the distributional effect at τ. Contrary to Koenker (2004), this distributional effect represents the effect of time-invariant individual characteristics which, like other variables, are allowed to have different impacts along the conditional distribution of Y. As Machado and Santos Silva (2019) point out, α_i can be interpreted as the average effect for individual i.

Accordingly, Machado and Santos Silva (2019) show that the moment conditions have a convenient triangular structure with respect to the model parameters that allow the one-step GMM estimator

(Hansen, 1982) to be calculated sequentially. One novelty of this approach is a transformation performed in the residuals that greatly simplifies the MM-QR estimator of the above model. Besides simplifying the treatment of the asymptotic properties of the estimator, this allows the practitioner to make inference about the parameters of the scale function directly from the least-squares results. All in all, the approach provides an easier way to estimate regression quantiles retaining the coherence of existing approaches, but computationally lighter. See Machado and Santos Silva (2019) for further details.

3.4. Data

In this subchapter, we describe the data used to analyze the impact of monetary policy on bank profitability. The foreseen data includes bank, macroeconomic, and market data for a cross-section of United States banks. Our scope is attached to the Fed's monetary policy, and consequently, the banks are affected by the single monetary policies employed. In short, we examine the role of monetary policy, macroeconomic prospects, and bank balance sheet characteristics.

We rely on different datasets with different degrees of granularity, which comprise data sources such as Bloomberg, Thomson Reuters Eikon or DataStream. More specifically, the analysis is carried out on a quarterly frequency, using different sets of commercial data available for the U.S. over January 2008 to December 2019, which includes the Global Financial Crisis and its aftermath. Therefore, the analyzed time span covers the period in which one country, with a single monetary policy, implemented expansionary measures to cope with the financial crisis. Therefore, data availability explains why there may be differences in some empirical specifications used in the analysis below. Before moving further, it is relevant to specify that a small number of the presented variables, both dependent and independent variables, have suffered transformations for the sake of our analysis. All dependent variables have been submitted to a process of Winsorise, which is the transformation of statistics by limiting extreme values, to deal with outliers and avoid misleading results. On our data we limit 5th percentile and the 95th percentile. By doing it so, we deal with outliers and avoid misleading results from our regression methodology employed. Expected GDP Growth, extracted from DataStream, was linearized between periods to obtain quarterly frequency. Appendix D presents the units, frequency, data level, sources and data transformations to each of our variables employed. [3]

Table 3.1 summarizes the descriptive statistics of our full sample under analysis, Q1 2008 until Q4 2019.

[3] The results are robust to winsorization at the 7.5 and 2.5% levels.

Table 3.1: Descriptive Statistics - Q1 2008 - Q4 2019 - Dependent and Independent Variables

	Obs.	Mean	Stand. Dev.	10th percentile	25th percentile	Median	75th percentile	90th percentile	Max	Min
Bank Performance Variables:										
Return on Assets	21505	0.0036	0.0071	-0.0007	0.0013	0.0023	0.0032	0.0083	0.0287	-0,0066
Net Interest Income per Total Assets	17745	0.0081	0.0012	0.0065	0.0073	0.0081	0.0089	0.0098	0.0107	0.0057
Non-Net Interest Income per Total Assets	17841	-0.0047	0.0015	-0.0068	-0.0057	-0.0046	-0.0036	-0.0027	-0.0018	-0.0077
Loan Loss Provision per Total Assets	17757	0.0007	0.0009	0.0000	0.0001	0.0004	0.0008	0.0021	0.0031	-0.0002
Monetary Policy Variables:										
Short-term interest rate	48	0.0069	0.0078	0.0009	0.0014	0.0021	0.0130	0.0209	0.0241	0.0007
UMP Deviation (Wu and Xia)	48	-0.0078	0.0093	-0.0223	-0.0150	-0.0044	-0.0002	0.0011	0.0052	-0.0300
Sovereign Yield Slope	48	0.0155	0.0082	0.0024	0.0094	0.0157	0.0232	0.0266	0.0295	0.0003
Market and Macroeconomic Variables:										
VIX Index	48	0.1535	0.0588	0.0991	0.1202	0.1342	0.1657	0.2793	0.3331	0.0805
GDP Growth	48	0.0169	0.0239	-0.0139	0.0080	0.0218	0.0317	0.0393	0.0524	-0.0845
Inflation	48	0.0171	0.0140	-0.0050	0.0105	0.0160	0.0260	0.0390	0.0520	-0.0090
Expected GDP Growth	48	0.0226	0.0024	0.0195	0.0215	0.0225	0.0243	0.0260	0.0260	0.0150
Expected Inflation	48	0.0212	0.0057	0.0140	0.0170	0.0205	0.0230	0.0270	0.0390	0.0130
Bank-Specific Variables:										
5 Years Default Probability	21714	0.0341	0.0585	0.0107	0.0146	0.0199	0.0321	0.0569	0.8790	0.0001
Bank's Non-Performing Loans (NPL)	11151	0.0201	0.0418	0.0029	0.0059	0.0122	0.0237	0.0418	1.0112	0.0000
Capital Adequacy Ratio	15466	0.1403	0.0468	0.0103	0.0115	0.1300	0.1520	0.1843	1.1290	0.0260
Efficiency Ratio	18226	0.6990	0.6107	0.5189	0.5913	0.6651	0.7515	0.8641	70.5079	-14.1825

Notes: Data are at quarterly frequency covering the period Q1 2008–Q4 2019.

Additionally, Table 3.1 shows measures of central tendency and the 10th, 25th, 75th and 90th percentiles, which allows having a perception of the empirical distribution of our data. The first column of Table 3.1 presents the number of observations. This number of observations results from 601 banks studied. The number of banks grows over the period under analysis.

Based on this table, we visualize a wide variation in the data, on both dependent and independent variables, when we look at the distribution across percentiles. For example, the interquartile range of GDP growth ranges from -1.4% to 3.9%, while the inflation range ranges from -0.5% to 3.9%, thus showing the existing turmoil due to the Global Financial Crisis. Moreover, it is also possible to verify significant changes on the interquartile of the UMP Deviations, which ranges from -2.2% to 0.11%, because of UMP applied by U.S. Fed. As consequence, of the changes on the economic and monetary environment, but also because of the heterogeneity of U.S. banks, the ROA show interesting levels of variation, with an interquartile range from -0.66% to 0.83%.

Before we move to the discussion of the results obtained from the regressions, we consider one subsample from our original time series period. The subsample comprises Q1 2009 until Q2 2014. The rationale for this approach is related to the implementation of QE through the LSAP and the MEP from November 2008 until September 2014, in which the Fed purchased longer-term securities from the open market in order to increase the money supply and encourage lending and investment. Observing our proxy computed as the difference between Wu and Xia (2016) shadow rate and Overnight interest swap rate, we realize that after the announcement of the LSAP, Wu and Xia's shadow rate diverge significantly from short-term interest rate until the "taper off" of this measure. It is in our opinion of greater relevance to study in more detail the period in which this discrepancy between Wu and Xia (2016) shadow rate and short-term interest rate became sharply divergent and what impact this event caused to bank's performance components.

Our subsample is constraint by the quarters where the QE and MEP was fully implemented. Table 3.2 presents the descriptive statistics for the dependent and monetary policy variables, during the subsample period, Q1 2009 until Q2 2014.[4]

[4] We omit the remaining control variables for presentation purposes, as they do not change significantly from the full sample period.

Table 3.2: Descriptive Statistics - Q1 2009 – Q2 2014 - Dependent and Monetary Policy Variables

	Obs.	Mean	Stand. Dev.	10th percentile	25th percentile	Median	75th percentile	90th percentile	Max	Min
Bank Performance Variables:										
Return on Assets	9221	0.0032	0.0072	-0.0018	0.0009	0.0020	0.0029	0.0076	0.0287	-0.0066
Net Interest Income per Total Assets	7643	0.0082	0.0013	0.0066	0.0074	0.0082	0.0090	0.0100	0.0107	0.0057
Non-Net Interest Income per Total Assets	7660	-0.0048	0.0016	-0.0072	-0.0059	-0.0047	-0.0037	-0.0028	-0.0018	-0.0077
Loan Loss Provision per Total Assets	7621	0.0010	0.0010	0.0000	0.0003	0.0007	0.0016	0.0031	0.0031	-0.0002
Monetary Policy Variables:										
Short-term interest rate	22	0.0015	0.0005	0.0009	0.0010	0.0014	0.0018	0.0021	0.0023	0.0007
UMP Deviation (Wu and Xia)	22	-0.0126	0.0078	-0.0223	-0.0158	-0.0126	-0.0075	-0.0031	0.0052	-0.0300
Sovereign Yield Slope	22	0.0216	0.0053	0.0130	0.0177	0.0232	0.0256	0.0274	0.0295	0.0110

Notes: Data are at quarterly frequency covering the period Q1 2009–Q2 2014.

In comparison with the full sample period (Q1 2008 until Q4 2019), the short-term interest rate is characterized by having an approximate flat trend and a near to 0% level constraint, during this subsample period. The implementation of QE from U.S. Fed led to a decline of our proxy UMP deviation, which means a more negative value in relation to the full sample, given this event. Our descriptive statistics also show higher values for the slope of the sovereign yield than the full sample period, meaning that before the implementation of the unconventional measures the expectations of economic environment deteriorated.

In addition, Figure 3.5 plots the histograms of the banks' profitability components, which provides information about the subsample (Q1 2009 – Q2 2014) distribution across the quantiles. Figure 3.5 suggest that ROA is concentrated around 0,2% and 0,3%, NII has an approximate normal distribution, the plot of NNOII suggest a soft left-skewed distribution and, finally, the LLP has a pronounced right-skewed distribution.

Figure 3.6 presents the box plots of the bank profitability components in relation to the UMP deviation quantiles during the subsample period (Q1 2009 – Q2 2014). This Figure 3.6 has four panels, Panel A to D, one for each bank profitability component: ROA, NII, NNOII and LLP, respectively. Panel A advocates that with the UMP deviation reduction (quantile four to quantile one), the median ROA increased, and the interquartile range decreased. Panel B and C do not show a notable change in NII and NNOII with the UMP deviation decrease. Finally, Panel D display a decrease in the median LLP and interquartile range alongside with the UMP deviation reduction (more expansionary measures implemented by the U.S. Federal Reserve). These trends may signal that the UMP altered the banking sector overall return distribution mainly by the change on the LLP component.

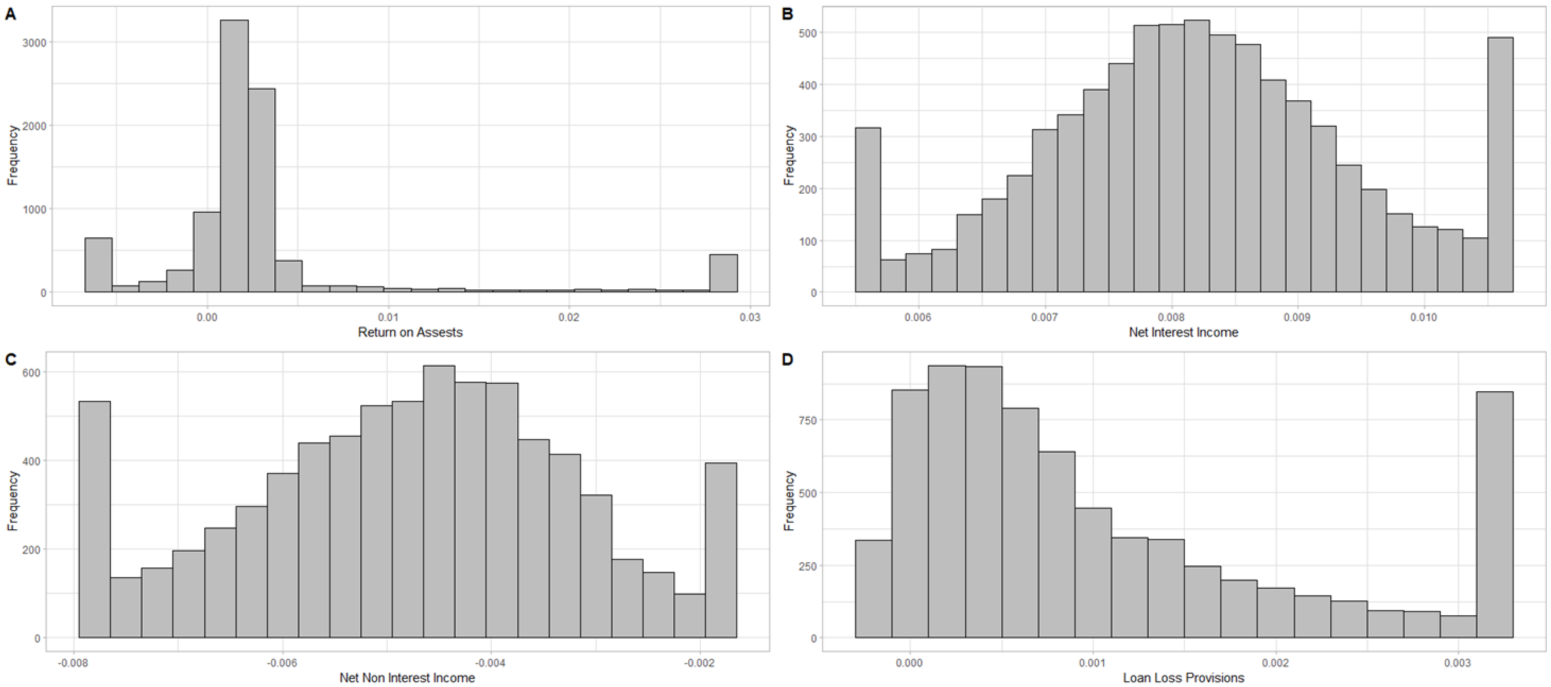


Figure 3.5: Histograms of bank's profitability components.

Notes: Panel A, B, C and D correspond to the Histograms of ROA, NII, NNOII and LLP, respectively. Data from Q1 2009 until Q2 2014.

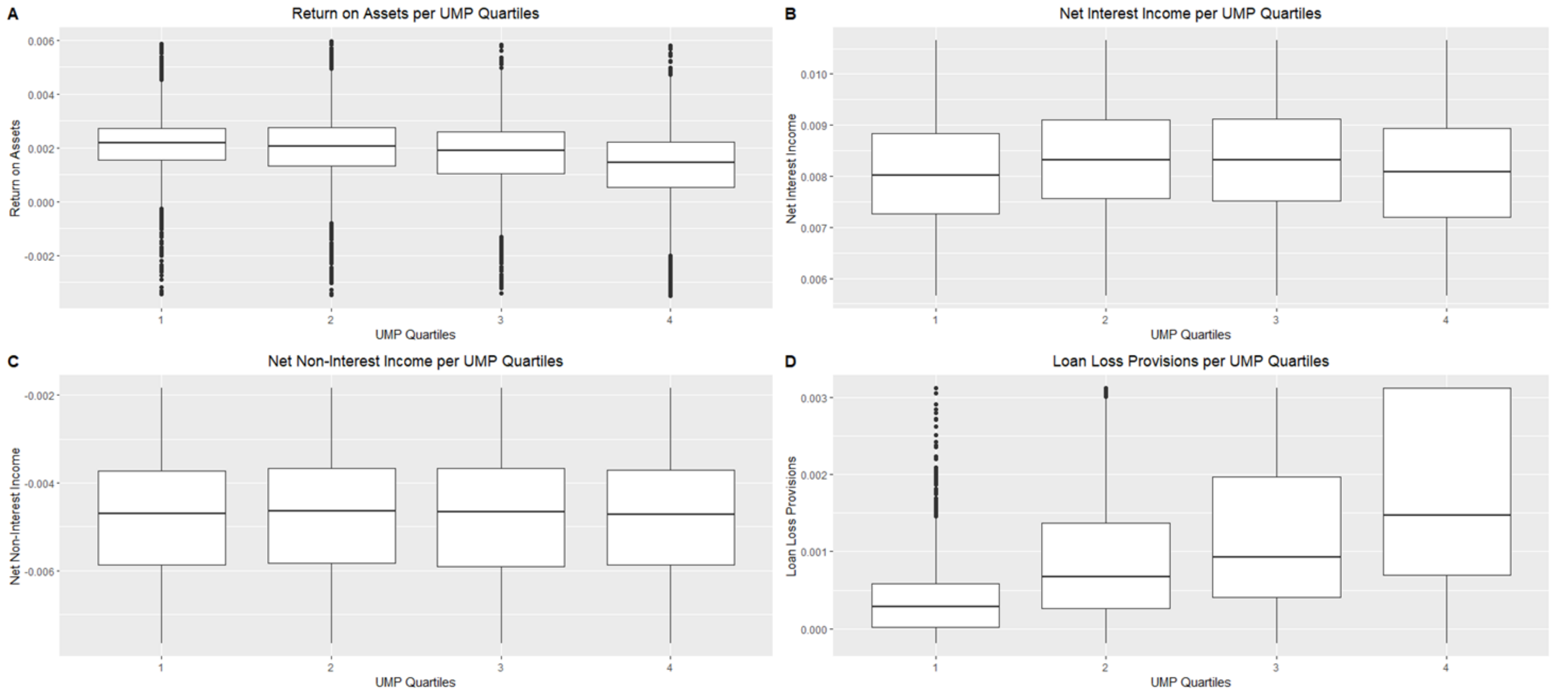


Figure 3.6: Box plots of bank's profitability components in relation to the UMP Deviation quantiles.

Notes: Panel A, B, C and D correspond to the Histograms of ROA, NII, NNOII and LLP, respectively. Data from Q1 2009 until Q2 2014.

3.5. Results

This chapter has two subchapters. Subchapter 3.5.1. shows the results for the benchmark conditional mean regression. For each bank profitability variable under analysis, we perform one estimation for the full sample period (Q1 2008 – Q4 2019) and another for the subsample period of UMP application (Q1 2009 – Q2 2014). Subchapter 3.5.2. presents the estimation results for the quantile regression for the regime of UMP application (Q1 2009 – Q2 2014).

3.5.1. Benchmark – Full Sample (Q1 2008 – Q4 2019) vs. QE Subsample (Q1 2009 – Q2 2014)- Conditional Mean Regression Results

For the analysis of both full and subsample periods, we use the Ordinary Least Squares with fixed effects as mentioned in Subchapter 3.3.3.1. The estimates for our specifications of Equations (3.2) and (3.3) are reported in Table 3.4 to Table 3.7.[5]

[5] For robustness purposes, we perform a static panel GMM estimation, as this approach has been shown to be more efficient than other static panel estimation methods such as fixed effects or random effects estimation in case of the presence of autocorrelation or not strictly exogenous explanatory variables (see Wooldridge, 2002; Baltagi, 2005).

3.5.1.1. Net Interest Income

The results in Table 3.3 suggest significant relationships between the monetary policy variables and the NII. First, we find that the relationship between the short-term interest rate and the NII differs within the sample. On the one hand, the results in columns (1) and (2) suggest a positive relationship between the short-term interest rate and the NII for the full sample. These results are in line with the literature; when the interest rate increases, banks tend to widen their margins by increasing the deposit-to-lending spread (e.g., Demirguç-Kunt and Huizinga, 1999; Borio et al., 2017; Claessens et al., 2018). On the other hand, the results in columns (3) and (4) advocate a negative relationship between the short-term interest rate and NII for the QE subsample. This relationship can be explained by the fact that the policy rate was constrained to a lower bound of 0%, between Q1 2009 and Q2 2014. During this period, the positive fluctuations in the short-term interest rate result from anticipating the growth of the policy interest rate by the U.S. Fed. This anticipation may stress the economy, negatively affecting the bank's net income.

Second, our results suggest a positive relationship between the UMP Deviation and NII for both periods under analysis. However, for the period Q1 2009 – Q2 2014, the impact of UMP Deviation is the triple compared to the full sample period. This relationship may mean that the UMP reinforces the decline of interest components. According to Demertzis and Wolff (2016), UMP reduces long-term yields and therefore reduces term spreads, which leads to declines in the loan-to-deposit ratio spread, making it more difficult for banks to generate NII on new loans.

Third, we find a positive relationship between the Sovereign Yield Slope and NII for both periods of analysis. A decrease in the sovereign yield slope means a decrease in risk expectations (a better economic outlook), which leads to decrease in interests. Moreover, the positive correlation may indicate a natural consequence of banks' maturity transformation activities (e.g., Flannery, 1981; Hancock, 1985; Bourke, 1989; Saunders and Schumacher, 2000).

Concerning our market and macroeconomic variables, we find a positive relationship between NII and the actual and expected GDP Growth for both periods of analysis. Under the full sample, we also find a positive relationship between NII and the Stock Market Volatility (represented by the VIX index) and Inflation. These results are in line with the literature (see, for example, Demirgüç-Kunt and Huizinga, 1999; Claessens et al., 2018; Altavilla et al., 2018).

Finally, regarding bank-specific variables, we find a positive relationship between Capital Adequacy Ratio and NII for both periods of analysis. This relationship was also found by Altavilla et al. (2018). For the full sample, we also find a negative relationship between Efficiency Ratio and NII, which is consistent with Campmas (2020).

Table 3.3: Net Interest Income and monetary policy, period Q1 2008–Q4 2019 vs. Q1 2009 – Q2 2014, Ordinary Least Squares (OLS) with fixed effects.

	(1)	(2)	(3)	(4)
Period	**Q1 2008 - Q4 2019**		**Q1 2009 - Q2 2014**	
Variables	**Net Interest Income**			
Model	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**
Dependent Variable Lag	0.7710***	0.7440***	0.6760***	0.6610***
	(0.0047)	(0.0064)	(0.0083)	(0.0119)
Monetary Policy Variables				
Short-term Interest Rate	0.0033***	0.0042***	-0.0696***	-0.0563*
	(0.0008)	(0.0010)	(0.0200)	(0.0295)
UMP Deviation	0.0031***	0.0041***	0.0094***	0.0125***
	(0.0006)	(0.0008)	(0.0014)	(0.0021)
Sovereign Yield Slope	0.0076***	0.0098***	0.0069***	0.0070***
	(0.0007)	(0.0009)	(0.0014)	(0.0021)
Market & Macroeconomic Variables				
VIX Index	0.0000***	0.0000***	0.0000	0.0000
	(0,0000)	(0.0000)	(0.0000)	(0.0000)
GDP Growth	0.0028***	0.0027***	0.0022***	0.0020***
	(0.0002)	(0.0003)	(0.0003)	(0.0004)
Inflation	0.0013***	0.0024***	0.0007	0.0006
	(0.0004)	(0.0006)	(0.0006)	(0.0009)
Expected GDP Growth	0.0036*	0.0059**	0.0214***	0.0220***
	(0.0021)	(0.0026)	(0.0045)	(0.0068)
Expected Inflation	0.0017	0.0005	0.0027	0.0046
	(0.0010)	(0.0014)	(0.0021)	(0.0032)
Bank-Specific Variables				
5 Year Default Probability		-0.0003		-0.0000
		(0.0002)		(0.0003)
Non-Performing Loan Ratio		0.0000		-0.0002
		(0.0002)		(0.0005)
Capital Adequacy Ratio		0.0000***		0.0000*
		(0.0000)		(0.0000)
Efficiency Ratio		-0.0000**		-0.0000
		(0.0000)		(0.0000)
Constant	0.0015***	0.0016***	0.0021***	0.0022***
	(0.0000)	(0.0000)	(0.0001)	(0.0002)
Observations	17,409	10,438	7,529	3,801
R-squared	0.623	0.601	0.504	0.494
Number of Banks	482	373	386	287

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variable: NII as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q1 2008–Q4 2019 and Q1 2009 – Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method is Ordinary Least Squares (OLS) with fixed effects. Unconventional Monetary Policy deviation is computed based on Wu and Xia’s shadow rate.

3.5.1.2. Net Non-Interest Income

The results in Table 3.4 suggest some significant relationships between the monetary policy variables and the NNOII that depend on the sample. First, we find a positive relationship between the short-term interest rate and NNOII for the QE subsample. As stated before, in this period, the positive changes in the short-term interest rate may result from anticipating the growth of the policy interest rate by the U.S. Fed. Thus, the NNOII is correlated with the expectations of a rise in policy interest rates rather than the effective policy rate increase.

Second, the results in columns (1) and (2) indicate a positive relationship between the UMP deviation and NNOII for the full sample, whereas the results in columns (3) and (4) suggest an inexistent relationship between these variables for the period of UMP application. Overall, these results suggest that UMP did not affect the non-interest components, but once UMP was "taped off", banks started to increase non-interest income components.

Third, we find a negative relationship between the slope of the Sovereign Yields and the NNOII for both periods under analysis. This finding may suggest that the expectation of better economic prospects – hence less interest applied – may require an increase of overall non-interest components to balance profits, given the decrease of profits from interest components.

Regarding the market and macroeconomics variables, we find that the NNOII is negatively correlated with Inflation and Expected Inflation. Recall that inflation was positively correlated with the NII, which may suggest an offset between the two profit components. During the period Q1 2009 - Q2 2014, we also find a positive correlation between VIX Index and NNOII, which suggest that the increase of volatility on the market leads to increase of non-interest components.

Concerning the bank-specific variables, we find that NNOII is negatively related with all variables. For the period restricted to the QE implementation, we only find that Non-Performing Loans and Efficiency ratio has a statistically significant relationship with NNOII.

Table 3.4: Net Non-Interest Income and monetary policy, period Q1 2008–Q4 2019 vs. Q1 2009 – Q2 2014, Ordinary Least Squares (OLS) with fixed effects.

	(1)	(2)	(3)	(4)
Period	**Q1 2008 - Q4 2019**		**Q1 2009 - Q2 2014**	
Variables	**Net Non-Interest Income**			
Model	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**
Dependent Variable Lag	0.3870***	0.3180***	0.2570***	0.2060***
	(0.0070)	(0.0091)	(0.0110)	(0.0155)
Monetary Policy Variables				
Short-term Interest Rate	-0.0010	0.0010	0.1010***	0.1020*
	(0.0015)	(0.0019)	(0.0375)	(0.0538)
UMP Deviation	0.0033***	0.0045***	-0.0028	-0.0035
	(0.0012)	(0.0014)	(0.0026)	(0.0039)
Sovereign Yield Slope	-0.0111***	-0.0101***	-0.0179***	-0.0145***
	(0.0013)	(0.0017)	(0.00260)	(0.0038)
Market & Macroeconomic Variables				
VIX Index	-0.0000	-0.0000	0.0000***	0.0000**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP Growth	-0.0003	0.0002	-0.0003	-0.0001
	(0.0004)	(0.0005)	(0.0005)	(0.0007)
Inflation	-0.0006	-0.0022**	-0.0031***	-0.0040**
	(0.0008)	(0.0011)	(0.0012)	(0.0017)
Expected GDP Growth	0.0095**	0.0032	0.0099	0.0063
	(0.0039)	(0.0049)	(0.0083)	(0.0124)
Expected Inflation	-0.0082***	-0.0085***	-0.0036	-0.0040
	(0.0020)	(0.0027)	(0.0040)	(0.0057)
Bank-Specific Variables				
5 Year Default Probability		-0.0009**		0.0001
		(0.0004)		(0.0005)
Non-Performing Loan Ratio		-0.0020***		-0.0029***
		(0.0004)		(0.0010)
Capital Adequacy Ratio		-0.0000*		0.0000
		(0.0000)		(0.0000)
Efficiency Ratio		-0.0002***		-0.0001***
		(0.0000)		(0.0000)
Constant	-0.0027***	-0.0023***	-0.0036***	-0.0034***
	(0.0001)	(0.0002)	(0.0002)	(0.0003)
Observations	17,493	10,438	7,545	3,801
R-squared	0.184	0.202	0.083	0.083
Number of Banks	483	373	386	287

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NNOII as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q1 2008–Q4 2019 and Q1 2009 – Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method is Ordinary Least Squares (OLS) with fixed effects. Unconventional Monetary Policy deviation is computed based on Wu and Xia's shadow rate.

3.5.1.3. Loan Loss Provision

The results in Table 3.5 suggest significant relationships between the monetary policy variables and the LLP. First, we find that the relationship between the short-term interest rate and the LLP changes when considering bank-specific variables. On the one hand, the results in columns (1) and (3) suggest a negative or insignificant relationship between the short-term interest rate and the LLP when disregarding bank-specific variables. On the other hand, the results in columns (2) and (4) advocate a positive relationship between the short-term interest rate and LLP when considering bank-specific variables. This result is in line with Altavilla et al. (2018), which obtain the same positive relation between short-term interest rate and LLP, although their study is performed in the European scope.

Second, our results suggest a positive relationship between the UMP Deviation and LLP for both periods under analysis. This impact may be explained because existing loans become more viable with UMP and need fewer provisions (Borio and Gambacorta, 2017). Furthermore, UMP may improve economic environment prospects, which help banks exposed to the economy find new credit opportunities and reduce problems with non-performing loans.

Third, in line with the other profitability components, we find a significant relationship between the Sovereign Yield Slope and LLP for both periods of analysis, although during the implementation of the UMP the impact is less pronounced. In these two cases the relationship is positive. This result may indicate that lower risk expectations translate into less necessity for provisions.

Regarding the market and macroeconomics variables, we find that the VIX index and GDP Growth positively relates with the LLP for both periods under analysis. For the full sample period, we also find a positive relationship between LLP and Inflation, and a negative relationship between LLP and Expected GDP Growth. Finally, we also find that expected inflation negatively affects LLP during the QE and MEP period.

Concerning bank-specific variables, our results suggest that, for both periods, 5 Years default probability and NPL ratio positively relates with LLP, whereas the increase of capital adequacy ratio leads to a decrease of provisions. These results are consistent with the existing literature, such as Altavilla et al. (2018).

Table 3.5: Loan Loss Provision and monetary policy, period Q1 2008–Q4 2019 vs. Q1 2009 – Q2 2014, Ordinary Least Squares (OLS) with fixed effects.

