UNIMORE CEFIN
UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA
Centro Studi Banca e Finanza

ISSN 2282-8168

CEFIN Working Papers
No 79

The effect of the Fed zero-lower bound announcement on bank profitability and diversification

Andrea Landi, Alex Sclip and Valeria Venturelli

October 2019

CEFIN – Centro Studi di Banca e Finanza www.cefin.unimore.it
Dipartimento di Economia Marco Biagi – Università di Modena e Reggio Emilia
Viale Jacopo Berengario 51, 41121 MODENA (Italy)
tel. 39-059.2056711 (Centralino) fax 39-059 205 6927

The effect of the Fed zero-lower bound announcement on bank profitability and diversification

Andrea Landi *Alex Sclip †Valeria Venturelli ‡

October 21, 2019

Abstract

In this paper we investigate the impact of the Federal Reserve's decision to maintain the zero-lower bound for at least two years on bank profitability and strategies. Using a difference in difference setting we find that banks with lower reliance on deposit funding are more sensitive to the policy event. Reduced net worth of low deposit banks, relative to high deposit banks, induces those banks to change their strategies toward an increase in fee income related products to maintain the targeted level of performance. Such an increase is mainly explained by fiduciary and insurance related revenues that entail a lower risk for financial stability.

Keywords: Profitability, diversification, zero-lower bound, unconventional monetary policy, banking

JEL classification: E43, E44, E52, G21

*"Marco Biagi" Department of Economics, University of Modena and Reggio Emilia. CEFIN - Centro Studi Banca e Finanza at the University of Modena and Reggio Emilia. Email: andrea.landi@unimore.it

†Deparment of Economics and Statistics, University of Udine. CEFIN - Centro Studi Banca e Finanza at the University of Modena and Reggio Emilia. Email: alex.sclip@uniud.it

‡"Marco Biagi" Department of Economics, University of Modena and Reggio Emilia. CEFIN - Centro Studi Banca e Finanza at the University of Modena and Reggio Emilia. Email: valeria.venturelli@unimore.it

1 Introduction

In response to the financial crisis, the Federal Reserve (Fed) took decision to lower short-term interest rates to zero and engaged in Large Scale Asset Purchase programmes (LSAP) of larger proportions[1]. Lower interest rates enhance banks' balance sheet and performance through lowering funding costs, capital gains on fixed-income securities and reductions on non-performing assets. However, a prolonged period of lower interest rates accompanied by a flattening of the yield curve reduces revenues from loans and fixed-income securities, compressing net interest margins of banks engaged in maturity transformation. This negative effect on the interest revenues may be partially offset through credit portfolio reallocation toward riskier loans, increase in lending volumes or an increase in noninterest income activities. Shift toward noninterest income activities would not be beneficial for the stability of the financial system if this result in an increase in risky activities such as trading, securitization and investment banking services. In this paper, we show that the Fed decision to maintain lower interest rates created a shock to bank performance, which resulted in a significant shift in banks' strategies from interest income activities to noninterest income sources of revenues[2].

The academic literature placed a lot of emphasis on understanding the impact of the zero-lower bound and the unconventional monetary actions on money market funds Di Maggio and Kacperczyk (2017), asset prices, interest rates and other macroeconomic variables (Bowman et al. (2015); D'Amico et al. (2012);Gagnon et al. (2011); Ihrigh et al. (2018); Krishnamurthy and Vissing-Jorgensen (2011); Swanson and Williams (2014); Wright (2012)). Emphasis has also been devoted on analysing the effect of lower interest rates and unconventional monetary policy on lending supply and risk-taking activities of US (Chakraborty et al. (2019); Rodnyansky and Darmouni (2017); Dell'Ariccia et al. (2017); Kandrac and Schlusche (2016); Kurtzman et al. (2018); Maddaloni and Peydró (2011)) and EU financial institutions (Heider et al. (2019); Acharya et al. (2019); among others). The effect of lower interest rates and unconventional monetary policy on banks' performance and strategies is analyzed in Montecino and Epstein (2014) and Mamatzakis and Bermpei (2016) with mixed results. Specifically, Montecino and Epstein (2014) focus their attention on the effect of the first Quantitative Easing (QE1) on bank performance, finding a positive association mainly explained by capital gains on mortgage-backed securities. While, Mamatzakis and Bermpei (2016) find that unconventional monetary policy exerts a negative effect on bank performance over the 2007Q2-2013Q2 period.