	(1)	(2)	(3)	(4)
Period	**Q1 2008 - Q4 2019**		**Q1 2009 - Q2 2014**	
Variables	**Loan Loss Provision**			
Model	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**
Dependent Variable Lag	0.5610***	0.5420***	0.4980***	0.5050***
	(0.0062)	(0.0082)	(0.010)	(0.0144)
Monetary Policy Variables				
Short-term Interest Rate	-0.0016*	0.0020*	-0.0036	0.0830**
	(0.0010)	(0.0012)	(0.0278)	(0.0353)
UMP Deviation	0.0143***	0.0136***	0.0242***	0.0157***
	(0.0008)	(0.0009)	(0.0020)	(0.0026)
Sovereign Yield Slope	0.0239***	0.0251***	0.0089***	0.0081***
	(0.0009)	(0.0011)	(0.0020)	(0.0025)
Market & Macroeconomic Variables				
VIX Index	0.0000***	0.0000***	0.0000***	0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP Growth	0.0027***	0.0018***	0.0047***	0.0034***
	(0.0003)	(0.0003)	(0.0004)	(0.0005)
Inflation	0.0037***	0.0022***	0.0008	-0.0020*
	(0.0005)	(0.0007)	(0.0009)	(0.0011)
Expected GDP Growth	-0.0203***	-0.0128***	0.0072	-0.0068
	(0.0026)	(0.0029)	(0.0062)	(0.0081)
Expected Inflation	0.0005	0.0040**	-0.0163***	-0.0139***
	(0.0013)	(0.0016)	(0.0029)	(0.0037)
Bank-Specific Variables				
5 Year Default Probability		0.0018***		0.0013***
		(0.0002)		(0.0003)
Non-Performing Loan Ratio		0.0020***		0.0047***
		(0.0002)		(0.0007)
Capital Adequacy Ratio		-0.0000***		-0.0000***
		(0.0000)		(0.0000)
Efficiency Ratio		0.0000		0.0000
		(0.0000)		(0.0000)
Constant	0.0003***	0.0001	0.0005***	0.0007***
	(0.0000)	(0.0000)	(0.0002)	(0.0002)
Observations	17,375	10,413	7,492	3,786
R-squared	0.557	0.625	0.479	0.611
Number of Banks	483	373	385	287

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: LLP as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q1 2008–Q4 2019 and Q1 2009 – Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method is Ordinary Least Squares (OLS) with fixed effects. Unconventional Monetary Policy deviation is computed based on Wu and Xia’s shadow rate.

3.5.1.4. Return on Assets

The results in Table 3.6 suggest significant relationships between the monetary policy variables and the ROA. First, we find scarce evidence of a relationship between the short-term interest rate and the ROA: we only find a positive relationship in the model considering bank-specific variables for the full sample period. Higher interest rates tend to lead to higher returns for banks, and some studies find similar results (e.g., Altavilla et al., 2018). Because the short-term interest rate is very close to zero during the QE and MEP period, we expect an absence of a relationship between this variable and the ROA.

Second, our results suggest a negative relationship between the UMP Deviation and the ROA for both periods under analysis. This relationship suggests that the implementation of UMP increased the banks' overall profitability.

Third, in line with all profitability components, we find a negative relationship between the Sovereign Yield Slope and ROA for both periods of analysis. Overall, the reduction in the Sovereign Yield Slope may have led to savings in LLP as well as a reduction in the NII, which may have been compensated by an increase in the NNOII; ultimately, the reduction in the Sovereign Yield Slope is associated to an increase in the banks' overall profitability.

Turning to the market and macroeconomic variables, we find a negative relationship between the stock volatility index and ROA, where higher volatility markets led to less return. The relationship can be explained by the problems of higher defaults caused by the higher risk environment. We also find scattered evidence that GDP growth, inflation and expected inflation may influence the ROA, depending on the model and sample.

Concerning bank-specific variables, as expected, we find significant evidence that all bank-specific variables impact ROA for both periods.

Table 3.6: Return on Assets and monetary policy, period Q1 2008–Q4 2019 vs. Q1 2009 – Q2 2014, Ordinary Least Squares (OLS) with fixed effects.

	(1)	(2)	(3)	(4)
Period	**Q1 2008 - Q4 2019**		**Q1 2009 - Q2 2014**	
Variables	**Return on Assets**			
Model	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**
Dependent Variable Lag	0.3710***	0.1500***	0.2830***	0.1060***
	(0.0065)	(0.0097)	(0.0100)	(0.0166)
Monetary Policy Variables				
Short-term Interest Rate	0.0057	0.0085**	-0.1830	-0.1510
	(0.0074)	(0.0040)	(0.1690)	(0.1350)
UMP Deviation	-0.0164***	-0.0205***	-0.0232*	0.0005
	(0.0057)	(0.0030)	(0.0119)	(0.0100)
Sovereign Yield Slope	-0.0384***	-0.0449***	-0.0292**	-0.0310***
	(0.0062)	(0.0036)	(0.0117)	(0.0094)
Market & Macroeconomic Variables				
VIX Index	-0.0000***	-0.0000**	-0.0000***	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP Growth	0.0019	-0.0010	-0.0016	-0.0044**
	(0.0018)	(0.0010)	(0.0024)	(0.0018)
Inflation	0.0081**	0.0037	0.0044	0.0012
	(0.0040)	(0.0023)	(0.0052)	(0.0042)
Expected GDP Growth	-0.0177	0.0043	-0.0034	0.0224
	(0.0190)	(0.0101)	(0.0375)	(0.0312)
Expected Inflation	-0.0476***	-0.0207***	-0.0166	0.0324**
	(0.0095)	(0.0055)	(0.0178)	(0.0144)
Bank-Specific Variables				
5 Year Default Probability		-0.0117***		-0.0119***
		(0.0008)		(0.0013)
Non-Performing Loan Ratio		-0.0063***		-0.0163***
		(0.0008)		(0.0025)
Capital Adequacy Ratio		0.0000***		0.0000***
		(0.0000)		(0.0000)
Efficiency Ratio		-0.0003***		-0.0002***
		(0.0000)		(0.0000)
Constant	0.0047***	0.0028***	0.0038***	0.0015*
	(0.0005)	(0.0003)	(0.0010)	(0.0008)
Observations	21,146	10,393	9,097	3,788
R-squared	0.160	0.211	0.105	0.172
Number of Banks	597	373	469	284

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: ROA. Data are at quarterly frequency covering an unbalanced sample for the period Q1 2008–Q4 2019 and Q1 2009 – Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method is Ordinary Least Squares (OLS) with fixed effects. Unconventional Monetary Policy deviation is computed based on Wu and Xia's shadow rate.

3.5.2. Quantile Regression Results

This section presents our results for the quantile regression. As mentioned in Subchapter 3.3.3.2., we use the Quantile Regression with fixed effects and we choose the following quantiles: 10%, 25%, 50%, 75%, and 90%, to analyze each dependent variable.

In this section, we follow the same structure as in the previous section by discussing the results of each profitability component. However, this section differs in three ways from the previous one. First, we only focus our attention in the UMP subsample, that is, QE and MEP period.

Second, for each profitability component, we only present and review the results of the monetary policy variables throughout the quantiles. We take this decision for conciseness purposes because we still use the control variables, which compress the macroeconomic, market and bank-specific variables. The full results are available upon request.

Finally, for each profitability component, we present two tables. The first table presents the quantile regression estimates, whereas in the second table we present the Beta Equality Tests for successive quantiles, i.e., we test coefficients equality across different quantiles. The purpose of this approach is to test whether or not these differences are statistically significant across quantiles. The null hypothesis, if not rejected, implies that the coefficients are equal, which indicate that the quantiles yield similar results and belong to the same regression equation. If the null hypothesis is rejected then the coefficients are not equal, hence the quantiles are significantly different and do not belong to the same regression equation.

3.5.2.1. Net Interest Income

In Table 3.7, we observe the estimates obtained for the conditional quantile regressions of the NII. From columns (1) to (5) we have the estimations for the reduced baseline model (equation 3.2), and from columns (6) to (10) we have the estimations for the extended baseline model (equation 3.3). Table 3.8 shows the Beta Equality Tests for different pairs of quantiles. For columns (1) to (4), we present the tests for the reduced baseline model, whereas in columns (5) to (8) we present the tests for the extended baseline model.

We highlight two key results from these two tables. First, the results in Table 3.7 suggest that the relationships and significance between the monetary policy variables and the NII remain similar in relation to the conditional mean benchmark estimates carried out in the previous section. Second, beta equality tests presented in Table 3.8 do not reject the hypothesis that the amplitude of the impact is similar across quantiles.

Table 3.7: Net Interest Income and Monetary Policy, period Q1 2009–Q2 2014, Quantile Regression with fixed effects for Panel Data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Net Interest Income**					**Net Interest Income**				
Model	**Reduced Model**					**Extended Model**				
Quantiles	**10%**	**25%**	**50%**	**75%**	**90%**	**10%**	**25%**	**50%**	**75%**	**90%**
Dependent Variable Lag	0.7260***	0.7010***	0.6750***	0.6490***	0.6260***	0.7370***	0.7010***	0.6600***	0.6180***	0.5820***
	(0.0239)	(0.0193)	(0.0182)	(0.0217)	(0.0275)	(0.0477)	(0.0401)	(0.0366)	(0.0395)	(0.0461)
Monetary Policy Variables										
Short-term Interest Rate	-0.0947***	-0.0822***	-0.0694***	-0.0564***	-0.0448*	-0.0883**	-0.0730**	-0.0560**	-0.0384	-0.0231
	(0.0311)	(0.0242)	(0.0199)	(0.0203)	(0.0247)	(0.0382)	(0.0288)	(0.0253)	(0.0318)	(0.0425)
UMP Deviation	0.0093***	0.0094***	0.0094***	0.0095***	0.0096***	0.0119***	0.0122***	0.0125***	0.0128***	0.0131***
	(0.0020)	(0.0017)	(0.0017)	(0.0019)	(0.0024)	(0.0026)	(0.0022)	(0.0022)	(0.0029)	(0.0038)
Sovereign Yield Slope	0.0062***	0.0066***	0.0070***	0.0073***	0.0077***	0.0067**	0.0068***	0.0070***	0.0072***	0.0073**
	(0.0019)	(0.0015)	(0.0013)	(0.0017)	(0.0022)	(0.0030)	(0.0022)	(0.0020)	(0.0027)	(0.0037)
Observations	7,529	7,529	7,529	7,529	7,529	3,801	3,801	3,801	3,801	3,801

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Data are at quarterly frequency covering an unbalanced sample for the period Q1 2009–Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method Quantile Regression with fixed effects from Machado and Santos Silva (2019). Quantiles under analysis: 10%, 25%, 50%, 75%, and 90%. Bootstrap with 100 repetitions. Unconventional Monetary Policy deviation is computed based on Wu and Xia's shadow rate. Control variables: Market, Macroeconomic and Bank-specific variables are omitted.

Table 3.8: Net Interest Income - Beta Equality Test, $H_0: \beta_i - \beta_j = 0$ and $H_1: \beta_i - \beta_j \neq 0$.

	Model	**Reduced Baseline Model**				**Extended Baseline Model**			
Dep. Variable	Quantile / Indep. Variable	**10%-25%**	**25%-50%**	**50%-75%**	**75%-90%**	**10%-25%**	**25%-50%**	**50%-75%**	**75%-90%**
Net Interest Income	Short-term Interest Rate	0.200	0.203	0.197	0.217	0.293	0.300	0.303	0.299
	UMP Deviation	0.921	0.921	0.922	0.925	0.810	0.809	0.811	0.808
	Sovereign Yield Slope	0.641	0.645	0.644	0.645	0.904	0.905	0.905	0.906

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.5.2.2. Net Non-Interest Income

In Table 3.9, in which we analyze in depth the relationships between monetary policy instruments and the quantiles of NNOII, the outputs of the quantile regression with fixed effects are in accordance with the conditional mean regression of reference regarding the short-term interest rates and sovereign yield slope. It is possible to observe, concerning the NNOII, a positive correlation with the short-term interest rate and a negative correlation with the Sovereign Yield Slope that occurs in all quantiles investigated, except for the 10% and 25 % in the extended baseline model for the relationship between NNOII and Short-Term Interest Rate. Furthermore, based on Table 3.10, according to the beta equality test, we do not reject the hypothesis that the magnitude of effects is uniform across quantiles.

However, thanks to the use of fixed-effects quantile estimation, for the reduced baseline model, we find evidence that the UMP deviation has a negative and significant relationship with NNOII for the 10% and 25% quantiles. Recall that this evidence could not be observed based on the conditional mean regression. Thus, our results suggest that banks with lower NNOII increase their non-interest components upon the implementation of UMP, more specifically using QE and MEP. Additionally, based on the beta equality test presented in Table 3.10, the results suggest that with the implementation of the UMP, banks increased their non-interest components, with a greater proportion, the lower the NNOII. This result may occur because banks with lower NNOII have a higher margin to increase their NNOII than their competitors, which means that banks with lower profits in non-interest components were forced to offset losses on the NII side.

Table 3.9: Net Non-Interest Income and Monetary Policy, period Q1 2009–Q2 2014, Quantile Regression with fixed effects for Panel Data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Net Non-Interest Income**					**Net Non-Interest Income**				
Model	**Reduced Model**					**Extended Model**				
Quantiles	**10%**	**25%**	**50%**	**75%**	**90%**	**10%**	**25%**	**50%**	**75%**	**90%**
Dependent Variable Lag	0.2560***	0.2570***	0.2570***	0.2580***	0.2580***	0.1800***	0.1920***	0.2070***	0.2210***	0.2350***
	(0.0322)	(0.0273)	(0.0250)	(0.0265)	(0.0310)	(0.0336)	(0.0312)	(0.0331)	(0.0396)	(0.0480)
Monetary Policy Variables										
Short-term Interest Rate	0.1000**	0.1010**	0.1010***	0.1020**	0.1030*	0.0697	0.0843	0.1030*	0.1200*	0.1360*
	(0.0510)	(0.0416)	(0.0388)	(0.0443)	(0.0557)	(0.0748)	(0.0621)	(0.0569)	(0.0654)	(0.0811)
UMP Deviation	-0.0074**	-0.0052*	-0.0028	-0.0005	0.0018	-0.0014	-0.0023	-0.0036	-0.0047	-0.0058
	(0.0036)	(0.0027)	(0.0023)	(0.0027)	(0.0036)	(0.0060)	(0.0050)	(0.0042)	(0.0041)	(0.0046)
Sovereign Yield Slope	-0.0207***	-0.0193***	-0.0178***	-0.0164***	-0.0150***	-0.0177***	-0.0162***	-0.0144***	-0.0126**	-0.0110*
	(0.0043)	(0.0032)	(0.0025)	(0.0027)	(0.0036)	(0.0047)	(0.0038)	(0.0039)	(0.0051)	(0.0066)
Observations	7,545	7,545	7,545	7,545	7,545	3,801	3,801	3,801	3,801	3,801

Standard errors in parentheses

Notes: Data are at quarterly frequency covering an unbalanced sample for the period Q1 2009–Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method Quantile Regression with fixed effects from Machado and Santos Silva (2019). Quantiles under analysis: 10%, 25%, 50%, 75% and 90%. Bootstrap with 100 repetitions. Unconventional Monetary Policy deviation is computed based on Wu and Xia’s shadow rate. Control variables: Market, Macroeconomic and Bank-specific variables are omitted.

Table 3.10: Net Non-Interest Income - Beta Equality Test, $H_0: \beta_i - \beta_j = 0$ and $H_1: \beta_i - \beta_j \neq 0$.

	Model	**Reduced Baseline Model**				**Extended Baseline Model**			
Dep. Variable	Quantile / Indep. Variable	**10%-25%**	**25%-50%**	**50%-75%**	**75%-90%**	**10%-25%**	**25%-50%**	**50%-75%**	**75%-90%**
Net Non-Interest Income	Short-term Interest Rate	0.968	0.968	0.968	0.968	0.533	0.517	0.540	0.530
	UMP Deviation	0.095*	0.091*	0.091*	0.084*	0.518	0.496	0.501	0.501
	Sovereign Yield Slope	0.352	0.355	0.348	0.346	0.430	0.408	0.440	0.433

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.5.2.3. Loan Loss Provision

As well as the previous dependent variables under study, the LLP, illustrated in Table 3.11, are also no exception to the rule, obtaining results, for the purposes of quantile regression in accordance with the conditional mean regression reference. It is possible to observe, concerning the LLP, a positive correlation with Sovereign Yield Slope that occurs in all quantiles investigated. Furthermore, based on Table 3.12, according to the beta equality test, we do not reject the hypothesis that the magnitude of these effects is uniform across quantiles.

Regarding the UMP deviation, we find a positive relationship with the LLP across all quantiles from 10% to 90%. Without surprise, the U.S. Fed's use of UMP has improved the economic outlook over the years of its implementation, which has translated into a decrease in required provisions given the lower probability of bank loan defaults. Moreover, based on Table 3.12, the beta equality tests indicate that banks with higher default provisions benefited more than banks with lower default provisions through the application of UMP. In fact, the implementation of unconventional monetary policy led to a decrease in provisions with greater proportion, the higher the bank’s size of LLP on total assets, in all quantiles analyzed, without exception.

Table 3.11: Loan Loss Provision and Monetary Policy, period Q1 2009–Q2 2014, Quantile Regression with fixed effects for Panel Data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Loan Loss Provision**					**Loan Loss Provision**				
Model	**Reduced Model**					**Extended Model**				
Quantiles	**10%**	**25%**	**50%**	**75%**	**90%**	**10%**	**25%**	**50%**	**75%**	**90%**
Dependent Variable Lag	0.3640***	0.4210***	0.4920***	0.5670***	0.6380***	0.3720***	0.4270***	0.5050***	0.5730***	0.6310***
	(0.0223)	(0.0208)	(0.0201)	(0.0196)	(0.0212)	(0.0362)	(0.0342)	(0.0334)	(0.0348)	(0.0377)
Monetary Policy Variables										
Short-term Interest Rate	0.0203	0.0100	-0.0026	-0.0161	-0.0287	0.1160**	0.1020**	0.0831*	0.0662	0.0519
	(0.0383)	(0.0304)	(0.0271)	(0.0339)	(0.0461)	(0.0526)	(0.0464)	(0.0434)	(0.0473)	(0.0540)
UMP Deviation	0.0193***	0.0214***	0.0240***	0.0267***	0.0292***	0.0119***	0.0135***	0.0157***	0.0177***	0.0194***
	(0.0025)	(0.0021)	(0.0021)	(0.0027)	(0.0036)	(0.0030)	(0.0026)	(0.0025)	(0.0029)	(0.0036)
Sovereign Yield Slope	0.0080***	0.0084***	0.0088***	0.0093***	0.0098***	0.0083**	0.0082***	0.0081***	0.0080**	0.0079*
	(0.0023)	(0.0018)	(0.0016)	(0.0019)	(0.0026)	(0.0034)	(0.0028)	(0.0027)	(0.0033)	(0.0042)
Observations	7,492	7,492	7,492	7,492	7,492	3,786	3,786	3,786	3,786	3,786

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Data are at quarterly frequency covering an unbalanced sample for the period Q1 2009–Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method Quantile Regression with fixed effects from Machado and Santos Silva (2019). Quantiles under analysis: 10%, 25%, 50%, 75% and 90%. Bootstrap with 100 repetitions. Unconventional Monetary Policy deviation is computed based on Wu and Xia's shadow rate. Control variables: Market, Macroeconomic and Bank-specific variables are omitted.

Table 3.12: Loan Loss Provision - Beta Equality Test, $H_0: \beta_i - \beta_j = 0$ and $H_1: \beta_i - \beta_j \neq 0$.

	Model	**Reduced Baseline Model**				**Extended Baseline Model**			
Dep. Variable	Quantile / Indep. Variable	**10%-25%**	**25%-50%**	**50%-75%**	**75%-90%**	**10%-25%**	**25%-50%**	**50%-75%**	**75%-90%**
Loan Loss Provision	Short-term Interest Rate	0.439	0.444	0.446	0.449	0.312	0.281	0.302	0.291
	UMP Deviation	0.025**	0.026**	0.029**	0.032**	0.077*	0.068*	0.081*	0.084*
	Sovereign Yield Slope	0.613	0.623	0.617	0.620	0.953	0.951	0.953	0.953

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.5.2.4. Return on Assets

According to Table 3.13, the outputs of the quantile regression with fixed effects are in accordance with the conditional mean regression of reference regarding the short-term interest rates and sovereign yield slope. Concerning the ROA, it is possible to observe an insignificant correlation with the short-term interest rate and a negative correlation with the Sovereign Yield Slope. Furthermore, based on Table 3.14, the beta equality tests indicate that the magnitude of the impact of these two variables is similar across the asset return quantiles.

Table 3.13 also suggests that the UMP deviation negatively impacts the banks' ROA for the 10%, 25% and 50% quantiles, which is in line with our benchmark model. However, two additional conclusions can be inferred from the quantile regression with fixed effects estimation. First, the results suggest that UMP, specifically QE and MEP, may have led to a recovery of banks with low overall returns on assets. According to Table 3.13, in the reduced baseline model, the relationship is significant at the 10%, 25% and 50% quantiles but not significant at the 75% and 90% quantiles, which alludes to banks with high returns on assets are not affected. Second, based on Table 3.14, the beta equality test for the return on asset quantiles 10%, 25%, and 50% are not equal in magnitude with respect to the UMP deviation. The lower the bank's profitability, the higher the impact of UMP on its returns.

Table 3.13: Return on Assets and Monetary Policy, period Q1 2009–Q2 2014, Quantile Regression with fixed effects for Panel Data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Return on Assets**					**Return on Assets**				
Model	**Reduced Model**					**Extended Model**				
Quantiles	**10%**	**25%**	**50%**	**75%**	**90%**	**10%**	**25%**	**50%**	**75%**	**90%**
Dependent Variable Lag	0.3230***	0.3000***	0.2820***	0.2690***	0.2560***	0.1230***	0.1140***	0.1060***	0.0991**	0.0927*
	(0.0502)	(0.0423)	(0.0417)	(0.0441)	(0.0482)	(0.0429)	(0.0268)	(0.0273)	(0.0393)	(0.0557)
Monetary Policy Variables										
Short-term Interest Rate	0.1410	-0.0484	-0.1930	-0.2990*	-0.4080**	-0.1690	-0.1600	-0.1510	-0.1440	-0.1370
	(0.3130)	(0.2150)	(0.1610)	(0.1530)	(0.182)	(0.2110)	(0.1290)	(0.1130)	(0.1610)	(0.2340)
UMP Deviation	-0.0605***	-0.0387***	-0.0221*	-0.0098	0.0026	-0.0185	-0.0087	0.0008	0.0085	0.0157
	(0.0200)	(0.0141)	(0.0124)	(0.0139)	(0.0175)	(0.0148)	(0.0078)	(0.0078)	(0.0132)	(0.0205)
Sovereign Yield Slope	-0.0310*	-0.0299***	-0.0291**	-0.0285*	-0.0279	-0.0165	-0.0240***	-0.0313***	-0.0371**	-0.0426*
	(0.0173)	(0.0112)	(0.0120)	(0.0157)	(0.0207)	(0.0124)	(0.0085)	(0.0104)	(0.0155)	(0.0218)
Observations	9,097	9,097	9,097	9,097	9,097	3,788	3,788	3,788	3,788	3,788

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Data are at quarterly frequency covering an unbalanced sample for the period Q1 2009–Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method Quantile Regression with fixed effects from Machado and Santos Silva (2019). Quantiles under analysis: 10%, 25%, 50%, 75% and 90%. Bootstrap with 100 repetitions. Unconventional Monetary Policy deviation is computed based on Wu and Xia's shadow rate. Control variables: Market, Macroeconomic and Bank-specific variables are omitted.

Table 3.14: Return on Assets - Beta Equality Test, $H_0: \beta_i - \beta_j = 0$ and $H_1: \beta_i - \beta_j \neq 0$.

	Model	**Reduced Baseline Model**				**Extended Baseline Model**			
Dep. Variable	Quantile / Indep. Variable	**10%-25%**	**25%-50%**	**50%-75%**	**75%-90%**	**10%-25%**	**25%-50%**	**50%-75%**	**75%-90%**
Return on Assets	Short-term Interest Rate	0.129	0.126	0.143	0.179	0.934	0.929	0.935	0.939
	UMP Deviation	0.021**	0.021**	0.027**	0.048**	0.288	0.244	0.308	0.380
	Sovereign Yield Slope	0.917	0.917	0.922	0.921	0.346	0.320	0.390	0.436

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.6. Robustness

This chapter presents additional analysis carried out to check the robustness of the results. Specifically, we assess the estimators of the monetary policy variables using different estimation techniques for the subsample period of Q1 2009 until Q2 2014. We perform two robustness exercises, one for each model, i.e., the benchmark and the quantile regression, respectively. The detailed results are displayed in Appendix E, regarding the estimation of the mean regression benchmark model, in Appendix F to I the estimations for the quantile regression models and, finally, Appendix J display the beta equality tests.

First, using OLS estimation with fixed effects may lead to biased results in a dynamic panel with fixed time periods and a large number of banks. For robustness purposes, we use the two-step difference Generalized Method of Moments (GMM) dynamic panel estimator developed by Blundell and Bond (1998), which accounts for the "individual effects" that arise due to the bank's heterogeneity upon their characteristics. This estimation method tackles two potential sources of endogeneity, which come from including the lagged dependent variable and from explanatory variables, using the lagged variables at levels as instruments. The consistency of the GMM estimator depends both on the assumption that the error term has no serial correlation and on the validity of the instruments used for that purpose we perform those tests.

From this estimation method, the results are widely similar to those we present in the previous section. We only find two exceptions. On the one hand, the results of the short-term interest rate are not robust, in terms of significance, to those we find in the NNOII and ROA. This lack of consistency may result from the fact that the policy rate was constrained to a lower bound of 0% in our sample, which may provoke misleading results. On the other hand, the relationship between the Yield Slope and LLP is different from that we find earlier. This difference may be explained by the fact that the GMM estimation required two more lags, which may condition the dynamic of the variable.

Second, in addition to the quantile regression with fixed effects for panel data developed by Machado and Santos Silva (2019), we also perform the estimations using robust bootstrapped standard errors, clustered at the bank level, following Parente and Santos Silva (2016) approach. This approach follows an asymptotic distribution of maximum likelihood and least-squares estimators rather than a least absolute deviation estimators employed in Machado and Santos Silva (2019). This approach thus provides a quantile regression with an estimator of the covariance matrix of the asymptotic distribution, which is consistent and asymptotically normal when the error terms are correlated within clusters but independent across clusters, working reasonably well in practice.

From this estimation method, the results are widely similar to those we present in the previous section. We only find two exceptions. One the one hand, in line with the benchmark model, we also find that the results of the short-term interest rate are not robust to those we find in the NNOII and ROA. On the other hand, despite the fact that we also find a negative relationship between the UMP deviation and the NNOII, this model suggests that the differences between quantiles are not significant.

3.7. Summary and Discussion

In this study, we have scrutinized the impact of UMP on U.S. banks' profitability across various quantiles for each of the profitability components. We take advantage of the shadow rate of Wu and Xia (2016), computing a proxy called the UMP deviation, which accounts for the impulses of unconventional monetary policy measures. To better answer our question, we split our full sample from Q1 2008 to Q4 2019 into a specific sub-sample/regime period characterized by the implementation of UMP by the U.S. Fed, Q1 2009 through Q2 2014. We adopted the quantile regression methodology of Machado and Santos Silva (2019) which allows for fixed effects in panel data and provides information on how the regressors affect the entire conditional distribution of the variable of interest.

Our conditional mean regression results suggest that UMP impacted several bank profitability components and the overall ROA. First, with the introduction and continued application of QE and maturity extension, the banks' NII shifted towards further declines, adding to the reduction provoked by the decrease in policy interest rates. Second, UMP may have improved the economic outlook that led to a reduction in banks' LLP, as fewer provisions would be needed to cover a reduction in delinquency. Third, we do not find a relationship between the UMP and the banks' NNOII using the conditional mean regression methodology. Finally, the results suggest that QE benefits the overall return on bank assets. In other words, our results advocate that QE led to a recovery in the average profitability of the U.S banking system.

Due to the employment of quantile regression with fixed effects for panel data, we highlight several results. Overall, the unconventional monetary policy, QE and MEP, does not impact the bank profitability components similarly across U.S. banks. First, the decrease in NII components seems to be reinforced by the evolution of the UMP evenly among the banks with higher or lower NII. Second, banks with low NNOII (quantile 10% and 25%) apparently increased these components with the implementation of QE and MEP. The lower the NNOII, the more these banks increase the component with the growth of the unconventional monetary policy. Third, the LSAP by the U.S. Fed benefit most banks with higher LLP compared to banks with a lower volume of provisions. Last, we find that banks with a lower ROA (quantiles 10%, 25% and 50%) were positively affected by UMP, but banks with a higher ROA seem to have no relationship with unconventional monetary measures applied. Furthermore, the lower the return on bank assets, the greater the recovery obtained with the UMP implemented by the U.S. Fed.

Our results enlighten two relevant insights. First, the results regarding the impact of UMP on banks' ROA suggest that these monetary policy measures improved financial stability, strengthening the most fragile banks. Second, since we do not find evidence of negative effects of the UMP in banks' ROA, we suggest that the UMP did not hinder the monetary transmission mechanism via the bank's profitability channel.

Finally, we reinforce a consideration for the future monetary policies applied by the U.S. Fed. Having unequal effects on the banks' profitability distribution components, our results imply that the U.S. Fed should look beyond the average effects of the policy when they are making their decisions. One size does not fit all, or perhaps, one measure does not affect equally all.

Appendix B

U.S. Fed’s Unconventional Monetary Policies

On January 16, 2008, the Federal Open Market Committee (FOMC), after reducing short-term interest rates to near zero, sought to directly affect long-term bond yields and other financial asset prices by providing guidance about futures short-term interest rates. To understand this process, note that long-term returns have two main components. The first – the expectations component – is the average of expected future short-term interest rates at the maturity of the longest-term bond. The second component is the term premium, which includes compensation to investors for the risk of holding long-term bonds. The expectations component may change when the Fed provides information on the future path of short rates. After the Great Recession, the Fed's forward guidance was aimed at reducing expectations of future short rates, lowering long-term yields and easing financial conditions. In addition, if forward guidance results in a narrower distribution of short rate expectations around a future path, it could also reduce interest rate volatility and uncertainty, which could reduce term risk and premiums and contribute even more to easier financial conditions.

The Fed's second and third unconventional monetary policy tool was quantitative easing (QE), or LSAP and MEP, which involved the Fed buying long-term and selling short-term bonds. At the start of the crisis, these holdings were less than $1 trillion. Then, with three separate waves of purchases and two MEP – LSAP1, LSAP2 and LSAP3 plus MEP1 and MEP2 – the Fed's balance sheet has increased to more than $4 trillion. These purchases are believed to work through a direct supply and demand channel: increased Fed demand for bonds tends to drive bond prices higher, which lowers yields. This “portfolio balance” channel requires some imperfect substitutability between financial assets and operates by reducing the term premium over long-term yields. Bond purchases can also provide a signal about how the benchmark interest rate will adjust in the future – a form of forward guidance – and in this way QE can also reduce the expectations component of yields (Bauer and Rudebusch, 2016).

As economic conditions became more favorable, the Fed began reducing the size of its balance sheet in 2017, limiting the replacement of maturing bonds in its portfolio. The Fed's balance sheet is unlikely to return to pre-crisis levels for two main reasons. First, the economy has grown and there is now about twice as much U.S. currency in circulation as there was at the start of the financial crisis, which proportionately increases the size of the Fed's balance sheet. Second, along with more currency, there are substantially more reserves, in the financial system. In part, these reserves reflect an increase in preventive liquidity demand by many private financial institutions since the crisis. This reserve cushion also represents a possible shift from a pre-crisis monetary policy regime from operating with scarce reserves to one with abundant reserves (Rudebusch, 2018).

Appendix C

Table C.1: Chronology of the U.S. unconventional monetary policies events implemented by the Fed.

ID	Event Date	Program	Description
1	November 25, 2008	LSAP1	Large-scale asset purchases of up to $100 billion of U.S. agency debt and $500 billion of mortgage-backed securities (MBS).
2	December 16, 2008	FG	Reduced federal funds rate to a range of 0% to 0.25%; anticipated "exceptionally low" federal funds rate would likely be maintained "for some time."
3	March 18, 2009	LSAP1, FG	Large-scale asset purchases which, combined with Nov. 2008 announcement, totaled $300 billion of U.S. Treasury securities, $200 billion of U.S. agency debt (later revised to $175 billion), $1.25 trillion of MBS over about one year (popularly known as "quantitative easing"); anticipated "exceptionally low" federal funds rate would likely be maintained "for an extended period."
4	August 10, 2010	LSAP1	Following completion of large-scale asset purchases, maturing assets would be replaced with U.S. Treasury securities to prevent the balance sheet from shrinking.
5	November 3, 2010	LSAP2	Large-scale asset purchases of $600 billion of U.S. Treasury securities over eight months (popularly known as "QEII").
6	August 9, 2011	FG	Set a target date (mid-2013) for period Fed anticipated it would keep the federal funds rate at "exceptionally low levels"; the Fed subsequently moved back the target date incrementally to mid-2015.
7	September 21, 2011	MEP1	Maturity Extension Program (popularly known as "Operation Twist"), under which Fed purchased $400 billion long-term U.S. Treasury securities, and sold an equivalent amount of short-term Treasury securities over nine months. Began rolling over existing agency debt and MBS into new agency MBS (instead of U.S. Treasury securities).
8	January 25, 2012	FG	Set "longer-run goal" of 2% inflation; public release of FOMC members forecast of "appropriate" federal funds target.
9	June 20, 2012	MEP2	Extended and expanded the Maturity Extension Program to an additional $267 billion of Treasury securities, through the end of 2012.
10	September 13, 2012	LSAP3, FG	Announced large-scale asset purchases of $40 billion of Agency MBS per month for unspecified duration (popularly known as "QE3").

(continues)

Table C.1: Chronology of the U.S. unconventional monetary policies events implemented by the Fed. ***(continued)***

ID	Event Date	Program	Description
11	December 12, 2012	LSAP3, FG	Announced that the Fed would continue purchasing $45 billion of Treasury securities per month after the expiration of the Maturity Extension Program; changed the threshold for ending "exceptionally low levels" of the federal funds rate from "at least through mid-2015" to "at least as long as the unemployment rate remains above 6-1/2 percent," contingent on low inflation.
12	December 18, 2013 until September 17, 2014	LSAP3	Announced that the Fed would begin to "taper off" its securities purchases, initially reducing monthly purchases by $10 billion.
13	March 18, 2015	FG	The increase in the target range for the federal fund rate remains unlikely.
14	December 16, 2015	FG	Expectations that economic conditions will evolve in a manner that will warrant only gradual increases in the federal funds rate.

Appendix D

Table D.1: Summary of units, frequency, data level, sources and data transformations to each of our variables employed.

	Units	Frequency	Data Level	Source	Manipulation/Transformations
Dependent Variables					
Net Interest Income per TA	Hundredth of percent	Quarterly-basis	Bank-level	Refinitiv Eikon	Winsorise
Net Non-Interest Income per TA					
Loan Loss Provision per TA					
Return on Assets					
Independent Variables					
Monetary Policy Instruments					
Short-term interest rate	Hundredth of percent	Quarterly-basis	Time-level	Refinitiv DataStream	-
UMP Deviation (Wu and Xia)					-
Sovereign Yield Slope				Refinitiv DataStream	-
Market and Macroeconomic					
VIX Index	Hundredth of percent	Quarterly-basis	Time-level	Bloomberg	-
GDP Growth				Eurostat	-
Inflation					-
Expected GDP Growth		Semi-annual		Refinitiv DataStream	Linearization Semi-annual to Quarterly basis
Expected Inflation		Quarterly-basis			-
Bank-specific					
5 Years default probability	Hundredth of percent	Quarterly-basis	Bank-level	Bloomberg	-
Non-Performing Loans (NPL)				Refinitiv Eikon	
Capital Adequacy Ratio				Refinitiv Eikon	
Efficiency Ratio					

Appendix E

Table E.1: Profitability components and monetary policy, period Q1 2009–Q2 2014, System Generalized Method of Moments (GMM).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Model	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**
Dependent Variable t-1	0.4840***	0.4000***	0.0681***	0.0322***	0.4940***	0.4730***	0.2650***	0.1280***
	(0.0119)	(0.0076)	(0.0128)	(0.0097)	(0.0095)	(0.0098)	(0.0141)	(0.0069)
Dependent Variable t-2	0.1460***	0.1660***	-0.0199*	-0.0272***	0.2470***	0.1870***	0.0638***	0.0847***
	(0.0072)	(0.0048)	(0.0105)	(0.0063)	(0.0081)	(0.0044)	(0.0100)	(0.0046)
Dependent Variable t-3					0.1170***	0.1160***		
					(0.0077)	(0.0060)		
Monetary Policy Variables								
Short-term Interest Rates	-0.0605***	-0.0265***	0.0163	-0.0146	-0.0317*	0.0271**	0.2480**	0.0678
	(0.0106)	(0.0068)	(0.0241)	(0.0211)	(0.0169)	(0.0120)	(0.0992)	(0.0672)
UMP Deviation	0.0096***	0.0095***	-0.0007	0.0000	0.0011	0.0023**	-0.0301**	-0.0012
	(0.0008)	(0.0008)	(0.0017)	(0.0020)	(0.0014)	(0.0010)	(0.0119)	(0.0045)
Sovereign Yield Slope	0.0070***	0.0089***	-0.0210***	-0.0218***	-0.0041***	-0.0082***	-0.0103	-0.0104**
	(0.0008)	(0.0007)	(0.0019)	(0.0020)	(0.0012)	(0.0009)	(0.0096)	(0.0042)
Market & Macroeconomic Variables								
VIX Index	0.0000***	0.0000***	0.0000***	0.0000	0.0000***	0.0000***	-0.0000*	-0.0000**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP Growth	0.0017***	0.0017***	0.0008***	0.0007***	0.0020***	0.0018***	-0.0021*	0.0004
	(0.0001)	(0.0001)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0012)	(0.0006)
Inflation	0.0009**	0.0008**	-0.0046***	-0.0051***	-0.0011*	-0.0027***	-0.0124***	-0.0052***
	(0.0004)	(0.0003)	(0.0009)	(0.0009)	(0.0006)	(0.0005)	(0.0033)	(0.0019)
Expected GDP Growth	0.0169***	0.0162***	0.0341***	0.0423***	-0.0419***	-0.0504***	0.0109	0.0696***
	(0.0027)	(0.0024)	(0.0065)	(0.0066)	(0.0047)	(0.0034)	(0.0290)	(0.0167)
Expected Inflation	0.0009	0.0007	0.0038	0.0027	-0.0282***	-0.0246***	0.0373***	0.0370***
	(0.0011)	(0.0007)	(0.0027)	(0.0023)	(0.0021)	(0.0013)	(0.0087)	(0.0071)

(continues)

Table E.1: Profitability components and monetary policy, period Q1 2009–Q2 2014, System Generalized Method of Moments (GMM). ***(continued)***

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	**Net Interest Income**	**Net Interest Income**	**Net Non-Interest Income**	**Net Non-Interest Income**	**Loan Loss Provision**	**Loan Loss Provision**	**Return on Assets**	**Return on Assets**
Model	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**	**Reduced Model**	**Extended Model**
Bank-Specific Variables								
5 Year Default Probability		0.0001		0.0034***		-0.0005***		0.0078***
		(0.0001)		(0.0003)		(0.0002)		(0.0008)
Non-Performing Loan Ratio		0.0008***		0.0011		0.0013***		-0.0013
		(0.0003)		(0.0008)		(0.0004)		(0.0022)
Capital Adequacy Ratio		0.0000***		0.0000***		-0.0000***		0.0000***
		(0.0000)		(0.0000)		(0.0000)		(0.0000)
Efficiency Ratio		-0.0000**		-0.0002***		0.0000		-0.0002*
		(0.0000)		(0.0000)		(0.0000)		(0.0001)
Constant	0.0026***	0.0028***	-0.0049***	-0.0051***	0.0016***	0.0020***	0.0004	-0.0019***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0000)	(0.0007)	(0.0006)
Observations	7,108	3,637	7,124	3,637	6,969	3,594	8,606	3,625
Number of Banks	378	285	379	285	372	283	455	281
Arellano-Bond test for AR(1) in first differences [p-value]	0	0	0	0	0	0	0	0
Arellano-Bond test for AR(2) in first differences [p-value]	0,7832	0,9542	0,009	0,1863	0,905	0,9186	0,3282	0,9084
Hansen test of overid. Restrictions [p-value]	0	0,404	0	0,0989	0,0001	0,131	0,0774	0,0258

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Dependent variables: NII, NNOII and LLP as a percent of assets. Data are at quarterly frequency covering an unbalanced sample for the period Q1 2009–Q2 2014. Empirical estimation with a two-step System Generalized Method of Moments (GMM) dynamic panel estimator developed by Blundell and Bond (1998). Unconventional Monetary Policy deviation is computed based on Wu and Xia's shadow rate. Three lags of dependent variables have been employed for the estimation of LLP. The remain estimations, have been performed only with two lags of dependent variables. Endogenous variables differ on the number of own lags used as instrumental variables. For the estimation of NII we use the eighth own lag for the endogenous variables, for NNOII until sixth, LLP until seventh and ROA only until the second lag.

Appendix F

Table F.1: Net Interest Income and Monetary Policy, period Q1 2009–Q2 2014, Quantile Regression with Cluster Data for Cross-Sectional Data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Net Interest Income**					**Net Interest Income**				
Model	**Reduced Model**					**Extended Model**				
Quantiles	**10%**	**25%**	**50%**	**75%**	**90%**	**10%**	**25%**	**50%**	**75%**	**90%**
Dependent Variable Lag	0.8760***	0.9300***	0.9760***	0.9510***	0.9050***	0.8730***	0.9310***	0.9720***	0.9670***	0.9420***
	(0.0101)	(0.0038)	(0.0059)	(0.0069)	(0.0159)	(0.0146)	(0.0070)	(0.0073)	(0.0093)	(0.0170)
Monetary Policy Variables										
Short-term Interest Rate	-0.1050***	-0.0529***	-0.0372**	-0.0238	-0.0609*	-0.0625	-0.0291	-0.0029	-0.0319	-0.0742*
	(0.0316)	(0.0148)	(0.0154)	(0.0192)	(0.0359)	(0.0449)	(0.0270)	(0.0206)	(0.0287)	(0.0384)
UMP Deviation	0.0063***	0.0049***	0.0045***	0.0056***	0.0081***	0.0069**	0.0053***	0.0037***	0.0052***	0.0083***
	(0.0022)	(0.0010)	(0.0010)	(0.0014)	(0.0026)	(0.0029)	(0.0016)	(0.0013)	(0.0020)	(0.0027)
Sovereign Yield Slope	0.0026	0.0025**	0.0025**	0.0037***	0.0055**	0.0032	0.0050**	0.0029*	0.0037**	0.0046
	(0.0022)	(0.0010)	(0.0011)	(0.0012)	(0.0027)	(0.0025)	(0.0020)	(0.0015)	(0.0015)	(0.0035)
Market & Macroeconomic Variables										
Observations	7,529	7,529	7,529	7,529	7,529	3,801	3,801	3,801	3,801	3,801

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Data are at quarterly frequency covering an unbalanced sample for the period Q1 2009–Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method Quantile Regression with Cluster data following Parente and Santos Silva (2016). Quantiles under analysis: 10%, 25%, 50%, 75% and 90%. Bootstrap with 100 repetitions. Unconventional Monetary Policy deviation is computed based on Wu and Xia's shadow rate.

Appendix G

Table G.1: Net Non-Interest Income and Monetary Policy, period Q1 2009–Q2 2014, Quantile Regression with Cluster Data for Cross-Sectional Data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Net Non-Interest Income**					**Net Non-Interest Income**				
Model	**Reduced Model**					**Extended Model**				
Quantiles	**10%**	**25%**	**50%**	**75%**	**90%**	**10%**	**25%**	**50%**	**75%**	**90%**
Dependent Variable Lag	0.7200***	0.8840***	0.9270***	0.8360***	0.6670***	0.6210***	0.7240***	0.8060***	0.7890***	0.6490***
	(0.0254)	(0.0093)	(0.0117)	(0.0096)	(0.0151)	(0.0422)	(0.0514)	(0.0615)	(0.0478)	(0.0289)
Monetary Policy Variables										
Short-term Interest Rate	0.0834	-0.0025	0.0021	0.0450*	0.1020*	-0.0183	0.0308	0.0248	0.1050*	0.1790**
	(0.0728)	(0.0430)	(0.0356)	(0.0266)	(0.0554)	(0.1120)	(0.0630)	(0.0380)	(0.0544)	(0.0909)
UMP Deviation	-0.0137**	-0.0061**	-0.0040*	-0.0024	-0.0018	-0.0020	-0.0047	-0.0025	-0.0035	-0.0025
	(0.0057)	(0.0026)	(0.0023)	(0.0023)	(0.0030)	(0.0068)	(0.0045)	(0.0026)	(0.0028)	(0.0055)
Sovereign Yield Slope	-0.0167***	-0.0144***	-0.0129***	-0.0051**	0.0027	-0.0106*	-0.0128***	-0.0130***	-0.0046	0.0045
	(0.0049)	(0.0029)	(0.0021)	(0.0024)	(0.0030)	(0.0060)	(0.0042)	(0.0031)	(0.0037)	(0.0058)
Observations	7,545	7,545	7,545	7,545	7,545	3,801	3,801	3,801	3,801	3,801

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Data are at quarterly frequency covering an unbalanced sample for the period Q1 2009–Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method Quantile Regression with Cluster data following Parente and Santos Silva (2016). Quantiles under analysis: 10%, 25%, 50%, 75% and 90%. Bootstrap with 100 repetitions. Unconventional Monetary Policy deviation is computed based on Wu and Xia’s shadow rate.

Appendix H

Table H.1: Loan Loss Provision and Monetary Policy, period Q1 2009–Q2 2014, Quantile Regression with Cluster Data for Cross-Sectional Data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Loan Loss Provision**					**Loan Loss Provision**				
Model	**Reduced Model**					**Extended Model**				
Quantiles	**10%**	**25%**	**50%**	**75%**	**90%**	**10%**	**25%**	**50%**	**75%**	**90%**
Dependent Variable Lag	0.3280***	0.6140***	0.9170***	0.8900***	0.7550***	0.4090***	0.6710***	0.9040***	0.8650***	0.7680***
	(0.0191)	(0.0262)	(0.0134)	(0.0106)	(0.0271)	(0.0346)	(0.0293)	(0.0163)	(0.0190)	(0.0389)
Monetary Policy Variables										
Short-term Interest Rate	0.0624**	-0.0094	-0.0136	0.0046	-0.1820**	0.0778*	0.0295	0.0293	0.0520*	-0.1360*
	(0.0274)	(0.0193)	(0.0187)	(0.0332)	(0.0813)	(0.0404)	(0.0310)	(0.0245)	(0.0316)	(0.0823)
UMP Deviation	0.0039**	0.0048***	0.0030***	0.0088***	0.0347***	0.0053**	0.0022	0.0013	0.0038*	0.0161***
	(0.0017)	(0.0015)	(0.0011)	(0.0022)	(0.0055)	(0.0024)	(0.0021)	(0.0010)	(0.0023)	(0.0049)
Sovereign Yield Slope	0.0038**	-0.0010	-0.0044***	0.0061***	0.0002	0.0050*	-0.0032	-0.0015	0.0049***	0.0016
	(0.0016)	(0.0013)	(0.0011)	(0.0018)	(0.0049)	(0.0027)	(0.0022)	(0.0014)	(0.0018)	(0.0065)
Observations	7,492	7,492	7,492	7,492	7,492	3,786	3,786	3,786	3,786	3,786

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Data are at quarterly frequency covering an unbalanced sample for the period Q1 2009–Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method Quantile Regression with Cluster data following Parente and Santos Silva (2016). Quantiles under analysis: 10%, 25%, 50%, 75% and 90%. Bootstrap with 100 repetitions. Unconventional Monetary Policy deviation is computed based on Wu and Xia's shadow rate.

Appendix I

Table I.1: Return on Assets and Monetary Policy, period Q1 2009–Q2 2014, Quantile Regression with Cluster Data for Cross-Sectional Data.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Variables	**Return on Assets**					**Return on Assets**				
Model	**Reduced Model**					**Extended Model**				
Quantiles	**10%**	**25%**	**50%**	**75%**	**90%**	**10%**	**25%**	**50%**	**75%**	**90%**
Dependent Variable Lag	0.6480***	0.8920***	0.9980***	0.9810***	0.9320***	0.1220***	0.2950***	0.4060***	0.4090***	0.3440***
	(0.0643)	(0.0408)	(0.0185)	(0.0018)	(0.0072)	(0.0416)	(0.0567)	(0.0763)	(0.0731)	(0.0576)
Monetary Policy Variables										
Short-term Interest Rate	0.3520	0.0886	0.0244	0.1610***	0.7950***	-0.1520	-0.0522	0.0089	0.0219	-0.0192
	(0.3380)	(0.0743)	(0.0195)	(0.0514)	(0.2650)	(0.1780)	(0.0704)	(0.0473)	(0.0664)	(0.1080)
UMP Deviation	-0.0832***	-0.0102**	0.0002	0.0002	-0.0233	-0.0091	-0.0045	-0.0047	-0.0009	0.0077
	(0.0292)	(0.0045)	(0.0013)	(0.0025)	(0.0144)	(0.0085)	(0.0046)	(0.0031)	(0.0039)	(0.0084)
Sovreign Yield Slope	-0.0602**	-0.0029	0.0005	0.0076**	0.0195	-0.0201**	-0.0123***	-0.0054	-0.0058	-0.0187**
	(0.0274)	(0.0041)	(0.0011)	(0.0035)	(0.0158)	(0.0085)	(0.0048)	(0.0037)	(0.0043)	(0.0094)
Observations	9,097	9,097	9,097	9,097	9,097	3,788	3,788	3,788	3,788	3,788

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Data are at quarterly frequency covering an unbalanced sample for the period Q1 2009–Q2 2014. Standard errors clustered at bank level in parentheses. The estimation method Quantile Regression with Cluster data following Parente and Santos Silva (2016). Quantiles under analysis: 10%, 25%, 50%, 75% and 90%. Bootstrap with 100 repetitions. Unconventional Monetary Policy deviation is computed based on Wu and Xia's shadow rate.

Appendix J

Table J.1: Bank Profitability Components - Beta Equality Test, $H_0: \beta_i - \beta_j = 0$ and $H_1: \beta_i - \beta_j \neq 0$, Quantile Regression with Cluster Data for Cross-Sectional Data.

	Model	Reduced Baseline Model				Extended Baseline Model			
Dep. Variable	Quantile / Indep. Variable	10%-25%	25%-50%	50%-75%	75%-90%	10%-25%	25%-50%	50%-75%	75%-90%
Net Interest Income	Short-term Interest Rate	0.048**	0.356	0.404	0.196	0.420	0.317	0.192	0.222
	UMP Deviation	0.436	0.715	0.382	0.225	0.491	0.324	0.374	0.142
	Yield Slope	0.911	0.975	0.325	0.478	0.479	0.277	0.607	0.796
Net Non-Interest Income	Short-term Interest Rate	0.210	0.917	0.195	0.249	0.638	0.909	0.137	0.329
	UMP Deviation	0.160	0.362	0.474	0.816	0.639	0.577	0.776	0.851
	Yield Slope	0.562	0.609	0.003***	0.006***	0.719	0.965	0.027**	0.047**
Loan Loss Provision	Short-term Interest Rate	0.008***	0.86	0.561	0.011**	0.168	0.993	0.428	0.01***
	UMP Deviation	0.590	0.188	0.001***	0.000***	0.124	0.619	0.210	0.003***
	Yield Slope	0.005***	0.017**	0.000***	0.197	0.000***	0.420	0.000***	0.577
Return on Assets	Short-term Interest Rate	0.404	0.340	0.004***	0.009***	0.512	0.344	0.825	0.626
	UMP Deviation	0.008***	0.009**	0.995	0.082*	0.537	0.964	0.232	0.170
	Yield Slope	0.032**	0.354	0.028**	0.401	0.310	0.047**	0.919	0.136

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4. Bank's Sailing Strategy through Unconventional Tides: The Dynamics of U.S. Bank Profitability Components

Synopsis: This study analyzes the dynamics between bank profitability components to understand how United States (U.S.) banks mitigated their losses in interest revenues during the period of unconventional monetary policy (UMP) (2009-2014). Using panel VAR models, we contribute to the literature by deepening the analysis of how the compensation unfolded through the computation of generalized impulse response functions for Interest Income (II), Interest Expense (IE), Non-Interest Income (NOII), Non-Interest Expense (NOIE), and Loan Loss Provisions (LLP). Our findings suggest that banks mitigated the losses on II, decreasing IE and increasing NOII. However, the majority of the compensation is achieved by the considerable decrease in LLP, as can be perceived from the predominant magnitude and persistence of this variable's response to the impulses of the remaining variables under study. These results thus suggest that UMP have not greatly constrained banks' profitability.

4.1. Motivation

The Global Financial Crisis (GFC), held between mid-2007 and early 2009, led to a deep recession in the United States (U.S.) and raised several concerns about the strength of the financial sector. One of the most important concerns was bank profitability, which affects the efficiency of how monetary policies – carried out to target the recession – are transmitted to the real economy. Therefore, it is essential to understand the interactions between monetary policy and bank profitability in order to understand how the monetary transmission mechanism unfolds (Zimmerman, 2019).

The GFC prompted the U.S. Federal Reserve (Fed) to act, lowering interest rates and employing additional unconventional monetary policy (UMP) tools. Upon the combination of these measures, the bank's interest income – the main source of income for the vast majority of banks – dropped significantly and consequently deteriorated overall banks profitability, which may restrict monetary transmission to the economy. Hence, banks needed to adapt to mitigate the losses of their interest income components. So how did banks' profitability components change after losses in the interest components during the UMP implementation?

So far, two strands of literature have partially addressed this question. First, several studies have analyzed how unconventional monetary policies individually affected each bank profitability component (e.g., Altavilla et al., 2018; García- Cruz, 2020; Chapter 2 and Chapter 3). However, while the individual analysis of each bank profitability component may be of value for this purpose, these studies have made limited analyses of accounting for the bank profitability dynamics between these components. In other words, static estimations of the bank's UMP measures in banks profitability may not identify the potentially dynamic nature of the bank's profitability components, which is only possible to verify with the use of dynamic methodologies, such as VAR models. Second, other authors have analyzed how banks have been managing their profitability components, given the fall in Net Interest Margins even before the Global Financial Crisis (e.g., Rogers and Sinkey, 1999; Smith et al., 2003; Lepetit et al., 2008; Albertazzi and Gambacorta, 2009). These studies, however, do not consider the impact of UMP on the banks' decisions.

Hence, the goal of this study is to analyze the dynamics between the different components of bank profitability during the period of implementation of unconventional momentary policies by the U.S. Fed (Q1 2009 – Q2 2014). Specifically, we analyze not only the traditional bank profitability components (i.e. Net Interest Income [NII], Net Non-Interest Income [NNOII] and Loan Loss Provisions [LLP]) but also their disaggregated components (i.e. Interest Income [II], Interest Expense [IE], Non-Interest Income [NOII] and Non-Interest Expense [NOIE]). Disaggregating the bank profitability components allows us to understand better the compensation dynamics that may be hidden in the net components, as the previous literature did. Namely, banks may have offset the losses in II components by increasing their fees and commissions, cutting administrative costs, or decreasing provisions. To achieve our goal, our approach uses Panel Vector Autoregression models following the Generalized Method of Moments estimation method developed by Sigmund and Ferstl (2021). This method allows differentiating between endogenous, weakly exogenous, and strictly exogenous explanatory variables in the model. Hence, this methodology is appropriate to disentangle the dynamics across bank profitability components.

We contribute to the literature in two ways. First, we study the dynamics between the endogenous variables II, IE, NOII, NOIE, and LLP to obtain the impulse response functions during the period of implementation of UMP. Second, we focus on bank management behavior during the period of UMP.

Our main findings are as follows. First, our results suggest that both NNOII and LLP mitigated the negative effects on bank profitability arising from the drop in NII. Second, the drop in II components is impacted after the drop of IE components, which can be explained by the concept of "maturity transformation" and the strategic reduction of bank deposit rates. Third, the decrease of IE components leads banks to adopt a strategy of increasing NOII before harming II, in an attempt to mitigate the expected losses in interest components. Fourth, the results suggest that the overall changes in NOIE may not have mitigated losses in interest components. Finally, LLP are responsible for the largest portion of compensation for losses related to interest components, as can be perceived from the predominant magnitude and persistence of this variable's response to the impulses of the other endogenous variables.

Our study provides an important insight to understand the implications of monetary policy on banks' profitability and activity, since we find that, during the UMP implementation, banks have substantially reduced the LLP component, which have allowed banks to avoid passing a significant part of their interest losses to customers and clients through the increase in fees and commissions. The results therefore suggest that, during the implementation of the UMP, banks were not greatly constrained in their profitability.

The remainder of the study is organized as follows. Section 4.2 reviews the literature with stylized facts on recent developments about how monetary policy impacted bank profitability and the overall compensation of bank profitability components. In Section 4.3, we present the methodology employed, and we describe our data in Section 4.4. Section 4.5 presents the results and their conclusions based on the employed estimations. In Section 4.6, we evaluate the robustness of our results. Section 4.7 concludes with the final remarks of our study.

4.2. Literature Review

Our study relates two main strands of the literature. The first strand is the impact of UMP on the components of bank profitability. The second strand is related to the evolution of banks' profitability strategy, more specifically, how banks have compensated or mitigated the decrease in II over time.

4.2.1. The impact of unconventional monetary policies on bank profitability

Prior to the implementation of non-standard measures by the Federal Reserve in the U.S. or the European Central Bank in Europe, the relationship between bank profitability and monetary policy had been studied since the early 1940s, providing important insights into how monetary policy affects bank profitability. For example, Samuelson (1945) and Hancock (1985) suggest that a rise in monetary policy interest rates increases bank profitability through an increase in bank interest margins. Furthermore, they also advocate that an increase in monetary policy interest rates will raise interest rates on loans to a greater extent than interest rates paid on bank deposits. Contrariwise, Flannery (1981) does not find a clear relationship between market interest rate levels and bank profitability and shows that large banks hedge against interest rate risks. In addition to the impact of monetary policy on interest margins, changes in interest rates can also affect the term premium, altering the yield curve and, consequently, bank profitability (English, 2002; English et al., 2018). Similarly, Demirgüç-Kunt and Huizinga (1999) find that a rise in interest rates increases bank interest margins and profitability.

While falling interest rates have characterized the past decade, research on the same topic remains consistent with the positive relationship between interest rates and bank profitability. For example, Borio et al. (2017) confirm that the interest rate level has a positive and significant relationship with both bank profitability and the slope of the yield curve (consistent with Weistroffer et al., 2013; Genay and Podjasek 2014; Alessandri and Nelson, 2015; Aydemir and Ovenc, 2016; Busch and Memmel, 2017; among others). Despite this positive relationship, Lopez et al. (2020) show that negative nominal interest rates have only a small effect on bank profitability compared to low positive rates. The smaller effect may occur because banks can act to mitigate the negative impact of falling interest rates on profitability. For instance, banks can reduce IE (Scheiber et al., 2016), increase loan spreads (Sääskilahti, 2018), set higher fees and commissions (Turk, 2016), and decrease the importance of deposits as a funding source (Jobst and Lin, 2016). Additionally, due to the boost of the real economy as a result of low interest rates, banks would benefit from the lower provisions thanks to the improved solvency of the borrowers (e.g., Albertazzi and Gambacorta, 2009; Borio et al., 2017; Bikker and Vervliet, 2018). However, in this context, banks can also carry out riskier lending strategies to increase their profits, which might deteriorate the bank's future loan portfolio quality because of the increase in credit risk (Albertazzi et al., 2021; Heider et al., 2019; Demiralp et al., 2021). Finally, low interest rates could also positively affect the volume of loans (Demiralp et al., 2021; Rostagno et al., 2021). Hence, the net impact of lower interest rates on bank profitability depends on banks' ability to manage the abovementioned factors.

Turning to unconventional monetary policies, the literature has established three different main channels through which UMP can have an impact on the bank's profitability, specifically for its effect on asset pricing (Bowdler and Radia, 2012). First, the "portfolio rebalancing" channel occurs because central bank asset purchases provide cash to asset owners. As cash and acquired assets are not perfect substitutes for each other, financial institutions will use this money to buy closer substitutes for previous assets, rebalancing their portfolios and taking on more risk than if they had cash alone. Second, according to the "liquidity channel", quantitative easing reduces the net supply of long-term assets, which causes an increase in their prices and a decrease in their yields (Altavilla et al., 2018). The availability of liquidity through asset purchase programs, not only for the financial sector but also for the non-financial sector, decreases liquidity premiums associated with times of financial difficulties (Bowdler and Radia, 2012). Finally, UMP can also affect the banking sector through the "signaling channel". The global financial crisis has made forward guidance an essential tool for central bankers (McKay et al., 2016). When central banks reveal their possible future policy decisions, it signals economic prospects to the market. The maintenance of asset purchase programs for a long period may signal that, as the economic situation is still fragile (Mamatzakis and Bermpei, 2016), there is an intention to keep short-term interest rates low for a long time (Altavilla et al., 2018) and that long-term interest rates may decrease (Bowdler and Radia, 2012).

The main channels for how UMP affect the banking sector may be well known, but the overall impact on bank profitability remains to be determined. The reason why the effects of quantitative easing and maturity extension are unclear is related to the fact that there are both negative and positive impacts on bank profitability. The negative effects of quantitative easing are the depression of long-term interest rates and the flattening of the yield curve, which can reduce banks' profits in maturity transformation activities. In addition, quantitative easing also hurts banks' profitability when deposit rates are close to the zero lower bound, as financial institutions are reluctant to pass negative rates on to commercial deposits. The positive effects of quantitative easing are the generation of capital gains due to the higher appreciation of bonds in banks' portfolios, hence reducing the cost of debt and improving the macroeconomic outlook, which can increase demand for credit, reduce defaults and decrease provisioning for loan losses, according to Tercero-Lucas (2021).

Consequently, results may depend on the countries analyzed and the period. In the U.S., the results of Montecino and Epstein (2014) suggest that depository institutions that sold mortgage-backed securities (MBS) to the Federal Reserve increased their profits during 2008-2009. Chodorow-Reich (2014) estimates that the introduction of non-standard monetary policies in the U.S. in 2008 positively impacted financial institutions. Lambert and Ueda (2014) find that bank profitability and risk-taking in the U.S. banking sector are ambiguously affected by non-standard monetary policies. Along the same lines, Lopez et al. (2020) investigate the effect of negative nominal interest rates on bank profitability using a panel of 5,100 European and Japanese banks, and determine that negative nominal interest rates have a small effect on bank profitability. On the contrary, Mamatzakis and Bermpei (2016) estimate that the Federal Reserve's UMP negatively affected the U.S. banks' performance. In the Euro area, Acharya et al. (2019) highlight that the 2012 ECB Outright Monetary Transactions (OMT) program could indirectly recapitalize the European banking sector, influencing the prices of assets held in banking portfolios. In particular, depository institutions with a significant amount of securities issued by Mediterranean European countries benefited the most. Altavilla et al. (2018) study the impact of conventional and unconventional eurozone monetary policies on a sample of 288 banks. They find no association between monetary easing and lower bank profits. As in Chapter 3, we have employed a quantile regression analysis, for the U.S. scope, suggesting that UMP improved the bank's overall profitability. The result indicates that Quantitative Easing has unequal impacts on the profitability components across U.S. banks. These unequal impacts can be seen across three measures of profitability. First, UMP increased the NNOII of banks in its lower quantiles. Second, UMP benefited the most banks with higher LLP. Third, UMP positively affected banks with lower asset returns.

4.2.2. Compensation across bank profitability components

Several studies have analyzed the dynamics between the components of bank profitability for the following reasons: revenue diversification; business cycles; monetary policy measures and other economic factors; volatility of interest rates, and level of risk aversion of banks; among others (e.g., Bikker and Hu, 2002; Dietrich and Wanzenried, 2011; Demirguç-Kunt and Huizinga, 1999). Throughout these studies, there is a common perception that, for most banks, the NII represents an important part of their overall operating return, and there has been a considerable decrease in bank net interest margin (NIM) in both U.S. and European banks lately (e.g., Smith et al., 2003; Nguyen, 2012).

From a macroprudential point of view, it is relevant to investigate the reasons for the NIM reduction. So far, the literature has mentioned three possible structural and cyclical developments responsible for the decline in NIM. First, NIM changes can be caused by unsustainable credit booms, when loans are not appropriately priced for their risk, and the resulting NII is insufficient to cover all current and future expenses (meaning low provisions for loan losses). Even before the financial crisis, Jimenez et al. (2006) detect a positive relationship between excessive credit growth and loan losses based on Spanish data. Second, as pointed out by Lepetit et al. (2008) and Albertazzi and Gambacorta (2009), competition became increasingly fierce in the banking sector with the changes in market structures and technological improvements in the 1980s. As a result, net interest margins are shrinking, and banks are forced to diversify their sources of income. Third, another structural reason for the fall in the NIM is the drop in the interest rate level and the UMP implemented by Central Banks in recent decades, as noted in Europe (Altavilla et al., 2018), U.S., Europe, U.K. and Japan (García-Cruz, 2020), and Japan (Harimaya and Ozaki, 2021).

Unsurprisingly, the last structural reason mentioned above is the most incisive for reinforcing the drop in the NIM in the last 5 to 10 years, forcing banks to change their strategy and business models. In other words, banks are obliged to manage the remaining components of income, that is, the non-interest components and provisions, to guarantee the survival of the overall returns of their operations in the face of the expected and continuous drop of gains from the interest components.

Previous literature noticed this banking problem of declining NIM, even before the fall in interest rates and UMP implementation, and analyzed this issue from which some considerations about the dynamic of profitability components were obtained. As noted by Nguyen (2012), banks in all countries have likely tried to offset reductions in NIM by increasing their NOII, such as fee and commission income, commercial income or other operating income. If this were the case, the expected relationship between NIM and NOII may be negative, as found in some articles (see, e.g., Rogers and Sinkey, 1999; Smith et al., 2003; Heffernan and Fu, 2008; Lepetit et al., 2008). In line with previous research, Lee et al. (2014) examine data from 967 banks in 22 Asian countries and find that increased reliance on NOII across banks is associated with decreased profitability. Thus, NIM and NOII should be interpreted as substitutes. However, Nguyen (2012) also argues that there may be a positive relationship between NIM and NOII, which should be interpreted as complements. This positive relationship implies that engaging in activities beyond traditional bank lending would allow banks to better compete with non-bank financial institutions that also carry out similar activities. Regardless of whether the NIM and NOII are complementary or substitutes, they are not independent. Hence, banks jointly optimize both variables as they are interested in maximizing their total profits, which creates an endogeneity problem and motivates the need for a VAR structure to analyze these dynamics.

In recent years, given the monetary policies implemented in the U.S. and Europe, additional investigations were carried out, allowing a better understanding of the dynamics of the components of bank profitability. For example, Bikker and Tobias (2018) examine a panel of U.S. banks from 2001 to 2015 and find that bank profitability is reduced with low interest rates; the main cause is the reduction of net interest margins. They also find that U.S. banks can maintain overall profitability at low rates by adjusting other margins. They speculate that defaults fall with low rates, allowing banks to reduce provisioning for bad loans. Claessens et al. (2018) obtain similar results for a large segment of banks driven by reductions in interest rate margins. Altavilla et al. (2018) examine 288 eurozone banks and find that short-term financial conditions, in the form of 3-month OIS rates, do not affect bank profitability as they condition expected future macroeconomic conditions and, consequently, the provisioning required. Their results also indicate that banks suffer losses from low rates on net interest margins but compensate with gains in NOII. Turk (2016) examines samples of Danish and Swedish banks and finds that bank margins were practically stable at the zero threshold because the reductions in wholesale financing costs and higher fees offset losses incurred in II. Basten and Mariathasan (2018) examine 68 Swiss banks, using the share of excess reserves as a proxy for exposure to negative rates, and find that banks with higher excess reserves raised rates and II to offset negative liability margins. Banks also adjusted liabilities, mainly through reductions in bond issuance, thus increasing the maturity mismatch. Lopez et al. (2020) suggest that banks offset losses in II under negative rates with lower deposit expenses and gains in NOII, including fees and capital gains. Finally, Williams (2020) finds that banks pass through NIM declines on the upside but not the downside, and the intensity of the positive relationship between NII and NOIE substantially increases closer to the end of the fiscal year.

4.3. Methodology

This subchapter presents and describes the endogenous and exogenous variables chosen to address the research problem. Then, we present the econometric approach employed to obtain our results.

4.3.1. Endogenous Variables

We select five endogenous variables to examine the impact of interest rates and unconventional monetary policy measures on the dynamics of bank profitability components. There are two components related to the bank's interest gains and costs, the II and the IE, divided by the Total Assets (TA), which together define the NII. Another two components, this time related to the bank's non-interest gains and costs, include the NOII and NOIE, divided by TA, that define the NNOII. Finally, our last endogenous variable is the LLP, also divided by the TA, which is the amount banks need to set aside for possible defaults of loan granted. The combination of these five endogenous variables approximates banks' overall Return on Assets (ROA), a common measure used to assess banks' profitability. Several studies have used in similar work, partially or to some extent all the above-mentioned variables (e.g., Claessens et al., 2018; Altavilla et al., 2018; Angori et al., 2019; García-Cruz, 2020; Campmas, 2020; and Lopez et al., 2020). For simplicity purposes, we omit the fact that endogenous variables are divided by TA from now on. Table 4.1 describes the endogenous variables employed in our study.

Table 4.1: Endogenous variables description.

Endogenous Variables	**Description**
Net Interest Income (NII)	NII is the difference between Interest Income and Interest Expenses components.
Net Non-Interest Income (NNOII)	NNOII is the difference between Non-Interest Income and Non-Interest Expenses components.
Interest Income (II)	II is composed by the interest and fees on loans, dividends on investment securities, trading account interest, among other items. The component translates the gains provided by interest operations.
Interest Expense (IE)	IE is composed by interest deposits, interest on other borrowings, federal fund purchases, among other items. The component represents total operating interest expenses for the financial institution.
Non-Interest Income (NOII)	NOII is a component that represents an extended sum of components, such as, fees and commissions from operations, securities activities or insurance, credit card fees, fees for customer services, real estate operation gains, investment securities gains, foreign currency gains, among others.
Non-Interest Expense (NOIE)	NOIE represents the sum of labor and related expenses, depreciation expenses, amortization of intangibles and acquisition costs, litigation expenses, real estate operations costs, foreign currency losses or investment securities losses, among others.
Loan Loss Provisions (LLP)	LLP represents provisions established for possible defaults by customers on loans from a financial institution. Reserves for possible loan losses are established on loans outstanding on the basis of country risks, industry risks and specific risks of group of borrowers.

Notes: The endogenous variables used are all divided by the Total Assets (TA) of banks.

Figure 4.1 illustrates the evolution over time of the main components of bank profitability, as well as their cross-sectional dispersion across quantiles 10%, 15%, 25%, 50%, 75%, 85%, and 90%. Panel A to C present Net Components and Panel D to G present Decomposed Components. It is possible to observe in Figure 4.1 a significant dispersion in the profitability components among the various banks under analysis, suggesting the existence of heterogeneity in our sample.

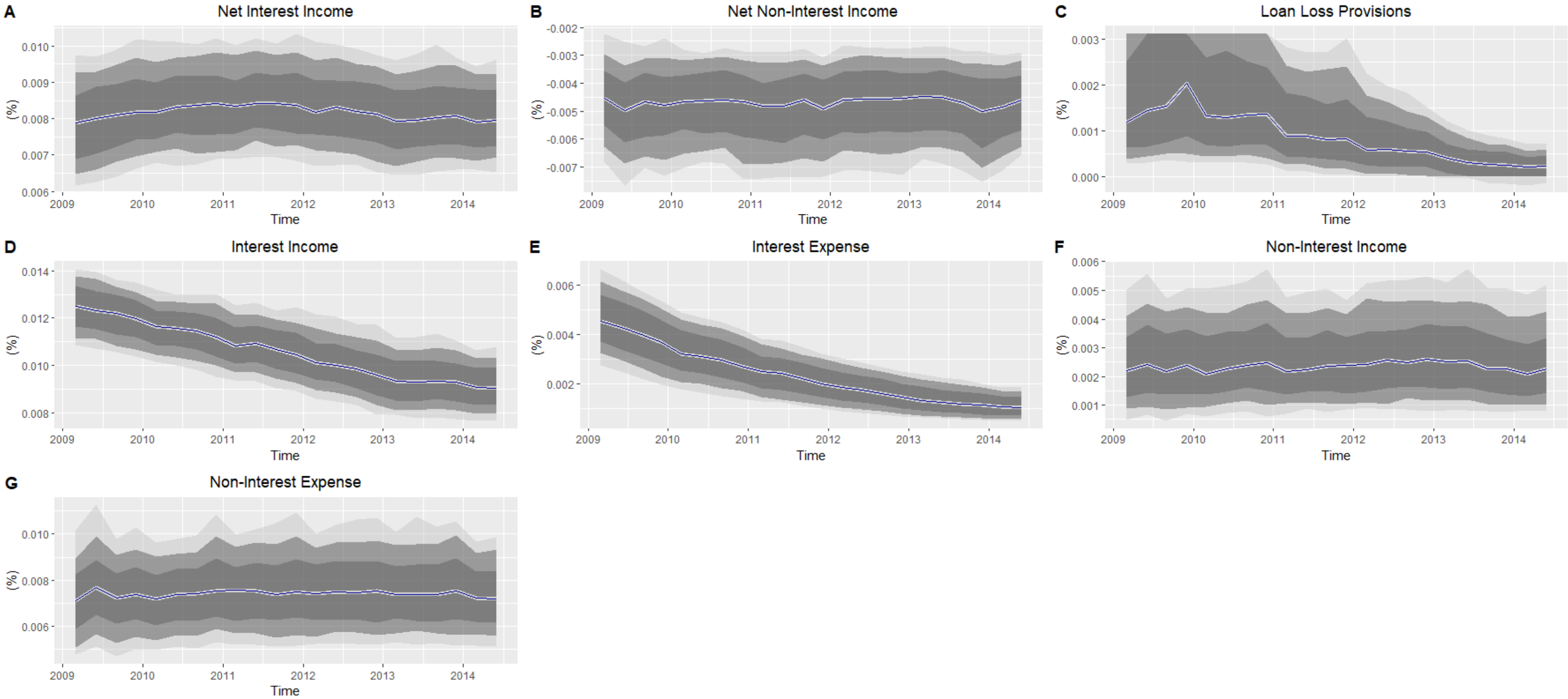


Figure 4.1: Evolution of Banks' Profitability Components during the implementation of Unconventional Monetary Policies – Q1 2009 until Q2 2014.

Notes: Cross sectional dispersion on the evolution of bank's profitability components. Blue line refers to the 50% quantile, dark grey band refers to the 25% to 75% quantiles, mid-grey band refers to the 15% to 85% quantiles and, finally, light grey refers to the 10% to 90% quantiles.

4.3.2. Exogenous Variables

We use three sets of control variables to analyze our research problem. The primary set of control variables are the monetary policy variables that track the development of monetary policy in the U.S. In addition to the traditional monetary policy instruments, which are widely used in the literature, short-term interest rates and the slope of the sovereign yield curve, we use a proxy, called unconventional monetary policy deviation (UMP), to account for the impulses generated by the unconventional monetary policy policies, specifically the effects of quantitative easing and maturity extension policies. The remaining two sets of control variables are the macroeconomic/market variables, providing information about the economic environment and bank-specific variables, which are known to influence bank profitability and are also widely used in various empirical studies. The bank-specific variables will be mainly used for the robustness checks. Table 4.2 summarizes these variables.

Table 4.2: Exogenous variables description.

Exogenous Variables	**Description**	**Literature**
	Monetary Policy Variables	
Short-term interest rate	Short-term interest rate is used to account the immediate effect of monetary policy measures on the bank's profitability components. We use the 3-months overnight index swap (OIS) as an approximation for the Short-term interest rate.	Alessandri and Nelson (2015), Borio et al. (2017), Altavilla et al. (2018), Cruz-García et al. (2019), García-Cruz (2020), and Angori et al. (2019).
Sovereign Yield Slope	We calculate the slope of the yield curve, as the difference between the interest rate of a ten-year sovereign bond and a two-year sovereign bond. The Sovereign Yield Slope express the expectations of market environment on a foreseen horizon regarding the interest rate evolution.	Aydemir and Ovenc (2016), Borio et al. (2017), Altavilla et al. (2018), Cruz-García et al. (2019), García-Cruz (2020), and Angori et al. (2019).
Unconventional Monetary Policy (UMP) Deviation	UMP Deviation is a proxy to account and isolate the impulses of non-standard measures, specifically the large-scale purchase assets and maturity extension from U.S. Federal Reserve. The variable results from the difference between the Wu and Xia (2016) Shadow rate and the Short-term interest rate. Thus, UMP Deviation is define as: $$UMP_t = SR_t - OIS_t \quad (4.1)$$	Chapter 2 and Chapter 3.

(continues)

Table 4.2: Exogenous variables description. ***(continued)***

	Macroeconomic and Market Variables	
Stock Market Volatility, VIX index	The VIX Index is a computation designed to produce a measure of constant, 30-day expected volatility of the U.S. stock market.	Ho and Saunders (1981), Angbazo (1997) and Altavilla et al. (2018).
GDP growth	The annual average rate of change of the gross domestic product (GDP) at market prices based on the U.S. dollars, for the United States of America.	Demirguç-Kunt and Huizinga (1999) and Bikker and Hu (2002).
Inflation	Inflation is the rate of increase in prices, for a basket of selected goods and services, over a given period of time and defines the purchasing power of U.S. dollars over time.	Angori et al. (2019) Altavilla et al. (2018).
Expected Inflation and Expected GDP Growth	The Expected Inflation and Expected GDP Growth are the foreseen Inflation and GDP Growth for a horizon of 3 to 5-years. Note: The introduction of these variables aims to offset the effects of other factors that simultaneously affect the monetary policy stance and the profitability components of banks.	Altavilla et al. (2018).
	Bank-specific Variables	
5 Years Default Probability	This variable is a forward-looking measure of credit risk provided on the Bloomberg issuer default risk model which generate a probability of default over the next five years.	Maudos and De Guevara (2004), Entrop et al. (2015), Altavilla et al. (2018), Cruz-García et al. (2019) and García-Cruz (2020).
Non-Performing Loans (NPL) per Total Assets	NPLs are the loans that are not repaid both in their principal and/or interest for a period above to the terms and conditions under the loan contract. Therefore, the non-performing loan ratio is a measure of the bank quality assets.	Altavilla et al. (2018).
Capital Adequacy Ratio (CAR)	The capital adequacy ratio (CAR) is a measure of how much capital a bank has available, reported as a percentage of a bank's risk-weighted credit exposures. The objective is to establish that banks have sufficient reserve capital to face a certain amount of losses, before they run the risk of becoming insolvent.	Altavilla et al. (2018).
Efficiency Ratio	The efficiency ratio is calculated by dividing operating expenses by the operating income generated, that is, net interest income plus other income.	Altavilla et al. (2018).

4.3.3. Econometric Approach

We adopt the approach of having a reduced version and an extended version of the econometric model for estimation purposes. On the reduced model, we study the impact of monetary policy on the banks' profitability components, controlling for the market and macroeconomic environment. In the extended model, which acts as a robustness check for the results obtained for the reduced model, we also analyze the impact of monetary policies on the banks' profitability components but this time controlling for the market and macroeconomic environment and also the bank's specific characteristics (see subchapter 4.6). By having these two models, we make it easier to compare results with other studies. Assuming one lag for sake of exposition, the baseline specifications can be expressed as below:

1.

$$Y_{it} = \alpha_i + \beta_1 Y_{it-1} + \beta_2 UMP_t + \beta_3 OIS_t + \beta_4 \Delta Sovereign\,Yield_t + \beta_5 VIX_t + \beta_5 GDP\ Growth_t + \beta_6 Inflation_t + \beta_7 GDP\ Expected\ Growth_t + \beta_8 Expected\ Inflation_t + \varepsilon_{it} \quad (4.2)$$

2.

$$Y_{it} = \alpha_i + \beta_1 Y_{it-1} + \beta_2 UMP_t + \beta_3 OIS_t + \beta_4 \Delta Sovereign\,Yield_t + \beta_5 VIX_t + \beta_5 GDP\ Growth_t + \beta_6 Inflation_t + \beta_7 GDP\ Expected\ Growth_t + \beta_8 Expected\ Inflation_t + \beta_9 5\ Year\ Default\ Probability_{it} + \beta_{10} Non-Performing\ Loans_{it} + \beta_{11} Capital\ Adequacy\ Ratio_{it} + \beta_{12} Efficiency\ Ratio_{it} + \varepsilon_{it} \quad (4.3)$$

where Y_{it} is the m-dimensional endogenous variable - $m = 3$ for the Bank's Net Profitability analysis, i.e., NII, NNOII and LLP and $m = 5$ for the Bank's Decomposed Profitability analysis, i.e., II, IE, NOII, NOIE and LLP - of bank i at time t; α_i are bank fixed effects; β's are the coefficients associated with the independent (exogenous) variables previously identified, and finally ε represents the model's error-term.

4.3.4. Panel Vector Autoregression (PVAR) with Generalized Method of Moments (GMM) estimators – PVARGMM

To investigate our research problem, we consider an empirical analysis based on a panel vector autoregressive model which is estimated with the generalized method of moments approach, capable to exploit the extended structure of our panel dataset. We begin the empirical analysis by approximating the unknown theoretically interdependencies between the following three endogenous variables: NII, NNOII and LLP (Y_{it} with $m = 3$, Bank's Net Profitability). We then increase the granularity of the interest and non-interest components, to scrutinize deeper the compensation across the profitability components, ending up studying the interdependencies between five endogenous variables, namely the II, IE, NOII, NOIE and LLP (Y_{it} with $m = 5$, Bank's Decomposed Profitability).

The first panel vector autoregressive (PVAR) model was developed by Holtz-Eakin et al. (1988). Then, Binder et al. (2005) extended their equation-by-equation estimator for a PVAR model with only endogenous variables that were lagged by one period and establishing the GMM conditions for each individual i. On our study we will adopt the model introduced by Sigmund and Ferstl (2021) which is slightly different from Binder et al. (2005), as it allows for p lags of m endogenous variables, k predetermined variables and n strictly exogenous variables, despite the fact that k=0 in our model. Hence, the stationary PVAR with fixed effects can be considered as the following:

$$Y_{it} = \left(I_m - \sum_{l=1}^{p} A_l \right) \mu_i + \sum_{l=1}^{p} A_l Y_{it-l} + Bx_{it} + Cs_{it} + e_{it} \tag{4.4}$$

I_m denotes an $m \times m$ identity matrix, m being the endogenous variables. Let $Y_{it} \epsilon R^m$ be a $m \times 1$ vector of endogenous variables for the $i\ th$ cross-sectional unit at time t with $i = 1;\ 2;\ \ldots;\ N$ and $t = 1;\ 2;\ \ldots;\ T$. Let $x_{it} \epsilon R^k$ be a vector of predetermined variables that are potentially correlated with past errors. Ultimately, let $s_{it} \epsilon R^n$ be a vector of strictly exogenous variables that neither depend on ε_t nor on ε_{t-s} for $s = 1;\ \ldots;\ T$. In this specification we assume parameter homogeneity for $A_l, B\ and\ C$. The idiosyncratic error vector $e_{it} \epsilon R^m$ is assumed to be well-behaved and independent from both regressors x_{it} and s_{it} and the individual error component μ_i. To obtain stationarity, all roots of the AR polynomial of the PVAR model are required to be inside the unit circle, which consequently led to some constraints on the fixed effect μ_i.

To estimate the coefficients of the abovementioned equation (4.4), two issues need to be discussed. The first issue is the well-known Nickell (1981) bias, which results from removing the fixed effects by standard procedures, first differences or forward orthogonal deviations, and employing the equation-by-equation Ordinary Least Square (OLS) estimation, as in the standard Vector Autoregression (VAR) model. The Nickell bias can be disregarded as $T \rightarrow \infty$, however, our T may not be very large, relative to N, which may contain bias on the results. The second issue is that the first differences/forward orthogonal deviations equation-by-equation OLS estimation of a (P)VAR model is equivalent to a full system estimation only asymptotically, as advocated by Cao and Sun (2011). Understanding these problems, Sigmund and Ferstl (2021) conclude that the application of GMM estimators is necessary to avoid any biased results based on standard estimators.

Sigmund and Ferstl (2021) follow several steps for the implementation of the GMM estimators on the PVAR model which can be briefly summarized as next. First, they apply the first differences to the equation (4.4) for each individual i, and then, they set up the moment conditions for the lagged endogenous, the predetermined and the strictly exogenous variables for a fixed i and t. Once constructed, the second stage is to rewrite the moment conditions in a different form by stacking over t and after stacking the moment conditions for each i. From these two steps a large matrix of moment conditions is created to identify only a small number of parameters. Two possibilities are provided by the dynamic panel literature to reduce this number. The first option is to reduce the number of moment conditions by fixing a maximal lag length. The second option is to reduce the number of moment conditions, through the collapsing of instruments. A minimization problem arises, and Sigmund and Ferstl (2021) follow the standard GMM literature which proposes a one-step and a two-step estimation procedures, combined with the so-called Feasible Efficient General Methods of Moment estimator (FEGMM) from Roodman (2009a) which optimize the weighting matrix of moment conditions (see e.g., Sigmund and Ferstl, 2021, for more details). As a result, and distinct to “difference” or “system” GMM estimation of a single dynamic panel equation (see Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998; Roodman, 2009b), the effect of the lagged dependent variable, and thus the potentially dynamic nature of the data-generating process, can be considered with the PVARGMM estimation.

Before moving on to the next subchapters, one remaining remark needs to be explained regarding our methodology employed. We follow Sigmund and Ferstl’s (2021) Panel Vector Autoregression with Generalized Method of Moments approach to tackle the decrease the number of moment conditions through instrument collapse. This idea is a combination of two existing studies: Roodman (2009a) in the context of single equation dynamic panel models and Mehrhoff (2009) in the context of matrix transformations, namely the collapsing of lagged endogenous variables that act as instruments, which is made up of identity matrices of increasing dimension stacked one upon the other with blocks of zero matrices to the right (see Sigmund and Ferstl, 2021, pp9). According to the theoretical study by Sigmund and Ferstl (2021) and the empirical study by Sigmund et al. (2017), the collapse technique maintains almost the same informational content as the non-collapsed instruments, although the collapse significantly reduces the number of instruments. Due to computational limitations, we cannot perform the analysis with non-collapsed instruments. Given the previously mentioned studies, we believe that the results would not change significantly from the results based on non-collapsed instruments.

As in any VAR-type study, it is relevant to obtain and interpret the estimated (h-step ahead) responses to shock’s impulses and their corresponding confidence intervals. The response functions from the Panel Vector Autoregression with a Generalized Method of Moments estimation approach can be computed either for orthogonal or generalized impulses. Let Σ_ε be the variance-covariance matrix of ε_t, i.e., the residuals (estimation of the errors e_{it}). Usually, the off-diagonal elements of Σ_ε are different from zero, so shocks across the m equations are not independent of each other and for that reason one cannot isolate the effect each shock causes to a particular endogenous variable. Therefore, for identification purposes, the parameters of the PVAR model are subject to identification restrictions such that the responses follow indeed from independent (orthogonal) shocks. The orthogonal impulse response functions (OIRFs) are derived from a symmetric positive definite variance-covariance matrix through a unique Cholesky decomposition. As stated in Lutkepohl (2007) and many others, although the Cholesky-decomposition is unique, it depends on the ordering of the endogenous variables in the system which has been criticized in the literature. In the face of the criticism put in this approach, we also adopted the generalized impulse response functions (GIRFs) for our analysis. For Pesaran and Shin (1998), generalized impulse response analysis is suggested as an alternative approach to the orthogonal impulse response analysis, where only one shock is chosen, say its $r-th$ element, and integrate out the effects of all the other shocks using the historically observed distribution of the errors. This approach does not depend on the order of the endogenous variables in the model. For completeness, on our Robustness subchapter we employ the orthogonal impulse response approach and compare with the results obtain with the generalized impulse response approach.

4.4. Data and Panel VAR Model's Specification

This subchapter is divided into two additional subchapters. The first subchapter describes and summarizes the data used. The second subchapter provides the parameterization of the PVAR model and corresponding GMM estimation approach employed to obtain the impulse response functions presented in the next chapter.

4.4.1. Data Description

Our dataset contains bank-level quarterly unbalanced data for a cross-section of 624 U.S. banks during the period of unconventional monetary measures applied by the U.S. Fed – Q1 2009 until Q2 2014. The envisaged dataset comprises accounting data, such as the endogenous variables presented in subchapter 4.3 (interest components, non-interest components and provisions) and some exogenous variables (such as Non-Performing Loan ratio, Efficiency ratio or Capital Adequacy Ratio). Beyond the previously mentioned data, we include monetary policy, macroeconomic and market data. Our sources of information are Bloomberg, Thomson Reuters Eikon, and DataStream.

The rationale for choosing the period of our dataset is related to the implementation of quantitative easing and the maturity extension program from November 2008 until September 2014. Observing the UMP Deviation in Figure 4.2, which is the difference between Wu and Xia's (2016) shadow rate and Overnight interest swap rate, one of our exogenous variables, it is possible to realize that, after the announcement of the large-scale asset purchase program and maturity extension program, Wu and Xia's shadow rate diverge significantly from short-term interest rate, that becomes constant, until the "taper off" of these measures. In our view, it is relevant to study in more detail this period and what impact this event had on the dynamics of bank's profitability components. Hence, our sample period is restricted to the quarters where the quantitative easing and maturity extension were fully implemented.

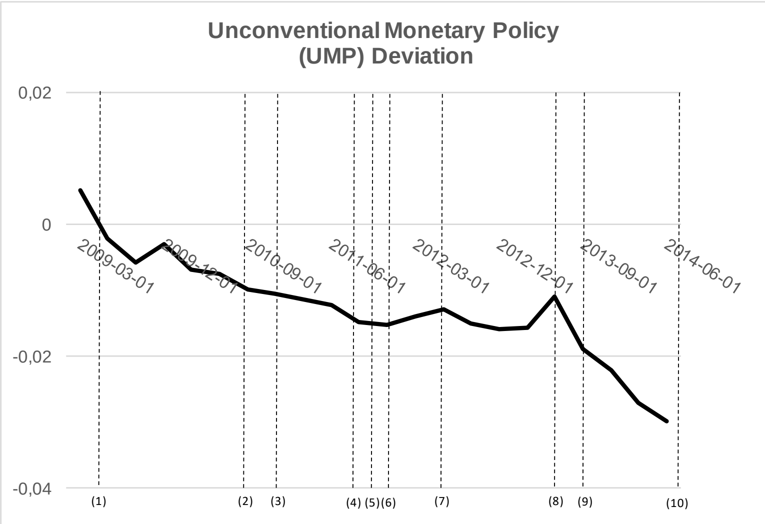


Figure 4.2: Unconventional Monetary Policy Deviation for the U.S.

Notes: The variable results from the difference between the Wu and Xia (2016) Shadow rate and the Short-term interest rate, from Q1 2009 until Q2 2014. Appendix K describes the events (1) to (10).

Due to some noise in the original dataset, it was necessary to carry out data transformations. All endogenous variables have been set forth to a process of winsorisation, which is the transformation of the data by limiting extreme values, allowing us to handle outliers and avoid misleading results from the regression methodology employed. In particular, we limit the 5th percentile and the 95th percentile. The expected GDP Growth, extracted from DataStream on an annual basis format, is linearized (average linearization) between periods to obtain a quarterly frequency. Table 4.3 summarizes the information previously described regarding the units, frequency, data level, sources and data transformations to each variable.

Table 4.4 summarizes the descriptive statistics of our full sample under analysis, Q1 2009–Q2 2014.

Table 4.3: Summary of units, frequency, data level, sources and data transformations to each variable employed.

	Units	Frequency	Data Level	Source	Manipulation / Transformations
Dependent Variables					
Net Interest Income per TA	Hundredth of percent	Quarterly-basis and Semi-annual	Bank-level	Refinitiv Eikon	Winsorise
Net Non-Interest Income per TA					
Loss Loan Provisions per TA					
Interest Income per TA					
Interest Expense per TA					
Non-Interest Income per TA					
Non-Interest Expense per TA					
Independent Variables					
Monetary Policy Instruments					
Short-term interest rate	Hundredth of percent	Quarterly-basis	Time-level	Refinitiv DataStream	-
UMP Deviation (Wu and Xia)					-
Sovereign Yield Slope				Refinitiv DataStream	-
Market and Macroeconomic					
VIX Index	Hundredth of percent	Quarterly-basis	Time-level	Bloomberg	-
GDP Growth				Eurostat	-
Inflation					-
Expected GDP Growth		Semi-annual		Refinitiv DataStream	Linearization Semi-annual to Quarterly basis
Expected Inflation		Quarterly-basis			-
Bank-specific					
5 Years default probability	Hundredth of percent	Quarterly-basis	Bank-level	Bloomberg	-
Non-Performing Loans (NPL)				Refinitiv Eikon	
Capital Adequacy Ratio				Refinitiv Eikon	
Efficiency Ratio					

Table 4.4: Summary of descriptive statistics.

Endogenous & Exogenous Variables	Obs.	Mean	Stand. Dev.	25th percentile	Median	75th percentile	Max	Min
Bank Performance Variables:								
Net Interest Income per TA	7643	0.0082	0.0013	0.0074	0.0082	0.0090	0.0107	0.0057
Interest Income per TA	7654	0.0106	0.0018	0.0094	0.0106	0.0118	0.0157	0.0073
Interest Expenses per TA	7629	0.0024	0.0015	0.0012	0.0021	0.0032	0.0074	0.0004
Non-Net Interest Income per TA	7660	-0.0048	0.0016	-0.0059	-0.0047	-0.0037	-0.0018	-0.0077
Non-Interest Income per TA	7641	0.0027	0.0016	0.0015	0.0023	0.0035	0.0064	0.0004
Non-Interest Expenses per TA	7659	-0.0075	0.0019	-0.0086	-0.0074	-0.0062	-0.0040	-0.0115
Loan Loss Provisions per TA	7621	0.0010	0.0010	0.0003	0.0007	0.0016	0.0031	-0.0002
Monetary Policy Variables:								
Short-term interest rate	22	0.0015	0.0005	0.0010	0.0014	0.0018	0.0023	0.0007
UMP Deviation (Wu and Xia)	22	-0.0126	0.0078	-0.0158	-0.0126	-0.0075	0.0052	-0.0300
Slope of the Yield Curve	22	0.0216	0.0053	0.0177	0.0232	0.0256	0.0295	0.0110
Market and Macroeconomic Variables:								
VIX Index	22	0.1570	0.0677	0.1162	0.1314	0.1750	0.3331	0.0845
GDP Growth	22	0.0174	0.0228	0.0044	0.0205	0.0331	0.0524	-0.0458
Inflation	22	0.0195	0.0129	0.0130	0.0200	0.0270	0.0400	-0.0090
Expected GDP Growth	22	0.0217	0.0018	0.0210	0.0221	0.0230	0.0240	0.0165
Expected Inflation	22	0.0202	0.0042	0.0170	0.0205	0.0220	0.0270	0.0130
Bank-Specific Variables:								
5 Years Default Probability	9548	0.0463	0.0744	0.0171	0.0270	0.0446	0.8790	0.0009
Bank’s Non-Performing Loans (NPL)	4135	0.0303	0.0277	0.0122	0.0222	0.0392	0.3746	0.0000
Capital Adequacy Ratio	6527	0.1448	0.0497	0.1180	0.1349	0.1570	0.6100	0.0350
Efficiency Ratio	7807	0.7155	0.8547	0.5984	0.6757	0.7654	70.5079	-14.1825

Notes: Data are at quarterly frequency covering the period Q1 2009–Q2 2014. Short-term rate is the three-month OIS, slope of the yield curve is the difference between 10- and 2-year sovereign yields. Expected real GDP growth is the 3 to 5-year-ahead expectation.

The table above shows a wide variation in the data, on both endogenous and exogenous variables, over the sample when we look at the distribution across percentiles. For example, the interquartile range of LLP per TA ranges from 0.03% to 0.16%, while the II per TA ranges from 0.1% to 0.15%, thus showing the existing turmoil due to the implementation of UMP.

4.4.2. Panel Vector Autoregression with Generalized Method of Moments – Parameterization

The Panel Vector Autoregression model with the Generalized Method of Moments estimation technique requires the specification of several characteristics, namely: the transformation approach to remove fixed effects, the selection of the set of moment conditions, the choice of the number of lags for endogenous variables, the calculation of the optimal covariance matrix of residuals, and choice for the number of instruments. We now briefly describe this parameterization.

First, starting with the model's transformation to remove the fixed effects, we implement the first differences approach. Second, regarding the moment conditions, we define the first differences moment conditions (see Holtz-Eakin et al., 1988; Arellano and Bond, 1991), which aims to reduce the number of moment conditions by linear transformations of the instrument matrix.

Third, based on Andrews and Lu's (2001) lag selection criteria, we adopt a single lag for the endogenous variables implemented in the PVAR since the AIC, BIC, and HQIC have the smallest values – that is, a better criterion – namely than the adoption of two lags for the endogenous variables implemented in the PVAR model (Appendix L). [6]

Fourth, we choose the one-step GMM estimator over the two-step GMM estimator for the optimal residual covariance matrix since, for several of our estimates, the Hansen's J-test was rejected for the two-step GMM estimators (see Appendixes M to P).[7] Finally, it was used the maximum number of instruments possible to be implemented: twenty instrumental variables. The previously announced set of specifications constitute our benchmark for PVAR with GMM estimation technique employed. In the robustness subchapter, we will present the results obtained after considering alternative options for the PVAR model and GMM estimation.

All results presented on the next subchapters are based on the estimated models using the previously mentioned specifications. In all cases, we do not reject the null hypothesis of the Hansen J-test and conclude that estimates are valid as per the stability test (see Appendix Q for the stability test, whereas the Hansen J-tests are stated in each estimates table).

[6] Adding additional lags to the exogenous variables did not yield significant coefficients.

[7] The reduced model with the two-step approach for the Net Profitability components and the extended model with the two-step approach for the Decomposed Profitability components are rejected by the Hansen-J test. The reduced model with two-step approach for Decomposed Profitability components is not rejected by the Hansen-J test, however the results are equal to the reduced model with one-step approach.

4.5. Results

This chapter is divided into two subchapters. We start our empirical analysis which includes the estimated panel VAR model and the impulse response functions by studying the interdependencies between NII, NNOII and LLP. Then, we decompose the net interest and non-interest components to examine further the balance between the profitability components. Thus, the first subchapter refers to our results on the dynamics of banks' net profitability components, and the second subchapter refers to the dynamics of the granular of banks' profitability components, which are the II, IE, NOII, NOIE and LLP components.

4.5.1. Banks Net Profitability Components' Dynamics during the U.S. Fed's Unconventional Monetary Policies period.

Table 4.5 and Figure 4.3 indicate valuable insights about the bank net profitability components' dynamics during the U.S. Fed's UMP period (from the first quarter of 2009 until the second quarter of 2014). On the one hand, Table 4.5 presents the estimated PVAR reduced model which we use to analyze the impact of the monetary policy variables (i.e., exogenous variables) on the Net Profitability components (i.e., endogenous variables) [8]. On the other hand, Figure 4.3 presents the estimated generalized impulse responses, to a unit shock of the corresponding endogenous variables, which allows us to identify the dynamics between these variables.

Starting with Table 4.5, columns (1) to (3) refer to NII, NNOII, and LLP, respectively. The results in column (1) suggest three findings. First, we find a negative relationship between the short-term interest rate and NII. This relationship can be explained by the fact that the policy rate was constrained to a lower bound of 0% during this period. Hence, the positive fluctuations in the short-term interest rate may result from anticipating the growth of the policy interest rate by the U.S. Fed. This anticipation may stress the economy, negatively affecting the bank's net income. Second, our results advocate a positive relationship between the UMP Deviation and NII, which may imply that UMP reinforce the decline of interest components. According to Demertzis and Wolff (2016), UMP reduce long-term yields and term spreads, leading to declines in the loan-to-deposit ratio spread and making it more difficult for banks to generate NII on new loans. Third, we find a positive relationship between the Sovereign Yield Slope and NII. A decrease in the sovereign yield slope means a decrease in future risk expectations, which leads to a decrease in future interest. Moreover, the positive relationship may indicate a natural

[8]Recall that the reduced model is represented in equation 4.2, from subchapter 4.3.3. The extended model, represented in equation 4.3, is used for robustness purposes in relation to the reduced model. For the sake of exposition, we do not interpret the exogenous variables of market and macroeconomics.

consequence of banks' maturity transformation activities (e.g., Flannery, 1981; Hancock, 1985; Bourke, 1989; Saunders and Schumacher, 2000).

The results in column (2) provide another three findings on the relationship between NNOII and monetary policy variables. First, we find a positive relationship between the short-term interest rate and NNOII during the UMP period. As stated before, in this period, the positive changes in the short-term interest rate may result from anticipating the growth of the policy interest rate by the U.S. Fed. Thus, the NNOII may be correlated with the expectations of a rise in policy interest rates rather than the effective policy rate increase. Second, we find evidence that the UMP deviation has a negative and significant relationship with NNOII, suggesting that banks increase their non-interest components in reaction to UMP. Third, we find a negative relationship between the slope of the Sovereign Yields and the NNOII. This finding may suggest that the expectation of lower future interest may require an increase of overall non-interest components to balance profits, given the decrease of profits from interest components (e.g., Chapter 3).

From column (3), we highlight two significant findings. First, we find a positive relationship between the UMP Deviation and LLP, which may be explained because existing loans become more viable with UMP and need fewer provisions (e.g., Borio and Gambacorta, 2017; Altavilla et al., 2018). Furthermore, UMP may improve economic environment prospects, which help banks exposed to the economy find new credit opportunities and reduce problems with non-performing loans. Second, we find a positive relationship between the Sovereign Yield Slope and LLP, which may indicate that lower risk expectations translate into less necessity for provisions.

We highlight the fact that the results that we have obtained are in line with the results of Chapter 3, who argue that the period of unconventional monetary policy is characterized by a decrease in the NII and LLP and an increase in the NNOII.

Table 4.5: Banks Net Profitability Components - PVAR's reduced model.

	(1)	(2)	(3)
Period		**Q1 2009 - Q2 2014**	
Endogenous Variables	**NII**	**NNOII**	**LLP**
NII Lag (t-1)	0.5489***	0.0645	0.1937***
	(0.0502)	(0.0705)	(0.0508)
NNOII Lag (t-1)	0.0138	0.0970***	-0.0497**
	(0.0117)	(0.0282)	(0.0178)
LLP Lag (t-1)	0.0024	0.0743**	0.5323***
	(0.0126)	(0.0283)	(0.0248)
Monetary Policy Variables			
Short-term Interest Rate	-0.0717***	0.1150**	-0.0138
	(0.0200)	(0.0388)	(0.0328)
UMP Deviation	0.0117***	-0.0066*	0.0196***
	(0.0017)	(0.0027)	(0.0024)
Sovereign Yield Slope	0.0077***	-0.0186***	0.0045*
	(0.0016)	(0.0030)	(0.0022)
Market & Macroeconomic Variables			
VIX	0.0004***	0.0004*	0.0013***
	(0.0001)	(0.0002)	(0.0002)
GDP Growth	0.0019***	0.0009*	0.0034***
	(0.0003)	(0.0005)	(0.0004)
Inflation	0.0022**	-0.0067***	0.0015
	(0.0008)	(0.0015)	(0.0011)
Expected GDP Growth	0.0239***	0.0202*	-0.0141
	(0.0054)	(0.0101)	(0.0076)
Expected Inflation	0.0031	0.0010	-0.0294***
	(0.0025)	(0.0043)	(0.0033)

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: First-differences
Number of observations = 6714
Number of groups = 624
Number of instruments = 204, Collapsed Instruments
Hansen test of overid. restrictions: chi2(171) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

We now turn our attention to Figure 4.3. The first row of Figure 4.3, Panel A to C, plots the impulse that NII induces in itself, NNOII and LLP, respectively. The second row, Panel D to F, and third row, Panel G to I, correspond specifically to the impulses of NNOII and LLP, respectively.

From the visualization of Figure 4.3, we notice overall significant responses to impulses among endogenous variables that vary over time. These dynamics suggest that banks were reactive – and not passive – regarding the adjustment of their profitability components during the implementation of UMP. That is, Figure 4.3 shows interdependences between the components of profitability, which may translate into a profit-offsetting dynamic by banks during the application of UMP. These results could not have been found with a static estimation, thus motivating the need to employ a dynamic methodology, such as the PVAR model we use in our study.

Moving on to the analysis of Figure 4.3 in more detail, we start by analyzing the first row. In Panel B, we find a negative response on NNOII due to an impulse of NII, which means, for our case study period, that the decrease in the NII components induces an increase in the NNOII components that lasts a quarter. This dynamic suggests that, when faced with a decrease in the NII, banks strategically decided to compensate it, increasing the overall non-interest components. Turning to Panel C of Figure 4.3, we find a positive response on LLP after an impulse of NII, which implies that the decrease in the NII component is reflected in a decrease in provisioning in the next six quarters. Similar impulse responses are observed vice-versa, i.e., the impulse of the LLP and response on the NII (Panel G), and the impulse of the NNOII with responses on the NII (Panel D).

The impulse-response functions clarify that the profit-offsetting dynamics between the components of net profitability occurred gradually over the period when the UMP measures were applied instead of a one-off compensation that existed for the whole UMP period. In other words, we suggest that banks have considered the dynamics of each of these components to interdependently adjust profitability management, as argued by Boungou and Hubert (2021).

We highlight one final finding from Figure 4.3: the components of LLP play a more relevant counterweight to the change in the NII than the NNOII components, as per the magnitude and persistence of impulses shown in Panels C and F, respectively. This finding is important given the public perception that banks may have imposed most of their losses from NII on consumers through NNOII components, such as fees and commissions. Nevertheless, our results suggest that this was not the case.

To obtain more insights into the compensation dynamics of bank profitability components, we segregate the NII and NNOII into II, IE, NOII and NOIE in the next subchapter, and then we perform a similar analysis.

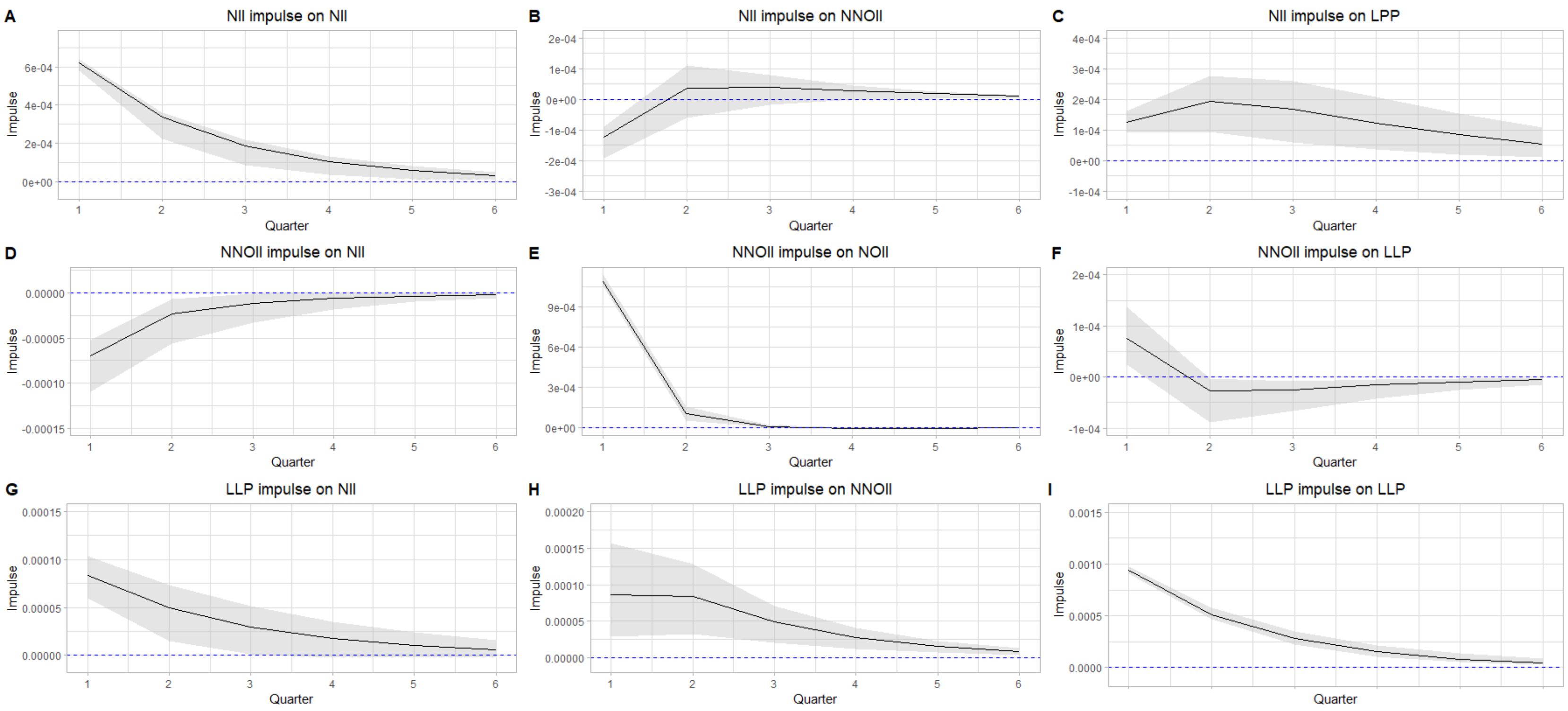


Figure 4.3: Banks Net Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

4.5.2. Banks Decomposed Profitability Components' Dynamics during the U.S. Fed's Unconventional Monetary Policies period.

In this subchapter, we analyze the banks decomposed profitability components' dynamics (i.e., II, IE, NOII, NOIE and LLP) during the implementation of the U.S. Fed's unconventional monetary policy period. For this purpose, similar as in the previous subchapter, we now present Table 4.6 and Figure 4.4. Table 4.6 presents the estimates of our PVAR's reduced model, which we mainly use to analyze the impact of the monetary policy variables (exogenous variables) on the Decomposed Profitability components (endogenous variables). Figure 4.4 presents the corresponding estimated generalized impulse response functions.

In Table 4.6, columns (1) to (5) refer to estimates of the II, IE, NOII, NOIE, and LLP, respectively. According to column (1), we find that the II has a negative relationship with the short-term interest rate and positive relationships with the UMP Deviation and Sovereign Yield Slope. On the one hand, the negative relationship between short-term interest rate and II is in line with the relationship we find for the NII, which may be justified because the II is the most representative component of NII. Recall that during our sample, the policy rate was constrained to a lower bound of 0% during this period, which means that positive swings in the short-term interest rate may result from anticipating the growth of the policy interest rate and stress the economy, negatively affecting the bank's income. On the other hand, the positive relationships with the UMP Deviation and Sovereign Yield Slope may occur because UMP reduce long-term yields and term spreads, leading to declines in the loan-to-deposit spread and making it more difficult for banks to generate NII on new loans (Demertzis and Wolff, 2016). In fact, these two relationships suggest that the decline in the loan-to-deposit spread occurs, not only because banks experience the immediate impacts of the UMP, but also because they may suffer from the anticipation of the future impacts of monetary policy (through the reduction of the sovereign yield slope).

From Column (2), while we do not find any relationship between the short-term interest rate and UMP deviation with IE, our results suggest a positive relationship between IE and Sovereign Yield Slope. These results suggest that the immediate impacts of the UMP do not impact IE because they may have been well anticipated by the banks, which may have reacted to the reduction of the sovereign yield slope and decreased beforehand their IE component. Hence, the impact of UMP ends up being reflected by strategic anticipation due to banks substantial market power over retail deposits, which is in line with Drechsler et al. (2021). Moreover, the positive relationship between the UMP deviation and II and the absence of a relationship with IE may also support the hypothesis that the zero lower bound disconnected the loan-to-deposit spread, which is also discussed in the literature (e.g., Tan, 2019).

Turning to column (3), we find a positive relationship between NOII and UMP Deviation but a negative relationship between NOII and Sovereign Yield Slope. These results may mean that the expectation of further expansionary monetary policy was perceived through the Sovereign Yield Slope, and banks implemented a strategy of increasing, for example, fees and commissions to mitigate in advance the losses in NII. However, the effective expansionary monetary policy, captured by the UMP Deviation, may have been less abrupt than expected and allowed banks to relieve the increase in NOII. Moving to column (4), our results suggest a positive relationship between UMP Deviation and Sovereign Yield Slope with the NOIE. These results suggest that, either the expected or effective expansionary monetary policy led to operational cuts executed by banks on the NOIE components (Boungou and Hubert, 2021). Jointly, the results from columns (3) and (4) motivate the need for the analysis of the segregated bank profitability components and suggest that banks react strategically in their non-interest components to monetary policy.

Finally, the results in column (5) advocate the positive relationship between UMP Deviation and LLP, which is consistent with the results we find in the last section. Moreover, we also find negative relationships of the short-term interest rate and Sovereign Yield Slope with the LLP, which differ from the results we find earlier (not so much for the short-term interest rate which was not statistically significant before). Nevertheless, in general, the results are consistent and in line with the estimates obtain for the Net Profitability components.

Table 4.6: Banks Decomposed Profitability Components - PVAR's reduced model.

	(1)	(2)	(3)	(4)	(5)
Period			**Q1 2009 - Q2 2014**		
Endogenous Variables	**II**	**IE**	**NOII**	**NOIE**	**LLP**
II Lag (t-1)	0.5424***	-0.0848***	0.1122*	0.1791***	0.1474***
	(0.0533)	(0.0140)	(0.0448)	(0.0507)	(0.0368)
IE Lag (t-1)	0.3163***	0.9840***	-0.2516***	-0.4505***	0.1318**
	(0.0492)	(0.0185)	(0.0563)	(0.0655)	(0.0414)
NOII Lag (t-1)	0.0322	-0.0086	0.1007***	0.0258	-0.0275
	(0.0235)	(0.0084)	(0.0283)	(0.0252)	(0.0217)
NOIE Lag (t-1)	-0.0116	-0.0250**	-0.0488	0.1313***	-0.0106
	(0.0237)	(0.0077)	(0.0263)	(0.0284)	(0.0194)
LLP Lag (t-1)	0.0081	-0.0102	-0.0009	-0.0504	0.4735***
	(0.0152)	(0.0075)	(0.0235)	(0.0265)	(0.0250)
Monetary Policy Variables					
Short-term Interest Rate	-0.0534*	0.0158	0.1163***	0.0641	-0.1370***
	(0.0239)	(0.0093)	(0.0338)	(0.0406)	(0.0364)
UMP Deviation	0.0129***	0.0004	0.0144***	0.0250***	0.0078***
	(0.0021)	(0.0007)	(0.0025)	(0.0028)	(0.0021)
Sovereign Yield Slope	0.0108***	0.0017*	-0.0106***	0.0106***	-0.0078***
	(0.0020)	(0.0007)	(0.0028)	(0.0031)	(0.0022)
Market & Macroeconomic Variables					
VIX	0.0007***	0.0004***	0.0002	0.0000	0.0007***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
GDP Growth	0.0026***	0.0005***	0.0011*	0.0007	0.0027***
	(0.0003)	(0.0001)	(0.0005)	(0.0004)	(0.0004)
Inflation	0.0045***	0.0020***	0.0013	0.0095***	0.0015
	(0.0009)	(0.0003)	(0.0013)	(0.0013)	(0.0010)
Expected GDP Growth	0.0150*	-0.0033	-0.0156	-0.0512***	0.0230**
	(0.0072)	(0.0027)	(0.0097)	(0.0118)	(0.0085)
Expected Inflation	-0.0028	-0.0050***	-0.0184***	-0.0307***	-0.0170***
	(0.0035)	(0.0013)	(0.0046)	(0.0045)	(0.0034)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: First-differences
Number of observations = 6703
Number of groups = 624
Number of instruments = 540, Collapsed Instruments
Hansen test of overid. restrictions: chi2(475) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Turning to Figure 4.4, we present eight generalized impulse response functions calculated from the estimated PVAR's reduced model, using all decomposed profitability components at stake (i.e., II, IE, NOII, NOIE, LLP).[9] The goal is to analyze how banks strategically managed their profitability components during the implementation of the unconventional monetary policy. Thus, our focus is on the impulses of the interest components (II and IE) on each other responses and other profitability components. To this end, the first two panels (A and B) of Figure 4.4 plot the impulse of IE and response of II and vice-versa. The following pairs of panels (C and D, E and F, and G and H) display the impulses of IE and II on NOII, NOIE, and LLP, respectively.

We highlight four findings in Figure 4.4, one for each pair of impulses. First, according to Panel A and B, we find a positive response on II due to an impulse of IE, which persists for more than twelve quarters and has a much larger magnitude and persistence than the inverse case (impulse of II and response of IE). As expected, expansionary monetary policies led to a decrease in both interest components. Nevertheless, given the larger magnitude and persistence of the impulse of IE on II, these estimated dynamics suggest that the most pronounced changes on II tend to occur *after* the changes in IE. We argue that this may result from how banks operate. On the one hand, since banks tend to borrow money on shorter timeframes than they lend money out, changes in interest rates may be reflected in IE faster than II. The literature refers to this timing disconnection as maturity transformation, which is a natural consequence of banking activity (e.g., Flannery, 1981; Hancock, 1985; Bourke, 1989; Saunders and Schumacher, 2000). On the other hand, banks tend to be price-makers regarding their deposit rates. Hence, banks may have strategically decreased their deposit rates to mitigate expected losses in II.

Turning to panels C and D in Figure 4.4, we focus on the banks' reaction regarding NOII (e.g., fees and commissions) to changes in the interest components. On the one hand, Panel C suggests a negative response of NOII to an impulse from IE, persisting for about twelve quarters. Recall that, in our period, expansionary monetary policies decreased the IE, hence increasing the NOII. On the other hand, from Panel D, the impulse of II and response in NOII is essentially insignificant. Both results may suggest that banks increase their NOII after the decrease in the IE but not after the decrease in the II. Since the previous result suggests that the most pronounced changes in II tend to occur after the changes in IE, we argue that the decrease in IE most likely signals a future decrease in II and consequently, banks may increase fees and commissions to mitigate expected losses on II. These results are in line with the literature (e.g., Brei et al., 2020; Kok et al., 2019), which suggests that the decrease on the NII was mitigated by an increase in the NOII components. In this study, the VAR framework allows us to go beyond this result, advocating that the banks may have anticipated the losses on the II component and proactively reacted by increasing NOII components.

[9] We provide the full information in Appendix R, with all the estimated generalized impulse response functions.

Regarding panels E and F, we assess whether banks changed their NOIE (e.g., administrative costs) to changes in the interest components. While Panel E suggests after two quarters a negative response of NOIE given an impulse of IE, Panel F suggests a positive response of NOIE to an impulse of II during the following four quarters. Upon the decrease in the interest components, these IRF suggest an increase in NOIE via changes in IE and a decrease via changes in II. Since the most pronounced changes on II tend to occur after the changes in IE, both dynamics may be consistent with the idea that reducing administrative costs (which occur after the impacts on II) may imply an immediate increase in bureaucratic expenses (which occur after the impacts on IE). Nevertheless, these dynamics suggest that banks may not have dedicated their major efforts on mitigating the decrease in the interest components by cutting NOIE.

Finally, panels G and H plot the impulse of the interest components with responses on the LLP. Both panels show positive responses on LLP, which is comparably higher than the responses to the other profitability components. These results suggest that, during the expansionary monetary policies, interest components have decreased and the banks reduced LLP. Broadly speaking, the results are consistent with the findings presented in the section above. Moreover, given the magnitude of the responses on LLP, we argue that the mitigation of the net-interest income widely occurs due to the decrease in LLP.

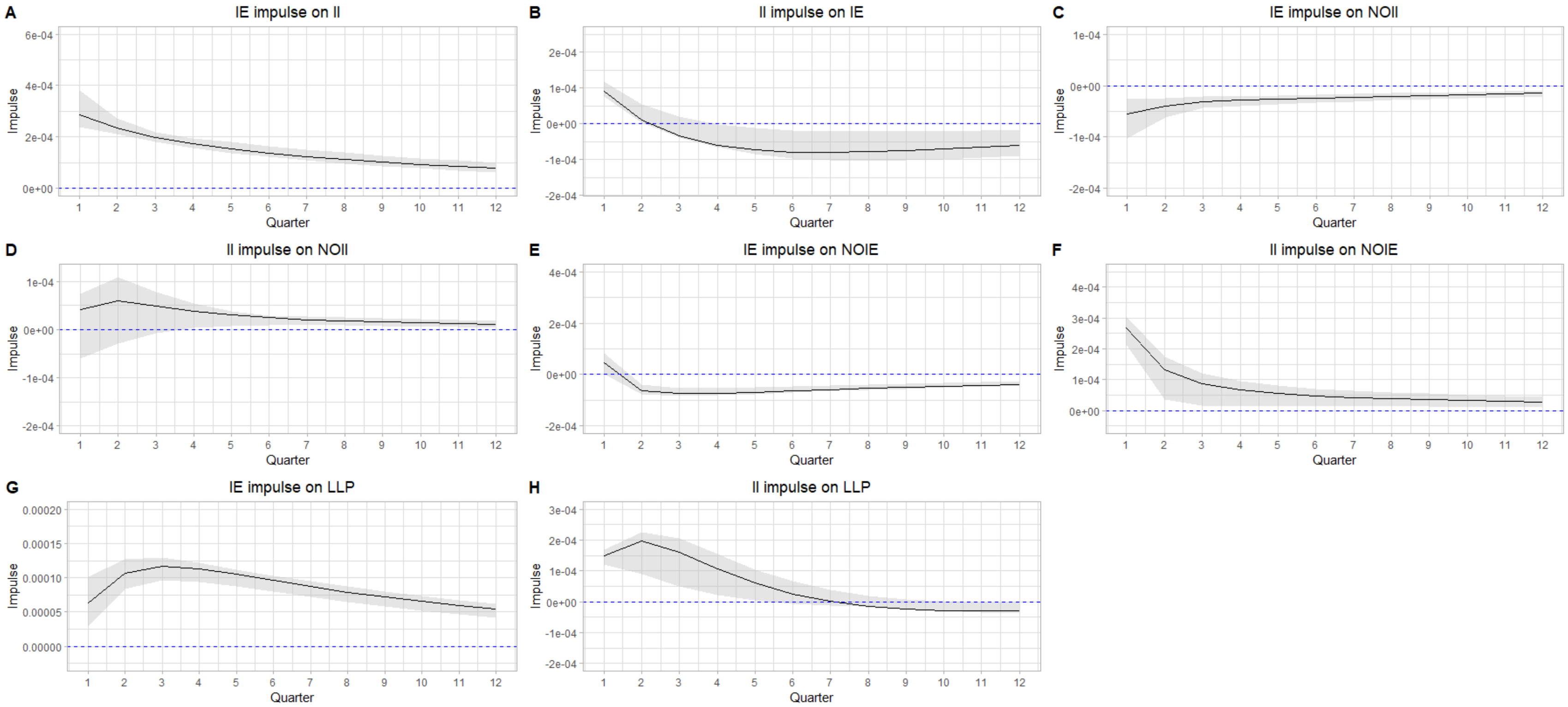


Figure 4.4: Banks Decomposed Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

4.6. Robustness

In this subchapter, we re-estimate our panel VAR model with the GMM approach using alternative options to check the robustness of the results and conclusions: the transformation applied to remove the fixed effects, the choice for the moment conditions, and the number of instrumental variables. We also perform a robustness exercise by having more exogenous variables - the bank's specific variables - and as an alternative to generalized IRFs we now estimate the orthogonal impulse response functions.

Starting with the removal of the fixed effects, instead of the first differences transformation, previously used as a benchmark specification, we now implement the forward orthogonal transformation which in any case produces similar results as before (see Appendixes S to V). Turning to the moment conditions, instead of using the first differences moment conditions, now we use the system moment conditions as defined in Blundell and Bond (1998) and present the extended GMM estimator. Again, we obtain similar results as in the benchmark (see Appendixes W to Z).

Third, regarding the number of instrumental variables, estimating with a smaller number of instruments (between 5 and 20 instruments) produces similar estimated coefficients and statistical significance (see Appendixes AA to AF). These results give us confidence in the validity of the employed econometric approach and the comprehensiveness of the large supervisory data set. In any case, we do not rule out the possibility of problems associated with the small number of periods, which, however, are difficult to overcome given the way data can be obtained.

Fourth, we study an extended version of the model by adding more exogenous variables: the 5 Years Default Probability, Non-Performing Loans (NPL) per TA, Capital Adequacy Ratio (CAR), and Efficiency Ratio. These variables are mainly used to control for bank individual characteristics. Appendixes AG to AJ present the estimation results and impulse response functions with respect to the Net Profitability components and the Decomposed Profitability components. We draw attention to the results of the extended model concerning the dynamics of the decomposed components of profitability because, although similar to the benchmark, they present a decrease in their statistical significance. This may be caused by some noise introduced from the bank-specific variables and by the decrease in the number of observations, given the lack of data for these variables.

Finally, for our last robustness exercise, we compute the orthogonal impulse response functions for the Net and Decomposed Profitability components. The order in which the endogenous variables enter in the model is one of two ways[10]. For the dynamics of Net Profitability components, the orders are: first NII, then NNOII and for last LLP; and vice-versa in the second case. For the Decomposed Profitability components, the orders are: II, IE, NOII, NOIE and LLP. The results show no significant difference between generalized impulse response functions and the orthogonal impulse response functions with

[10] It is important to keep in mind that for the computation of orthogonal impulse-response functions, the idea of the order of the variables is that the first one is the most exogenous one that does not depend on any other and so on until the last one, which depends on all the others.

different orderings of the endogenous variables, which suggests that the order of the variables does not impact the interpretation previously stated in the above subchapter.[11]

4.7. Summary and Discussion

In this study, we analyze the dynamics between the bank's profitability components during the implementation of several UMP by the U.S. Fed. We adopted a Panel Vector Autoregression with the Generalized Method of Moments estimation methodology proposed by Sigmund and Ferstl (2021) and calculated the generalized and the orthogonal Impulse Response Functions. At first, we studied the dynamics of the components of Net Profitability, including the NII, NNOII and LLP. Afterwards, to obtain a better-segregated view of the dynamics, we performed the same analysis but for the components of Decomposed Profitability, which includes II, IE, NOII, NOIE and LLP.

The results we obtained analyzing the dynamics of the Net Profitability components suggest that both the NNOII and LLP were induced to offset the NII. In other words, the NII losses, which result from the combination of UMP and the fall of interest rates, may have been mitigated with the increase in NNOII and decrease of LLP.

Regarding the dynamics of the Decomposed Profitability components, our results bring to light three key findings. First, we find that IE induces a positive impulse on II. This impulse can most likely be explained through the concept of "maturity transformation" and the strategic decrease of bank deposit rates, in which the II components are affected after the IE components. Second, IE induces a negative impulse NOII, which means that the decrease of IE components may lead banks to adopt a strategy of increasing NOII before the II is harmed in an attempt to mitigate the expected losses in interest components. Third, we find that IE induces a negative response in NOIE, but we also find that II induces a positive response of NOII. Overall, these results suggest that the optimization of the operational management may have not been the major responsible of the mitigation for the losses in interest components.

In both analyses - the dynamics of the Net and Decomposed Profitability components -, we also highlight that the components of the LLP are responsible for the largest portion of the counterweight of the losses referring to the interest components, since its response to the impulses of the other endogenous variables show a predominant magnitude and persistence.

Our results can be an interesting insight for the understanding of U.S. monetary policy. The monetary transmission, which the Federal Reserve Board intends to operate in order to fulfill its price stability and economic growth mandates, is not limited to the profitability of the banks, since the NOII components only mitigate a small part of the losses. In fact, most of the mitigation concerning the losses

[11] For more information about the specifications of PVAR with GMM estimation technique, please refer to Sigmund et al. (2021). Results from the orthogonal impulse responses are available upon request.

of II, is carried out by reducing the components of the LLP, which do not affect bank's customers and clients.

Finally, we highlight the broader research agenda on this topic. For example, one may analyze the inclusion of the shadow rate (or derivatives of this proxy) as an additional endogenous variable to study the way impulses that monetary policies may induce in the bank profitability components.

Appendix K

Table K.1: Chronology of the U.S. unconventional monetary policies events implemented by the U.S. Fed and represented in Figure 4.2.

ID	Event Date	Program	Description
1	March 18, 2009	LSAP1, FG	Large scale asset purchases which, combined with Nov. 2008 announcement, totaled $300 billion of U.S. Treasury securities, $200 billion of U.S. agency debt (later revised to $175 billion), $1.25 trillion of MBS over about one year (popularly known as “quantitative easing”); anticipated “exceptionally low” federal funds rate would likely be maintained “for an extended period.”
2	August 10, 2010	LSAP1	Following completion of large-scale asset purchases, maturing assets would be replaced with U.S. Treasury securities to prevent the balance sheet from shrinking.
3	November 3, 2010	LSAP2	Large scale asset purchases of $600 billion of U.S. Treasury securities over eight months (popularly known as “Quantitative Easing II”).
4	August 9, 2011	FG	Set a target date (mid-2013) for period Fed anticipated it would keep the federal funds rate at “exceptionally low levels”; the Fed subsequently moved back the target date incrementally to mid-2015.
5	September 21, 2011	MEP1	Maturity Extension Program (popularly known as “Operation Twist”), under which Fed purchased $400 billion long-term U.S. Treasury securities, and sold an equivalent amount of short-term Treasury securities over nine months. Began rolling over existing agency debt and MBS into new agency MBS (instead of U.S. Treasury securities).
6	January 25, 2012	FG	Set “longer-run goal” of 2% inflation; public release of FOMC members forecast of “appropriate” federal funds target.
7	June 20, 2012	MEP2	Extended and expanded the Maturity Extension Program to an additional $267 billion of Treasury securities, through the end of 2012.
8	September 13, 2012	LSAP3, FG	Announced large scale asset purchases of $40 billion of Agency MBS per month for unspecified duration (popularly known as “Quantitative Easing III”).
9	December 12, 2012	LSAP3, FG	Announced that the Fed would continue purchasing $45 billion of Treasury securities per month after the expiration of the Maturity Extension Program; changed the threshold for ending “exceptionally low levels” of the federal funds rate from “at least through mid-2015” to “at least as long as the unemployment rate remains above 6-1/2 percent,” contingent on low inflation.
10	December 18, 2013 until September 17, 2014	LSAP3	Announced that the Fed would begin to “taper off” its securities purchases, initially reducing monthly purchases by $10 billion.

Appendix L

Table L.1: Andrews and Lu's selection for one vs. two Endogenous Variables Lags - PVARGMM's reduced model – Banks' Net Profitability Components - Estimates - from Q1 2009 until Q2 2014.

	Andrew Lu's test	
	Model Selection	***Value***
Banks Net Profitability Components dynamics - Reduced model considering one endogenous lag	BIC	-1700.706
	AIC	-385.999
	HQIC	-881.976
Banks Net Profitability Components dynamics - Reduced model considering two endogenous lags	BIC	-1662.148
	AIC	-379.999
	HQIC	-865.368

Notes: Andrews and Lu's selection for one vs. two endogenous lags Banks' Net Profitability Components - PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Table L.2: Andrews and Lu's selection for one vs. two Endogenous Variables Lags - PVARGMM's reduced model – Banks' Decomposed Profitability Components - Estimates - from Q1 2009 until Q2 2014.

	Andrew Lu's test	
	Model Selection	***Value***
Banks Decomposed Profitability Components dynamics - Reduced model considering one endogenous lag	BIC	-4643.033
	AIC	-1053.999
	HQIC	-2408.093
Banks Decomposed Profitability Components dynamics - Reduced model considering two endogenous lags	BIC	-4565.786
	AIC	-1044.000
	HQIC	-2377.305

Notes: Andrews and Lu's selection for one vs. two endogenous lags Banks' Decomposed Profitability Components - PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Appendix M

Table M.1: Banks Net Profitability Components - PVAR's reduced model with two-step GMM estimator.

	(1)	(2)	(3)
Period		**Q1 2009 - Q2 2014**	
Endogenous Variables	**NII**	**NNOII**	**LLP**
NII Lag (t-1)	0.5596***	0.0750	0.2181***
	(0.0606)	(0.0930)	(0.0632)
NNOII Lag (t-1)	0.0154	0.0947**	-0.0562**
	(0.0146)	(0.0325)	(0.0208)
LLP Lag (t-1)	0.0045	0.0865*	0.5695***
	(0.0168)	(0.0349)	(0.0345)
Monetary Policy Variables			
Short-term Interest Rate	-0.0716**	0.0945*	-0.0123
	(0.0246)	(0.0457)	(0.0384)
UMP Deviation	0.0103***	-0.0058	0.0151***
	(0.0020)	(0.0032)	(0.0028)
Sovereign Yield Slope	0.0068***	-0.0197***	0.0011
	(0.0019)	(0.0039)	(0.0027)
Market & Macroeconomic Variables			
VIX	0.0003*	0.0005*	0.0011***
	(0.0001)	(0.0002)	(0.0002)
GDP Growth	0.0017***	0.0011	0.0031***
	(0.0003)	(0.0006)	(0.0005)
Inflation	0.0018	-0.0056**	0.0009
	(0.0009)	(0.0018)	(0.0012)
Expected GDP Growth	0.0211**	0.0198	-0.0202*
	(0.0067)	(0.0125)	(0.0087)
Expected Inflation	0.0031	-0.0024	-0.0306***
	(0.0029)	(0.0052)	(0.0041)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, two-step GMM
Transformation: First-differences
Number of observations = 6714
Number of groups = 624
Number of instruments = 204, Collapsed Instruments
Hansen test of overid. restrictions: chi2(171) = 289.5 Prob > chi2 = 0

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, two-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Appendix N

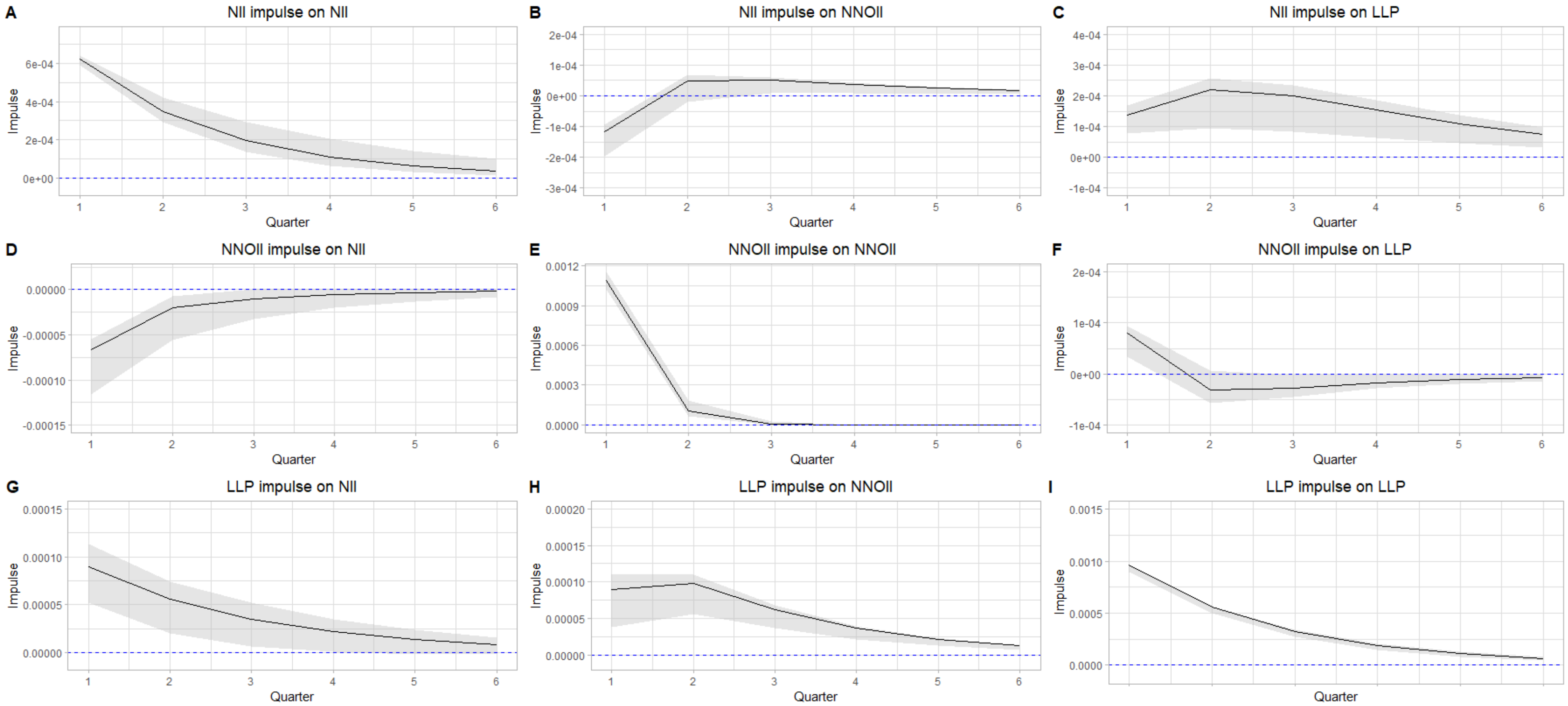


Figure N.1: Banks Net Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions - two-step GMM estimator.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, two-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

Appendix O

Table O.1: Banks Decomposed Profitability Components - PVAR's reduced model with two-step GMM estimator.

	(1)	(2)	(3)	(4)	(5)
Period			**Q1 2009 - Q2 2014**		
Endogenous Variables	**II**	**IE**	**NOII**	**NOIE**	**LLP**
II Lag (t-1)	0.5445***	-0.0791***	0.1121*	0.1786**	0.1428***
	(0.0569)	(0.0168)	(0.0502)	(0.0564)	(0.0420)
IE Lag (t-1)	0.3261***	0.9792***	-0.2526***	-0.4396***	0.1400**
	(0.0553)	(0.0218)	(0.0628)	(0.0743)	(0.0489)
NOII Lag (t-1)	0.0374	-0.0065	0.1033***	0.0268	-0.0231
	(0.0254)	(0.0099)	(0.0306)	(0.0271)	(0.0238)
NOIE Lag (t-1)	-0.0089	-0.0260**	-0.0502	0.1284***	-0.0058
	(0.0260)	(0.0091)	(0.0282)	(0.0313)	(0.0218)
LLP Lag (t-1)	0.0068	-0.0124	0.0066	-0.0542	0.4715***
	(0.0178)	(0.0092)	(0.0268)	(0.0298)	(0.0305)
Monetary Policy Variables					
Short-term Interest Rate	-0.0559*	0.0147	0.1127**	0.0665	-0.1315**
	(0.0269)	(0.0106)	(0.0378)	(0.0450)	(0.0425)
UMP Deviation	0.0122***	0.0005	0.0144***	0.0243***	0.0069**
	(0.0023)	(0.0007)	(0.0028)	(0.0031)	(0.0024)
Sovereign Yield Slope	0.0104***	0.0019*	-0.0108***	0.0112**	-0.0078**
	(0.0021)	(0.0008)	(0.0031)	(0.0034)	(0.0025)
Market & Macroeconomic Variables					
VIX	0.0007***	0.0004***	0.0002	0.0000	0.0007***
	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
GDP Growth	0.0026***	0.0005***	0.0010*	0.0006	0.0026***
	(0.0004)	(0.0001)	(0.0005)	(0.0005)	(0.0004)
Inflation	0.0042***	0.0020***	0.0013	0.0092***	0.0014
	(0.0010)	(0.0004)	(0.0014)	(0.0014)	(0.0011)
Expected GDP Growth	0.0168*	-0.0029	-0.0152	-0.0493***	0.0228*
	(0.0082)	(0.0030)	(0.0109)	(0.0132)	(0.0096)
Expected Inflation	-0.0019	-0.0051***	-0.0194***	-0.0292***	-0.0171***
	(0.0037)	(0.0014)	(0.0049)	(0.0049)	(0.0039)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, two-step GMM
Transformation: First-differences
Number of observations = 6703
Number of groups = 624
Number of instruments = 540
Hansen test of overid. restrictions: chi2(475) = 352.36 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, two-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Appendix P

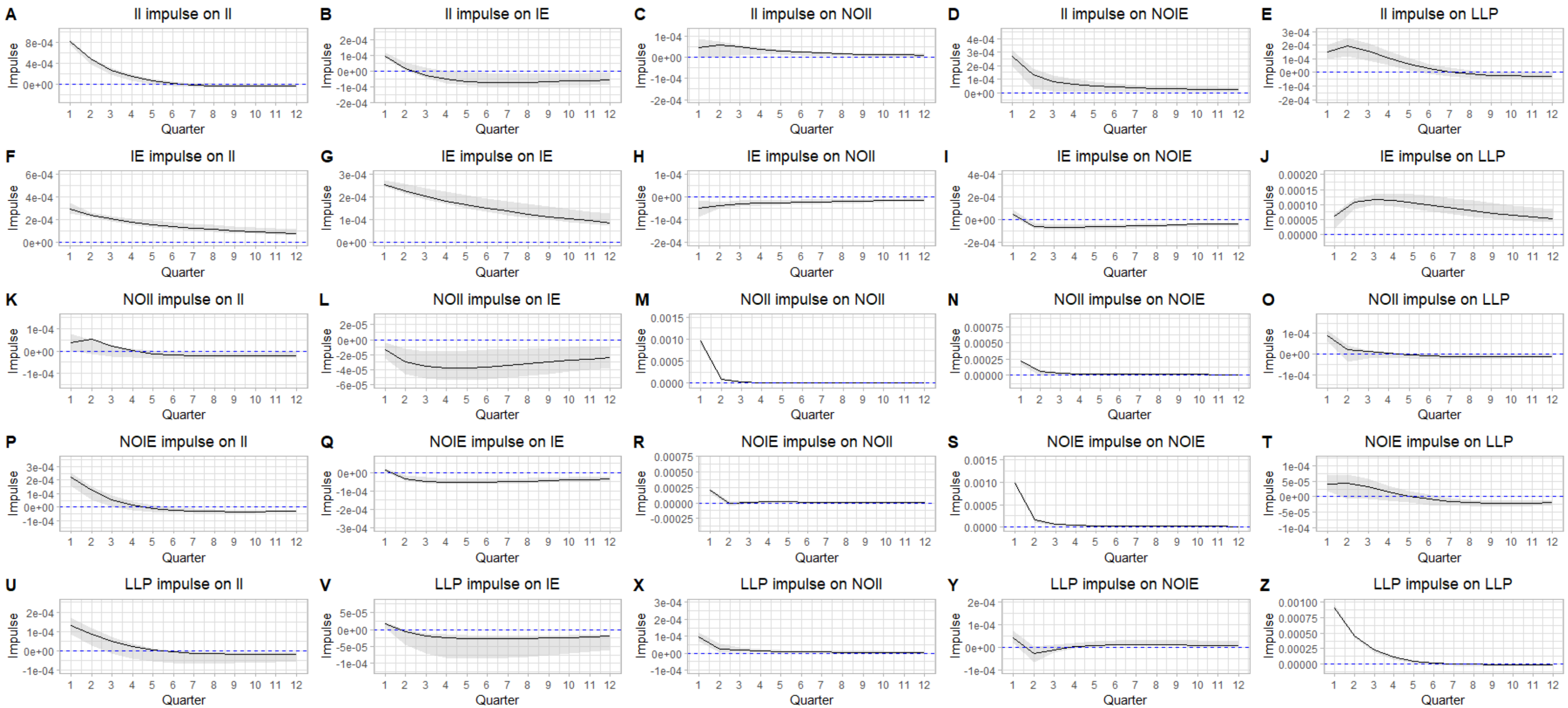


Figure P.1: Banks Decomposed Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions - two-step GMM estimator.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, two-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

Appendix Q

Table Q.1: Stability test - PVAR's reduced model - Banks' Net Profitability Components.

	Stability Test Eigenvalue Stability Conditions	
	Eigenvalue	***Modulus***
PVARGMM *Banks Net Profitability Components dynamics - Reduced model*	0.5695	0.5695
	0.5040	0.5040
	0.1047	0.1047

Notes: Bank's Net Profitability Components - PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Table Q.2: Stability test - PVAR's reduced model - Banks' Decomposed Profitability Components.

	Stability Test Eigenvalue Stability Conditions	
	Eigenvalue	***Modulus***
PVARGMM *Banks Decomposed Profitability Components dynamics - Reduced model*	0.9173+0.0000i	0.9173
	0.6428+0.0000i	0.6428
	0.4600+0.0000i	0.4600
	0.1059+0.0092i	0.1063
	0.1059-0.0092i	0.1063

Notes: Bank's Decomposed Profitability Components - PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

Appendix R

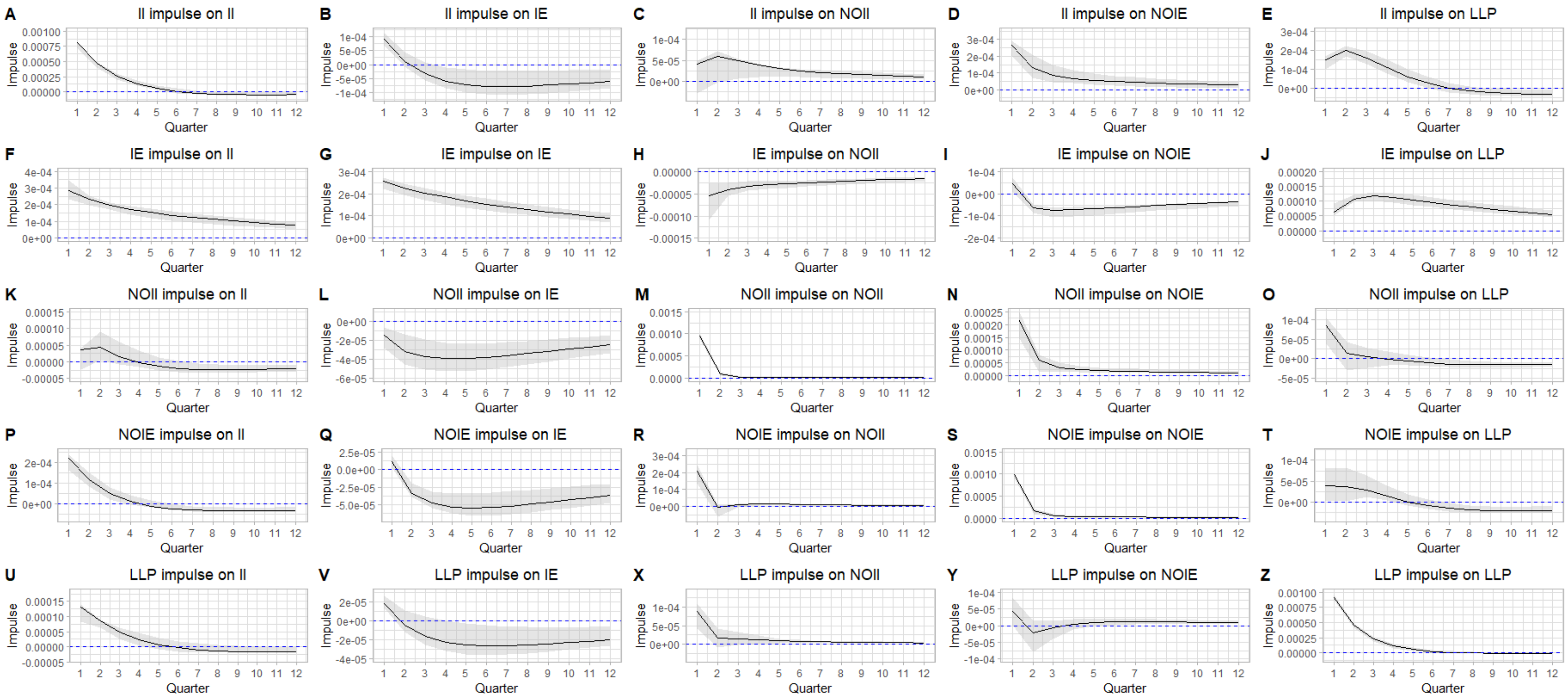


Figure R.1: Banks Decomposed Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

Appendix S

Table S.1: Banks Net Profitability Components - PVAR's reduced model - forward orthogonal transformation to remove fixed effects.

	(1)	(2)	(3)
Period		**Q1 2009 - Q2 2014**	
Endogenous Variables	**NII**	**NNOII**	**LLP**
NII Lag (t-1)	0.6942***	0.0006	0.0824*
	(0.0376)	(0.0512)	(0.0349)
NNOII Lag (t-1)	0.0162	0.1361***	-0.0414*
	(0.0124)	(0.0283)	(0.0170)
LLP Lag (t-1)	-0.0055	0.0749**	0.5871***
	(0.0108)	(0.0272)	(0.0216)
Monetary Policy Variables			
Short-term Interest Rate	-0.0682***	0.0896*	-0.0125
	(0.0191)	(0.0375)	(0.0306)
UMP Deviation	0.0091***	-0.0051	0.0180***
	(0.0015)	(0.0027)	(0.0021)
Sovereign Yield Slope	0.0066***	-0.0195***	0.0036
	(0.0014)	(0.0027)	(0.0019)
Market & Macroeconomic Variables			
VIX	0.0003**	0.0004*	0.0012***
	(0.0001)	(0.0002)	(0.0002)
GDP Growth	0.0016***	0.0009	0.0033***
	(0.0003)	(0.0005)	(0.0004)
Inflation	0.0016**	-0.0057***	0.0024**
	(0.0006)	(0.0013)	(0.0008)
Expected GDP Growth	0.0127**	0.0259**	-0.0205***
	(0.0043)	(0.0094)	(0.0062)
Expected Inflation	-0.0012	0.0037	-0.0280***
	(0.0026)	(0.0042)	(0.0032)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: Forward orthogonal deviations
Number of observations = 6714
Number of groups = 624
Number of instruments = 204, Collapsed Instruments
Hansen test of overid. restrictions: chi2(171) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: forward orthogonal transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Appendix T

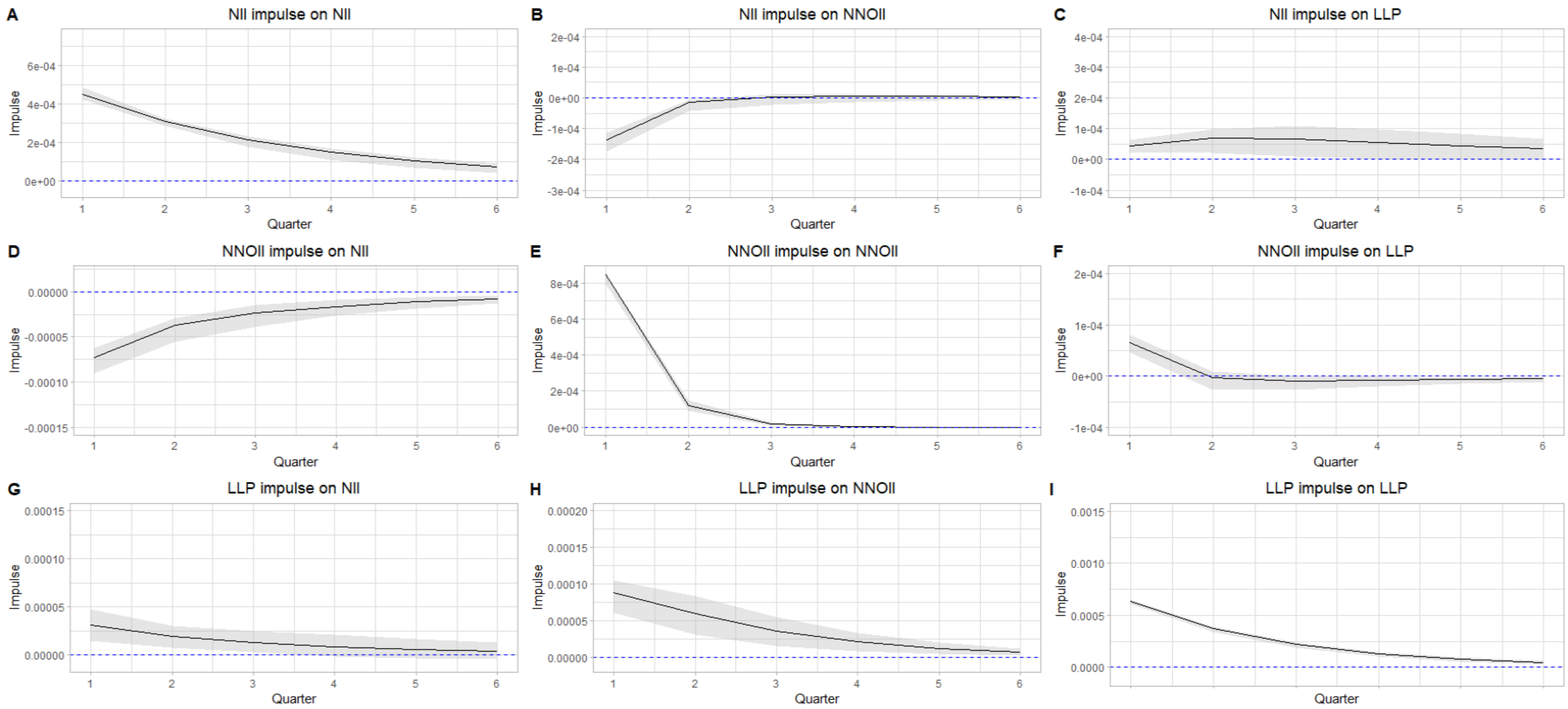


Table T.1: Banks Net Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions. - forward orthogonal transformation to remove fixed effects.

Notes: PVARGMM parameterization: forward orthogonal transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

Appendix U

Table U.1: Banks Decomposed Profitability Components - PVAR's reduced model - forward orthogonal transformation to remove fixed effects.

	(1)	(2)	(3)	(4)	(5)
Period			**Q1 2009 - Q2 2014**		
Endogenous Variables	II	IE	NOII	NOIE	LLP
II Lag (t-1)	0.6791***	-0.0488***	0.1579***	0.1636***	0.1411***
	(0.0393)	(0.0133)	(0.0420)	(0.0430)	(0.0298)
IE Lag (t-1)	0.1132**	0.9485***	-0.2844***	-0.5354***	0.0267
	(0.0381)	(0.0131)	(0.0574)	(0.0614)	(0.0301)
NOII Lag (t-1)	0.0251	-0.0017	0.1385***	-0.0095	-0.0388
	(0.0240)	(0.0070)	(0.0330)	(0.0285)	(0.0217)
NOIE Lag (t-1)	-0.0035	-0.0205***	-0.0464	0.2052***	-0.0084
	(0.0223)	(0.0061)	(0.0262)	(0.0304)	(0.0187)
LLP Lag (t-1)	0.0039	-0.0131	0.0017	-0.0363	0.5550***
	(0.0122)	(0.0073)	(0.0241)	(0.0273)	(0.0222)
Monetary Policy Variables					
Short-term Interest Rate	-0.0006	0.0167	0.0936**	0.1302**	-0.0933**
	(0.0257)	(0.0098)	(0.0348)	(0.0411)	(0.0337)
UMP Deviation	0.0143***	0.0001	0.0126***	0.0309***	0.0088***
	(0.0024)	(0.0007)	(0.0026)	(0.0031)	(0.0022)
Sovereign Yield Slope	0.0145***	0.0021**	-0.0105***	0.0195***	-0.0053*
	(0.0021)	(0.0007)	(0.0028)	(0.0032)	(0.0022)
Market & Macroeconomic Variables					
VIX	0.0008***	0.0004***	0.0002	0.0004	0.0008***
	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
GDP Growth	0.0025***	0.0005***	0.0009	0.0011*	0.0027***
	(0.0004)	(0.0001)	(0.0005)	(0.0004)	(0.0004)
Inflation	0.0040***	0.0019***	0.0018	0.0104***	0.0013
	(0.0008)	(0.0003)	(0.0012)	(0.0012)	(0.0008)
Expected GDP Growth	-0.0089	-0.0055*	-0.0136	-0.0668***	-0.0003
	(0.0060)	(0.0024)	(0.0096)	(0.0110)	(0.0069)
Expected Inflation	-0.0110**	-0.0058***	-0.0196***	-0.0371***	-0.0224***
	(0.0034)	(0.0011)	(0.0045)	(0.0046)	(0.0032)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: Forward orthogonal deviations
Number of observations = 6703
Number of groups = 624
Number of instruments = 540, Collapsed Instruments
Hansen test of overid. restrictions: chi2(475) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: forward orthogonal transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Appendix V

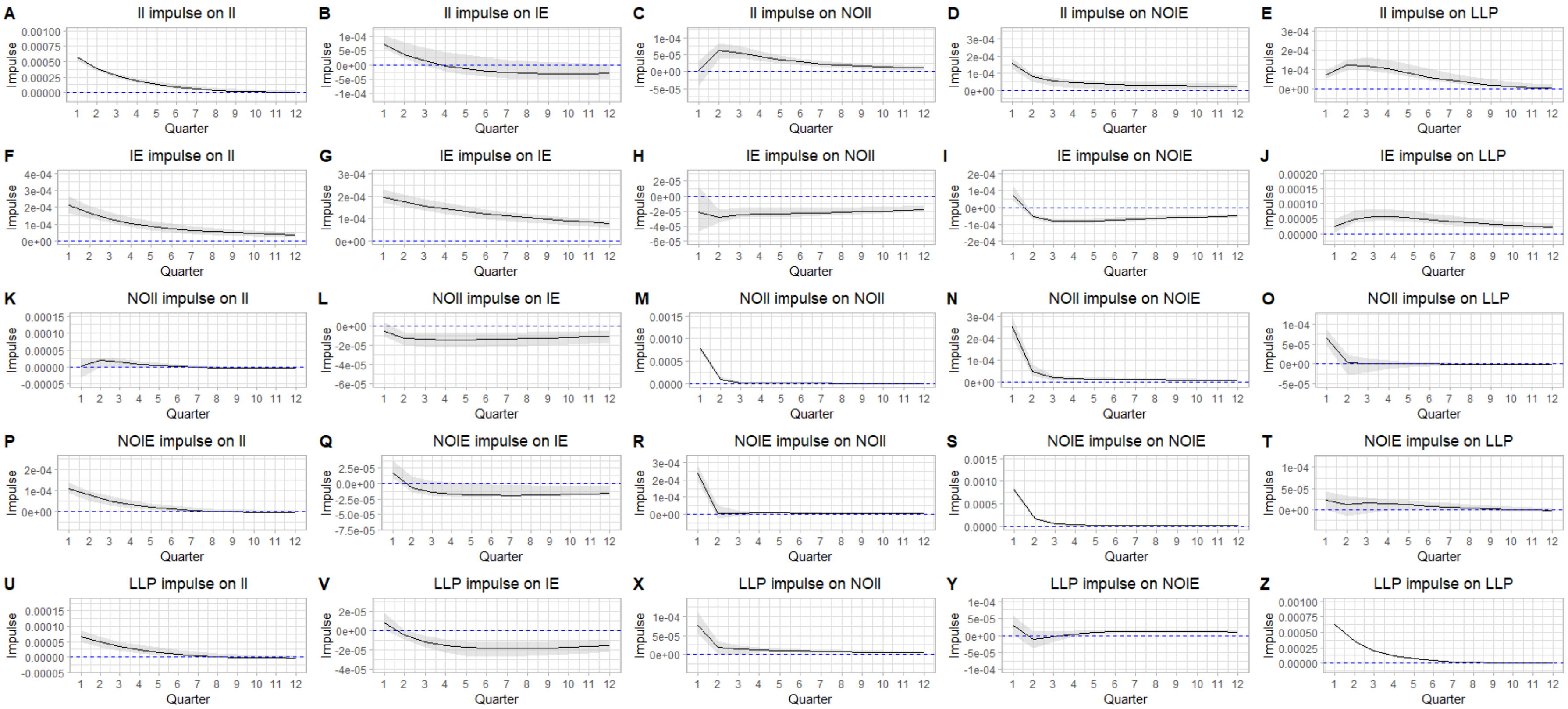


Figure V.1: Banks Decomposed Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions. - forward orthogonal transformation to remove fixed effects.

Notes: PVARGMM parameterization: forward orthogonal transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

Appendix W

Table W.1: Banks Net Profitability Components - PVAR's reduced model - System Moment Conditions.

	(1)	(2)	(3)
Period		**Q1 2009 - Q2 2014**	
Endogenous Variables	**NII**	**NNOII**	**LLP**
NII Lag (t-1)	0.4430***	-0.0202	0.0737
	(0.0429)	(0.0548)	(0.0441)
NNOII Lag (t-1)	0.0247*	0.1404***	-0.0336*
	(0.0115)	(0.0227)	(0.0141)
LLP Lag (t-1)	0.0007	0.0740**	0.5035***
	(0.0147)	(0.0282)	(0.0242)
Monetary Policy Variables			
Short-term Interest Rate	-0.0855***	0.0868*	-0.0048
	(0.0193)	(0.0383)	(0.0319)
UMP Deviation	0.0122***	-0.0042	0.0223***
	(0.0017)	(0.0028)	(0.0023)
Sovereign Yield Slope	0.0078***	-0.0202***	0.0060**
	(0.0017)	(0.0031)	(0.0020)
Market & Macroeconomic Variables			
VIX	0.0004***	0.0004*	0.0013***
	(0.0001)	(0.0002)	(0.0002)
GDP Growth	0.0017***	0.0007	0.0034***
	(0.0003)	(0.0005)	(0.0004)
Inflation	0.0032***	-0.0056***	0.0024*
	(0.0007)	(0.0014)	(0.0009)
Expected GDP Growth	0.0261***	0.0262**	-0.0151*
	(0.0053)	(0.0097)	(0.0072)
Expected Inflation	0.0031	0.0044	-0.0275***
	(0.0025)	(0.0043)	(0.0032)
constant	0.0040***	-0.0044***	0.0005
	(0.0003)	(0.0005)	(0.0003)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: First-differences
Number of observations = 6714
Number of groups = 624
Number of instruments = 216, Collapsed Instruments
Hansen test of overid. restrictions: chi2(180) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, System moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Appendix X

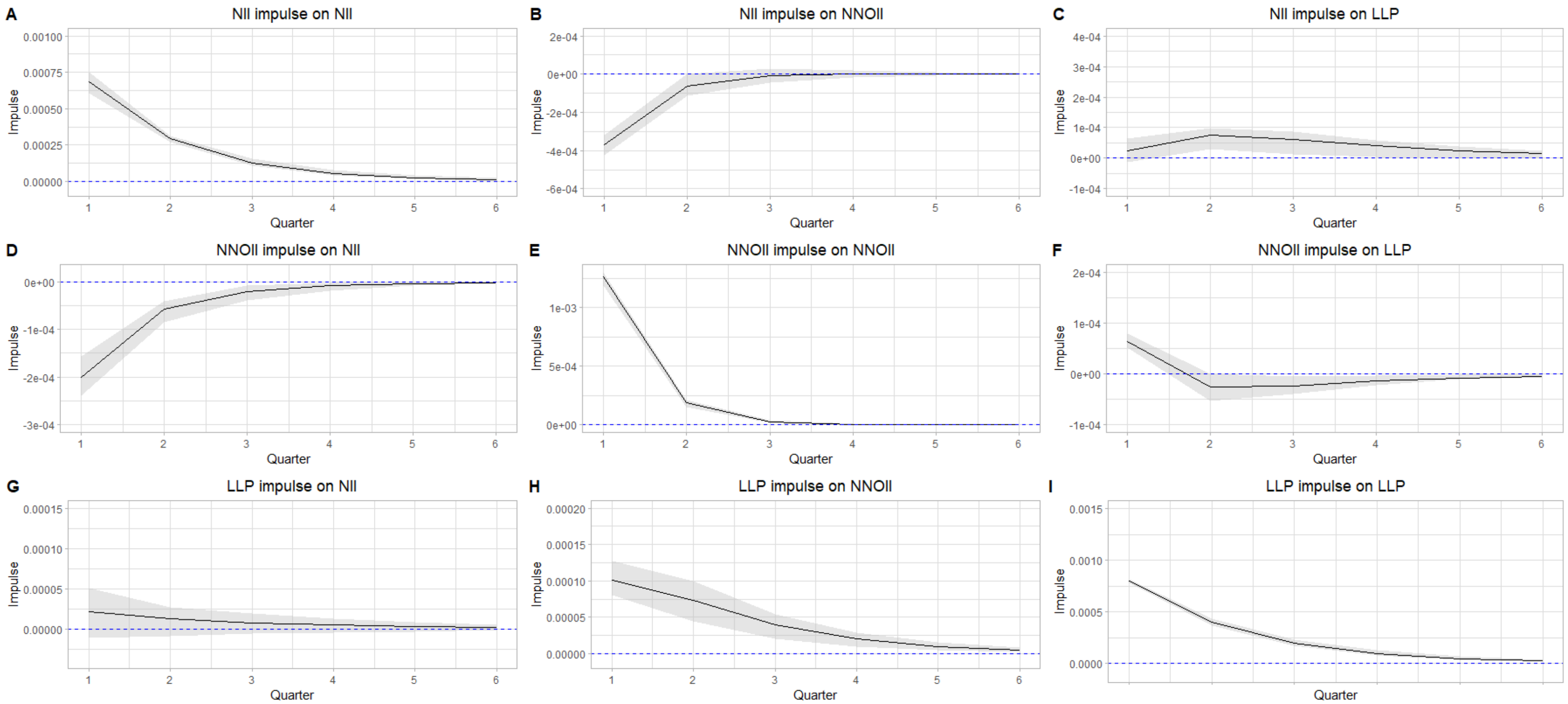


Figure X.1: Banks Net Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions - System Moment Conditions.

Notes: PVARGMM parameterization: first difference transformation, System moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

Appendix Y

Table Y.1: Banks Decomposed Profitability Components - PVAR's reduced model - System Moment Conditions.

	(1)	(2)	(3)	(4)	(5)
Period			**Q1 2009 - Q2 2014**		
Endogenous Variables	**II**	**IE**	**NOII**	**NOIE**	**LLP**
II Lag (t-1)	0.4529***	-0.0732***	0.0548	0.0562	0.0635*
	(0.0516)	(0.0138)	(0.0395)	(0.0457)	(0.0318)
IE Lag (t-1)	0.4074***	0.9916***	-0.3134***	-0.2985***	0.1474***
	(0.0546)	(0.0211)	(0.0551)	(0.0597)	(0.0354)
NOII Lag (t-1)	-0.0030	-0.0091	0.1726***	0.0396	-0.0033
	(0.0238)	(0.0072)	(0.0307)	(0.0282)	(0.0180)
NOIE Lag (t-1)	-0.0587*	-0.0274***	0.0178	0.2313***	0.0026
	(0.0254)	(0.0067)	(0.0271)	(0.0278)	(0.0174)
LLP Lag (t-1)	0.0042	-0.0130	0.0016	-0.0565*	0.4654***
	(0.0160)	(0.0074)	(0.0217)	(0.0257)	(0.0247)
Monetary Policy Variables					
Short-term Interest Rate	-0.0627*	0.0056	0.1685***	0.0684	-0.1036**
	(0.0290)	(0.0115)	(0.0392)	(0.0450)	(0.0338)
UMP Deviation	0.0132***	-0.0008	0.0221***	0.0248***	0.0110***
	(0.0027)	(0.0008)	(0.0033)	(0.0037)	(0.0025)
Sovereign Yield Slope	0.0105***	0.0007	-0.0019	0.0147***	-0.0042
	(0.0028)	(0.0009)	(0.0036)	(0.0039)	(0.0022)
Market & Macroeconomic Variables					
VIX	0.0007***	0.0003***	0.0005**	0.0002	0.0008***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
GDP Growth	0.0022***	0.0005***	0.0016***	0.0010*	0.0028***
	(0.0004)	(0.0001)	(0.0005)	(0.0005)	(0.0004)
Inflation	0.0048***	0.0019***	0.0033**	0.0110***	0.0020*
	(0.0009)	(0.0004)	(0.0012)	(0.0012)	(0.0009)
Expected GDP Growth	0.0138	-0.0011	-0.0282**	-0.0472***	0.0138
	(0.0083)	(0.0029)	(0.0097)	(0.0112)	(0.0077)
Expected Inflation	-0.0032	-0.0043**	-0.0226***	-0.0306***	-0.0189***
	(0.0037)	(0.0014)	(0.0043)	(0.0043)	(0.0033)
Constant	0.0047***	0.0009***	0.0033***	0.0072***	-0.0003
	(0.0005)	(0.0001)	(0.0004)	(0.0005)	(0.0003)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: First-differences
Number of observations = 6703
Number of groups = 624
Number of instruments = 570, Collapsed Instruments
Hansen test of overid. restrictions: chi2(500) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, System moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Appendix Z

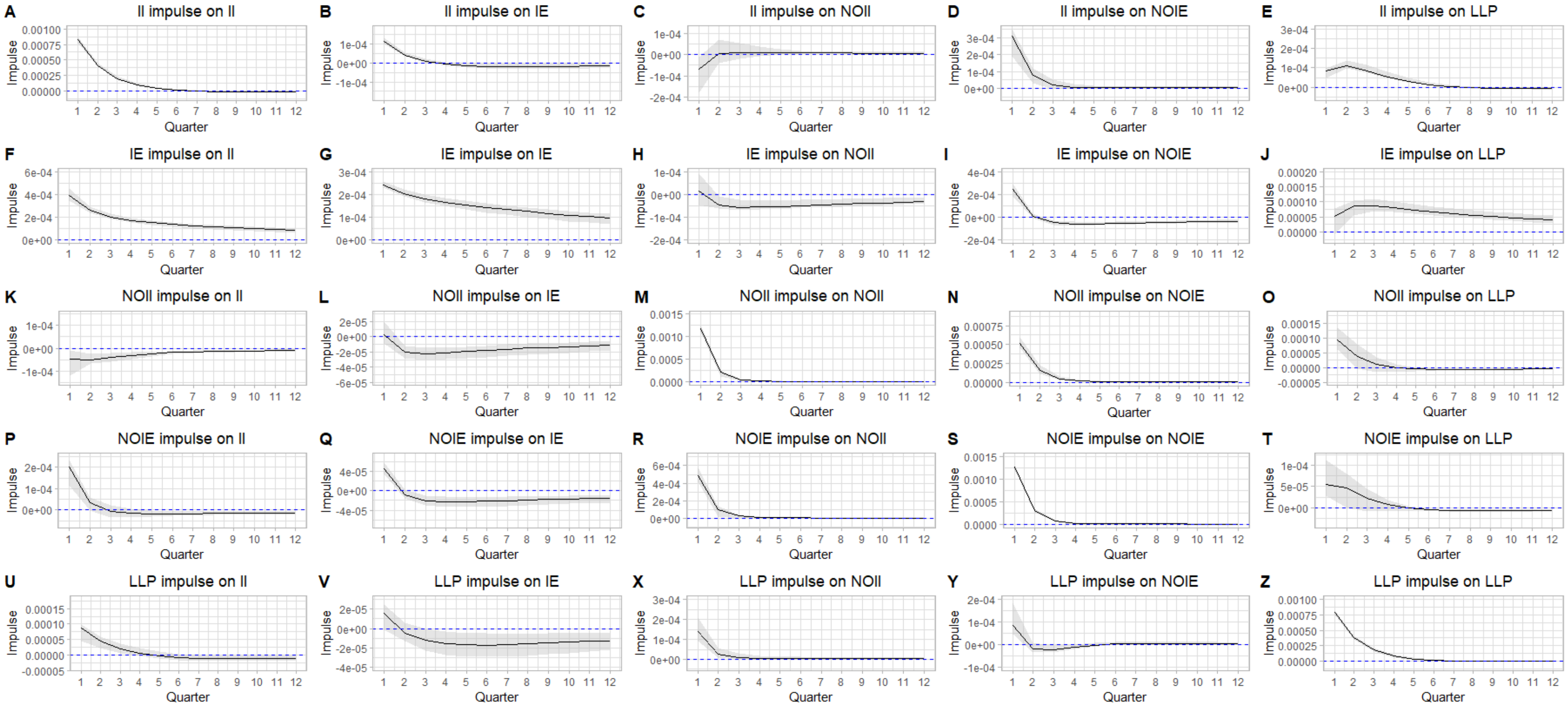


Figure Z.1: Banks Decomposed Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions - System Moment Conditions.

Notes: PVARGMM parameterization: first difference transformation, System moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

Appendix AA

Table AA.1: Banks Net Profitability Components - PVAR's reduced model - with three instrumental variables.

	(1)	(2)	(3)
Period		**Q1 2009 - Q2 2014**	
Endogenous Variables	**NII**	**NNOII**	**LLP**
NII Lag (t-1)	0.4962***	-0.0481	0.4974***
	(0.0701)	(0.1114)	(0.0929)
NNOII Lag (t-1)	0.0278*	0.1276***	-0.0879***
	(0.0134)	(0.0282)	(0.0193)
LLP Lag (t-1)	0.0219	0.0970**	0.4568***
	(0.0162)	(0.0314)	(0.0308)
Monetary Policy Variables			
Short-term Interest Rate	-0.1351***	0.0705	-0.0575
	(0.0249)	(0.0473)	(0.0427)
UMP Deviation	0.0159***	-0.0047	0.0263***
	(0.0021)	(0.0037)	(0.0033)
Sovereign Yield Slope	-0.0002	-0.0193***	-0.0068
	(0.0020)	(0.0043)	(0.0037)
Market & Macroeconomic Variables			
VIX	0.0002	0.0003	0.0008***
	(0.0001)	(0.0002)	(0.0002)
GDP Growth	0.0018***	-0.0001	0.0036***
	(0.0003)	(0.0005)	(0.0005)
Inflation	0.0024*	-0.0034	-0.0001
	(0.0011)	(0.0020)	(0.0015)
Expected GDP Growth	0.0317***	0.0440***	-0.0132
	(0.0076)	(0.0131)	(0.0113)
Expected Inflation	0.0063*	0.0003	-0.0271***
	(0.0025)	(0.0045)	(0.0038)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: First-differences
Number of observations = 6714
Number of groups = 624
Number of instruments = 42, Collapsed Instruments
Hansen test of overid. restrictions: chi2(9) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, minimum number of instruments imposed (3) and collapsed instruments.

Appendix AB

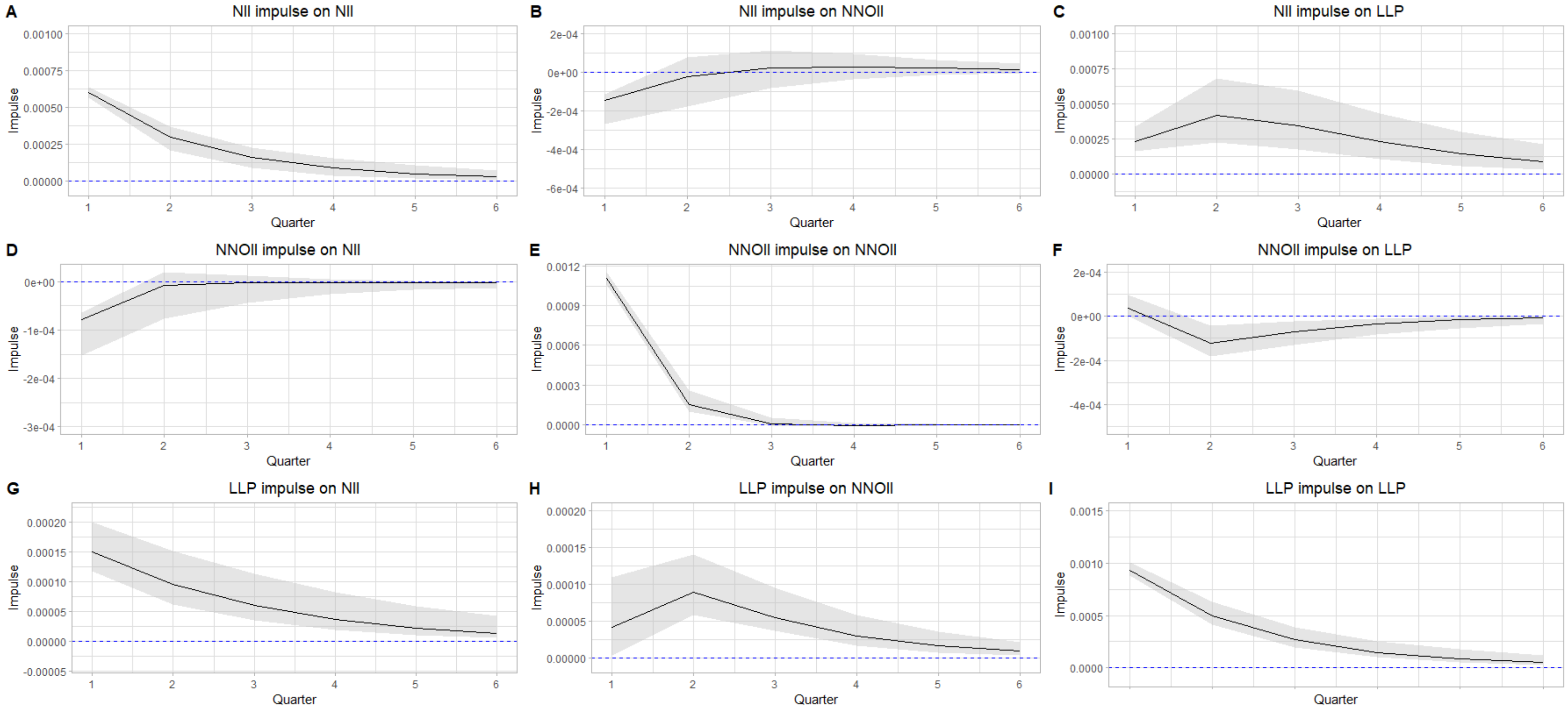


Figure AB.1: Banks Net Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions – with three instrumental variables.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, minimum number of instruments imposed (3) and collapsed instruments. 95% Confidence Bands.

Appendix AC

Table AC.1: Banks Decomposed Profitability Components - PVAR's reduced model - with three instrumental variables.

	(1)	(2)	(3)	(4)	(5)
Period			**Q1 2009 - Q2 2014**		
Endogenous Variables	**II**	**IE**	**NOII**	**NOIE**	**LLP**
II Lag (t-1)	0.4537***	-0.1188***	0.0090	0.1029*	0.1100*
	(0.0560)	(0.0148)	(0.0512)	(0.0508)	(0.0456)
IE Lag (t-1)	0.4602***	1.0681***	-0.0995	-0.3940***	0.2017***
	(0.0544)	(0.0189)	(0.0691)	(0.0677)	(0.0547)
NOII Lag (t-1)	0.0380	-0.0071	0.1127***	0.0350	-0.0109
	(0.0230)	(0.0084)	(0.0285)	(0.0258)	(0.0213)
NOIE Lag (t-1)	-0.0508*	-0.0362***	-0.0755**	0.1460***	0.0201
	(0.0219)	(0.0087)	(0.0256)	(0.0328)	(0.0208)
LLP Lag (t-1)	0.0127	-0.0130	0.0065	-0.0470	0.3686***
	(0.0183)	(0.0099)	(0.0269)	(0.0277)	(0.0273)
Monetary Policy Variables					
Short-term Interest Rate	-0.1527***	-0.0231*	0.0619	0.0539	-0.2018***
	(0.0319)	(0.0116)	(0.0435)	(0.0467)	(0.0435)
UMP Deviation	0.0179***	0.0007	0.0157***	0.0302***	0.0174***
	(0.0028)	(0.0010)	(0.0034)	(0.0038)	(0.0032)
Sovereign Yield Slope	-0.0007	-0.0023*	-0.0090*	0.0140***	-0.0121***
	(0.0026)	(0.0011)	(0.0040)	(0.0038)	(0.0037)
Market & Macroeconomic Variables					
VIX	0.0004*	0.0002***	0.0001	0.0001	0.0005**
	(0.0002)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
GDP Growth	0.0026***	0.0006***	0.0006	0.0016**	0.0027***
	(0.0004)	(0.0002)	(0.0005)	(0.0005)	(0.0004)
Inflation	0.0050***	0.0021***	0.0048**	0.0106***	0.0028*
	(0.0012)	(0.0004)	(0.0017)	(0.0016)	(0.0013)
Expected GDP Growth	0.0330**	0.0039	0.0195	-0.0407**	0.0415***
	(0.0101)	(0.0034)	(0.0128)	(0.0131)	(0.0109)
Expected Inflation	0.0059	-0.0001	-0.0175***	-0.0303***	-0.0121**
	(0.0036)	(0.0015)	(0.0051)	(0.0050)	(0.0039)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: First-differences
Number of observations = 6703
Number of groups = 624
Number of instruments = 90, Collapsed Instruments
Hansen test of overid. restrictions: chi2(25) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, minimum number of instruments imposed (3) and collapsed instruments.

Appendix AD

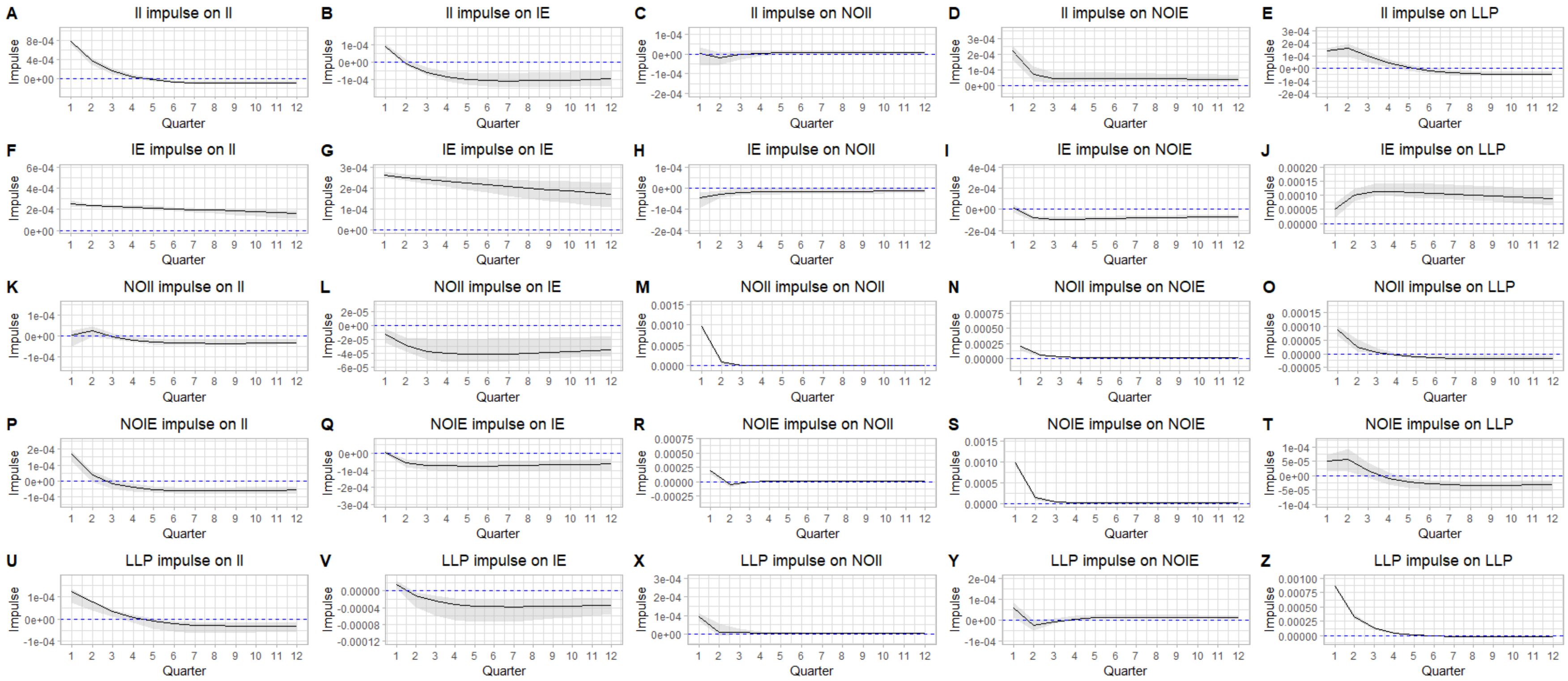


Figure AD.1: Banks Decomposed Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions – with three instrumental variables.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, minimum number of instruments imposed (3) and collapsed instruments. 95% Confidence Bands.

Appendix AE

Table AE.1: Banks Decomposed Profitability Components - PVAR's reduced model – with five instrumental variables.

	(1)	(2)	(3)	(4)	(5)
Period			**Q1 2009 - Q2 2014**		
Endogenous Variables	**II**	**IE**	**NOII**	**NOIE**	**LLP**
II Lag (t-1)	0.4733***	-0.0978***	0.0415	0.0677	0.0700
	(0.0601)	(0.0158)	(0.0495)	(0.0507)	(0.0458)
IE Lag (t-1)	0.4050***	1.0116***	-0.1432*	-0.3581***	0.1941***
	(0.0587)	(0.0228)	(0.0590)	(0.0643)	(0.0503)
NOII Lag (t-1)	0.0398	-0.0046	0.1132***	0.0245	-0.0263
	(0.0232)	(0.0083)	(0.0282)	(0.0248)	(0.0214)
NOIE Lag (t-1)	-0.0393	-0.0277***	-0.0718**	0.1259***	-0.0108
	(0.0224)	(0.0074)	(0.0261)	(0.0315)	(0.0205)
LLP Lag (t-1)	0.0199	-0.0096	-0.0095	-0.0480	0.4374***
	(0.0173)	(0.0088)	(0.0251)	(0.0268)	(0.0266)
Monetary Policy Variables					
Short-term Interest Rate	-0.1294***	-0.0117	0.0939*	0.0239	-0.1691***
	(0.0338)	(0.0111)	(0.0431)	(0.0467)	(0.0438)
UMP Deviation	0.0177***	0.0014	0.0147***	0.0322***	0.0165***
	(0.0027)	(0.0009)	(0.0031)	(0.0035)	(0.0032)
Sovereign Yield Slope	0.0024	-0.0012	-0.0071	0.0115**	-0.0067
	(0.0024)	(0.0011)	(0.0039)	(0.0038)	(0.0036)
Market & Macroeconomic Variables					
VIX	0.0005***	0.0003***	0.0002	0.0000	0.0007***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
GDP Growth	0.0025***	0.0005***	0.0009	0.0012*	0.0028***
	(0.0004)	(0.0001)	(0.0005)	(0.0005)	(0.0004)
Inflation	0.0051***	0.0025***	0.0037*	0.0114***	0.0022
	(0.0012)	(0.0004)	(0.0017)	(0.0015)	(0.0013)
Expected GDP Growth	0.0292**	-0.0023	0.0158	-0.0380**	0.0427***
	(0.0108)	(0.0034)	(0.0125)	(0.0130)	(0.0113)
Expected Inflation	0.0014	-0.0039**	-0.0190***	-0.0291***	-0.0153***
	(0.0035)	(0.0015)	(0.0046)	(0.0045)	(0.0036)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: First-differences
Number of observations = 6703
Number of groups = 624
Number of instruments = 140, Collapsed Instruments
Hansen test of overid. restrictions: chi2(75) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, five instrumental variables and collapsed instruments.

Appendix AF

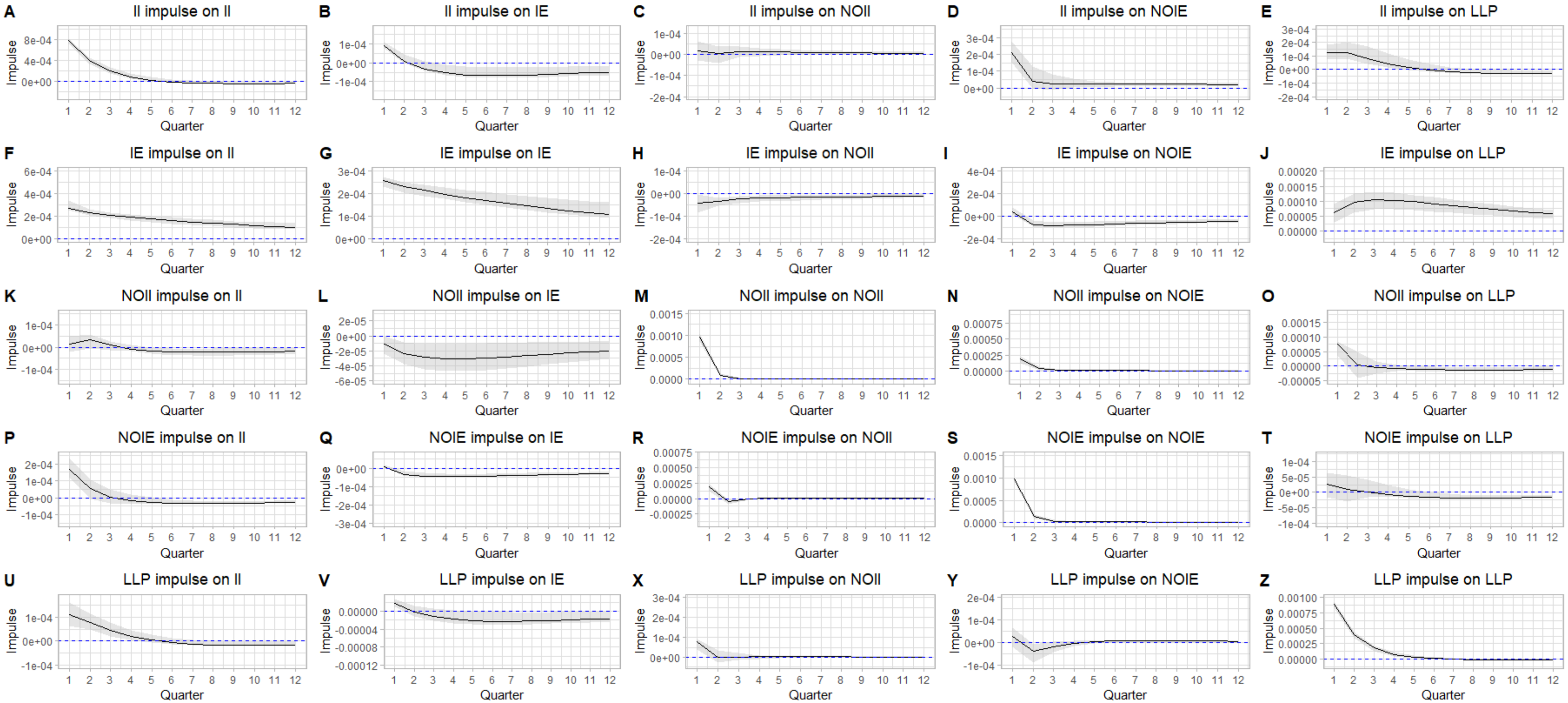


Figure AF.1: Banks Decomposed Profitability Components - PVAR's reduced model – Generalized Impulse Response Functions – with five instrumental variables.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, five instrumental variables and collapsed instruments. 95% Confidence Bands.

Appendix AG

Table AG.1: Banks Net Profitability Components - PVAR's extended model.

	(1)	(2)	(3)
Period		**Q1 2009 - Q2 2014**	
Endogenous Variables	**NII**	**NNOII**	**LLP**
NII Lag (t-1)	0.3000***	-0.1547	0.1898*
	(0.0901)	(0.0969)	(0.0792)
NNOII Lag (t-1)	0.0040	0.0616	-0.0886***
	(0.0147)	(0.0378)	(0.0241)
LLP Lag (t-1)	0.0036	0.0392	0.5039***
	(0.0236)	(0.0530)	(0.0427)
Monetary Policy Variables			
Short-term Interest Rate	-0.0405	0.0657	0.0762
	(0.0290)	(0.0665)	(0.0480)
UMP Deviation	0.0127***	-0.0032	0.0155***
	(0.0025)	(0.0047)	(0.0033)
Sovereign Yield Slope	0.0098***	-0.0179***	0.0007
	(0.0026)	(0.0047)	(0.0034)
Market & Macroeconomic Variables			
VIX	0.0004**	0.0005	0.0013***
	(0.0001)	(0.0003)	(0.0002)
GDP Growth	0.0017***	0.0007	0.0028***
	(0.0003)	(0.0006)	(0.0005)
Inflation	0.0023*	-0.0051*	-0.0018
	(0.0010)	(0.0022)	(0.0013)
Expected GDP Growth	0.0221*	0.0386*	-0.0322**
	(0.0099)	(0.0178)	(0.0116)
Expected Inflation	0.0056	0.0005	-0.0265***
	(0.0036)	(0.0067)	(0.0047)
Bank-Specific Variables			
5 Year Default Probability	0.0005	0.0039*	-0.0015
	(0.0004)	(0.0016)	(0.0009)
Non-Performing Loan Ratio	0.0019	-0.0015	0.0023
	(0.0013)	(0.0027)	(0.0016)
Capital Adequacy Ratio	0.0030*	0.0038	-0.0028*
	(0.0012)	(0.0023)	(0.0013)
Efficiency Ratio	-0.0000	-0.0001	0.0000
	(0.0000)	(0.0001)	(0.0000)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: First-differences
Number of observations = 3231
Number of groups = 624
Number of instruments = 216, Collapsed Instruments
Hansen test of overid. restrictions: chi2(171) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Appendix AH

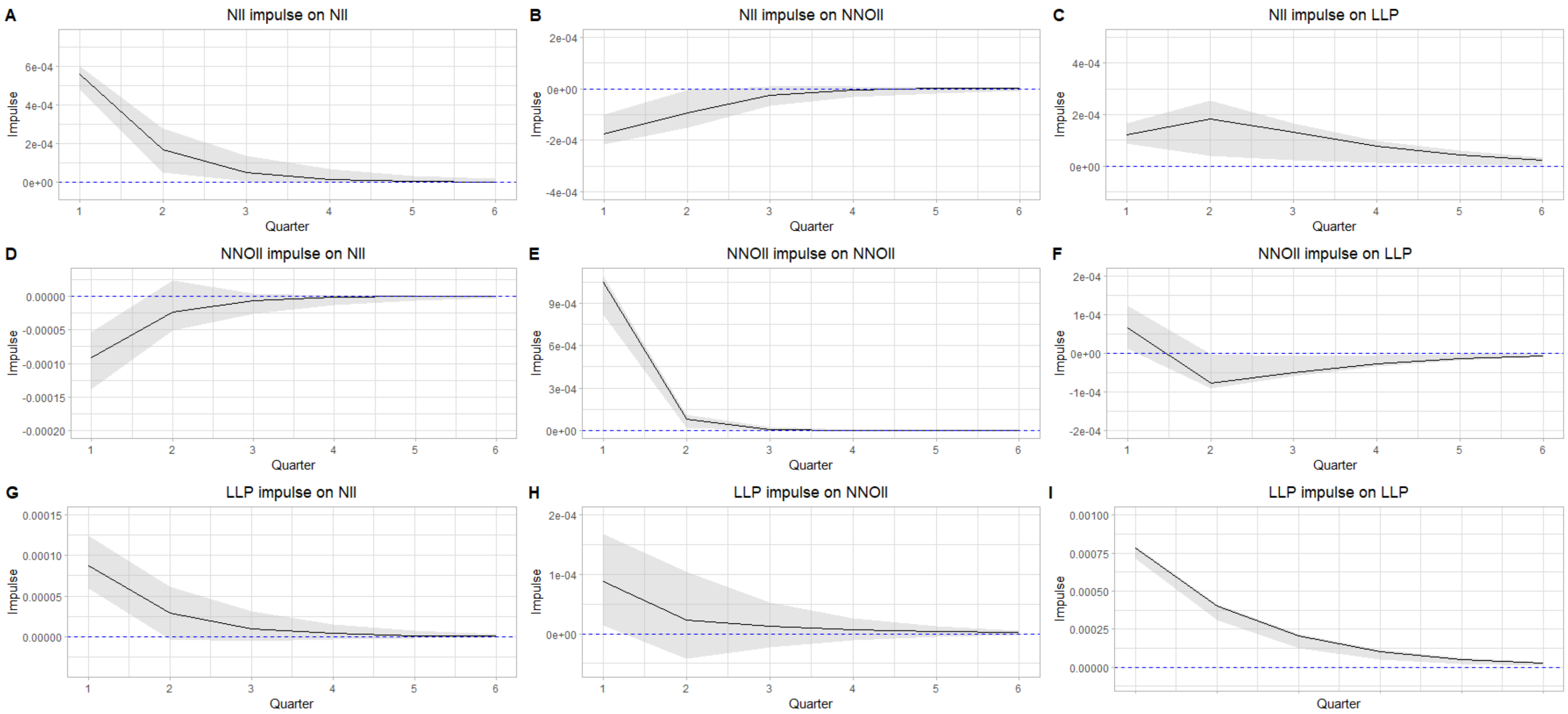


Figure AH.1: Banks Net Profitability Components - PVAR's extended model – Generalized Impulse Response Functions.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

Appendix AI

Table AI.1: Banks Decomposed Profitability Components - PVAR's extended model.

	(1)	(2)	(3)	(4)	(5)
Period			**Q1 2009 - Q2 2014**		
Endogenous Variables	**II**	**IE**	**NOII**	**NOIE**	**LLP**
II Lag (t-1)	0.3219***	-0.0714***	0.0599	0.2803**	0.1247
	(0.0966)	(0.0157)	(0.0716)	(0.0933)	(0.0655)
IE Lag (t-1)	0.5653***	0.9640***	-0.0935	-0.4601***	0.2076**
	(0.0890)	(0.0204)	(0.0966)	(0.1138)	(0.0754)
NOII Lag (t-1)	0.0397	0.0041	0.0523	0.0293	-0.0899**
	(0.0336)	(0.0092)	(0.0428)	(0.0351)	(0.0279)
NOIE Lag (t-1)	0.0177	-0.0147	-0.0122	0.0791*	-0.0104
	(0.0273)	(0.0082)	(0.0328)	(0.0374)	(0.0277)
LLP Lag (t-1)	0.0313	-0.0075	-0.0013	-0.0070	0.4182***
	(0.0314)	(0.0091)	(0.0449)	(0.0455)	(0.0444)
Monetary Policy Variables					
Short-term Interest Rate	-0.0245	0.0233*	0.0651	0.0712	-0.0390
	(0.0388)	(0.0112)	(0.0541)	(0.0583)	(0.0483)
UMP Deviation	0.0120***	0.0009	0.0161***	0.0209***	0.0077**
	(0.0030)	(0.0010)	(0.0040)	(0.0040)	(0.0029)
Sovereign Yield Slope	0.0106**	0.0025**	-0.0075	0.0116*	-0.0093**
	(0.0037)	(0.0009)	(0.0043)	(0.0047)	(0.0032)
Market & Macroeconomic Variables					
VIX	0.0006**	0.0003***	0.0002	-0.0000	0.0008***
	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0002)
GDP Growth	0.0022***	0.0006***	0.0006	0.0006	0.0021***
	(0.0005)	(0.0002)	(0.0006)	(0.0006)	(0.0005)
Inflation	0.0041**	0.0013*	0.0025	0.0102***	-0.0013
	(0.0014)	(0.0005)	(0.0022)	(0.0021)	(0.0013)
Expected GDP Growth	0.0162	0.0031	0.0049	-0.0406*	0.0162
	(0.0127)	(0.0040)	(0.0159)	(0.0175)	(0.0129)
Expected Inflation	0.0017	-0.0027	-0.0151	-0.0303***	-0.0129**
	(0.0049)	(0.0016)	(0.0077)	(0.0067)	(0.0044)
Bank-Specific Variables					
5 Year Default Probability	0.0009	0.0007**	0.0008	-0.0021**	-0.0013
	(0.0006)	(0.0003)	(0.0011)	(0.0007)	(0.0009)
Non-Performing Loan Ratio	0.0012	-0.0005	0.0007	-0.0003	0.0021
	(0.0016)	(0.0004)	(0.0022)	(0.0020)	(0.0015)
Capital Adequacy Ratio	0.0049**	0.0008	0.0012	-0.0026	-0.0024
	(0.0018)	(0.0005)	(0.0016)	(0.0023)	(0.0012)
Efficiency Ratio	-0.0000	0.0000	-0.0001	0.0001	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0000)

*** p < 0.001; ** p < 0.01; * p < 0.05
Standard errors in parantheses

Dynamic Panel VAR estimation, one-step GMM
Transformation: First-differences
Number of observations = 3229
Number of groups = 624
Number of instruments = 560, Collapsed Instruments
Hansen test of overid. restrictions: chi2(475) = 0 Prob > chi2 = 1

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments.

Appendix AJ

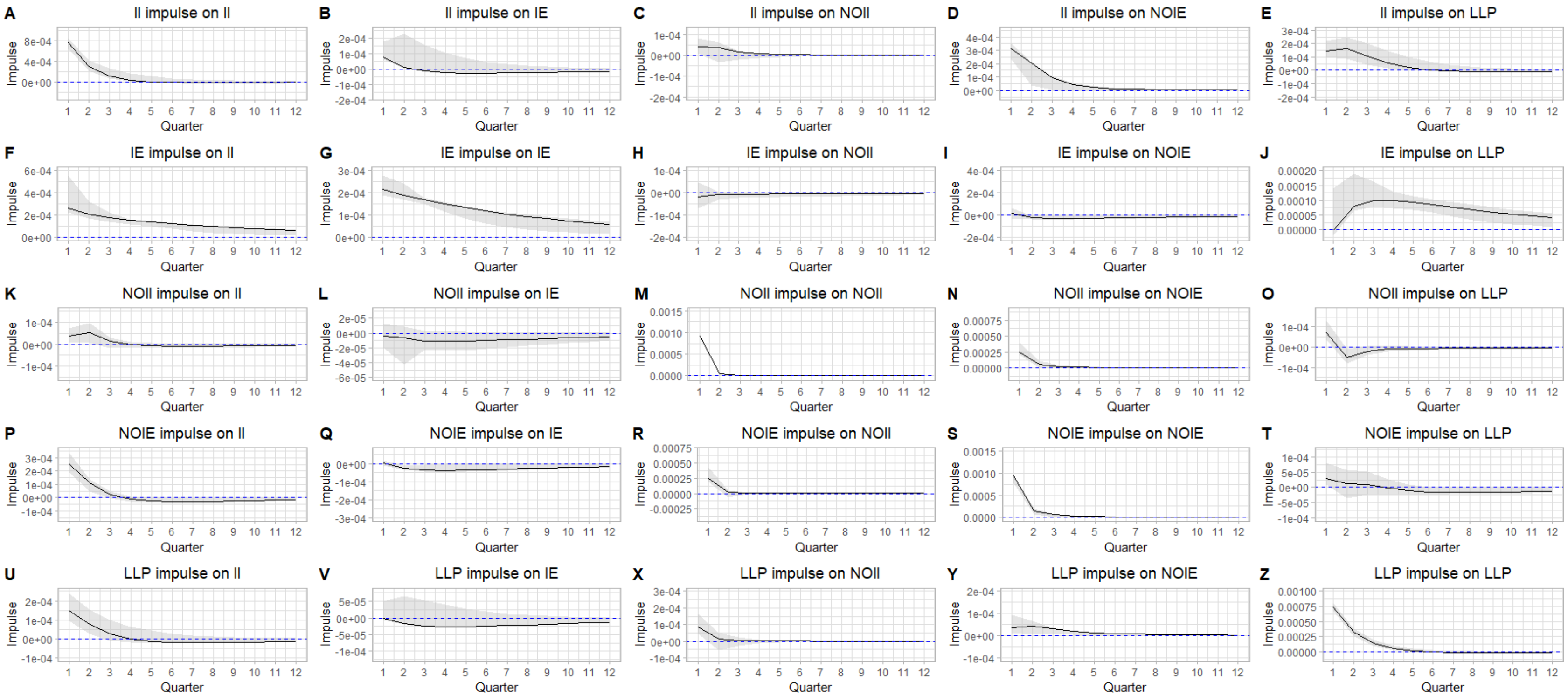


Figure AJ.1: Banks Decomposed Profitability Components - PVAR's extended model – Generalized Impulse Response Functions.

Notes: PVARGMM parameterization: first difference transformation, first difference moment conditions, single lag for endogenous variables, one-step GMM estimator, maximum number of instruments imposed (20) and collapsed instruments. 95% Confidence Bands.

5. Conclusion

The thesis studied the impact of unconventional monetary policy on bank profitability. In this section, we focus on the core and overall inferences of this study.

Regarding the European Central Bank's scope, our study found that the Unconventional Monetary Policy measures implemented by the ECB affected the banks' profitability components. Specifically, we found that non-standard measures reinforced the fall of Net Interest Income, but also led to an increase of the Net Non-Interest Income components and a decrease of Loan Loss Provisions. The effect of unconventional monetary policies in Net Non-Interest Income and Loan Loss Provisions may have mitigated the decrease in Net Interest Income in such a way that we do not find evidence that non-standard measures damaged or benefit the overall Return on Assets from ECB's banks. This last result allows admitting the possibility of reinforcing or extending the unconventional measures adopted so far by the ECB, should it be necessary to combat macroeconomic degradation.

For the U.S. Federal Reserve's scope, adopting a quantile regression method, we found that the Unconventional Monetary Policy employed did not impact most bank profitability components similarly across the U.S. banks. Specifically, we found that the banks with lower Net Non-Interest Income increase more this profitability component with the implementation of the unconventional monetary policy, and we also find that the implementation of unconventional monetary policies benefit most banks with higher Loan Loss Provisions compared to banks with a lower volume of provisions. Finally, this study also suggests that banks with lower returns were most beneficially impacted with the UMP implemented by the U.S. Fed.

Still on the U.S. Federal Reserve's scope, this time applying a PVAR methodology, our results suggest that during the Unconventional Monetary Policy period, banks may have strategically decreased Interest Expenses and increase Non-Interest Income. This change in profitability components occurred possibly in anticipation to the fall of Interest Income, in order to mitigate the drop of overall income. Nevertheless, the components of the Loan Loss Provisions are responsible for the largest portion of the compensation of the losses referring to the interest components.

The possibilities for future research look promising. The use of shadow rates or the UMP deviation – the proxy created in this thesis – can be applied not only to investigate the impacts of unconventional monetary policy on bank profitability, but also in other topics related to the banking system. Still, within the theme of the impact of unconventional monetary policies on the profitability components of banks, it would be interesting to further segregate the profitability components for a deeper comprehension of the effects of unconventional monetary policies. Finally, applying the PVAR with GMM methodology, one may consider the UMP deviation as an endogenous variable, in order to understand the shock of this variable on the bank's profitability components.

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