In this paper we analyse the effect of a particular measure of unconventional monetary policy - i.e. the Zero-Lower Bound (ZLB) forward guidance announcement - on banks

[1]LSAP were also called quantitative easing programmes.

[2]Rodnyansky and Darmouni (2017) discusses the lower impact of Quantitative Easing 2 on lending.

performance and strategies. The aim of the ZLB is to achieve beneficial outcomes for the real economy coming from a greater supply and demand for loans due to the decreased cost of funding for banks and borrowers. Nevertheless, maintaining interest rates to zero for a prolonged period deserves concerns about the effectiveness of this policy event on financial intermediaries performance and on the economy as a whole.

We start our analysis showing the different correlation between interest rate levels and bank performance. Specifically, using a longer panel of commercial and saving banks over the period 2004-2017, we find that net interest margins – i.e. the net interest income that arises from the difference between the long term lending rate and the short term deposit rate – are positively associated with interest rate levels and the slope of the yield curve. Noninterest income components show an opposite sensitivity, suggesting that banks shift their strategies toward fee related products when interest rates are lower, in an attempt to preserve their overall performance levels. This result give us a preliminary idea on how banks change their strategy in response to the level of interest rates.

In the core part of the paper, we analyse the impact of the Fed communication on the duration of the zero lower bound (ZLB) on banks' overall performance and strategies toward noninterest income activities. On August 2011, the Federal Reserve changed the communication strategy and gave an explicit information to the financial market regarding how long interest rates would remain at the zero level. Given this specific information, it is plausible to hypothesize that banks adjusted their strategy in an attempt to preserve their targeted profitability.

Starting from recent works that analyse the exposure of banks to interest rate risk fluctuations, with a specific emphasis on the role of deposits (Di Tella and Kurlat (2017); Drechsler et al. (2018)) and interest rate derivatives (Rampini et al. (2019); Hoffmann et al. (2018)) we develop our key hypothesis and empirical strategy. Specifically, following Drechsler et al. (2018) we conjecture that banks with higher deposit funding are better able to offset the negative effects of lower interest rates for longer periods, while banks with lower deposit funding have net interest margins less insulated from monetary policy actions and shift their strategies from interest income toward noninterest income sources of revenues in order to to preserve their targeted profitability. Based on this central hypothesis, we employ a difference-in-difference (DiD) strategy and quantify the effect of the ZLB announcement by comparing banks that have lower deposit shares (treatment group) with banks that deeply rely on deposit funding sources (control group). Based on this logic, we compare the performance behaviour of banks with low and high deposit ratios before and after the Fed announcement on the duration of the ZLB in 2011Q3[3].

[3]LSAP announcements contain an implicit prevision on the duration of interest rates. When central banks engage in asset purchase programs financial markets expect that interest rates will be kept low for a longer period of time ("signalling channel" - Krishnamurthy and Vissing-Jorgensen (2011)). Differently

A common problem of identifying the impact of monetary policy on bank performance is the endogeneity of monetary policy. The Fed sets interest rates and engages in LSAP because of concerns related to deteriorating economic conditions. At the same time, it is plausible that bank performance diminishes when economic conditions deteriorate Altavilla et al. (2017). In this case the estimated impact of ZLB and LSAP is biased because the deteriorating economy drives both. Comparing the behavior of high deposit and low deposit banks can address the endogeneity issue. If both types of banks face a similar performance pattern before the announcement of the ZLB (parallel trend assumption) the endogeneity problem is removed out when considering only the difference in performance between high deposit and low deposit banks around the policy event. A similar identification framework is used in Heider et al. (2019) to assess the impact of negative interest rates on bank lending and risk-taking.

Within our setting, we find a pressure on interest margins of treated banks after the policy event. This pressure is compensated through a significant increase in noninterest income activities. Since these activities comprise a wide range of line of businesses, we divide those lines based on their riskiness and we compare their difference across the policy event for low deposit and high deposit banks. We find that the shift toward noninterest income is mostly explained by fiduciary and insurance activities which entail a lower risk. Securitization and investment banking increased as well, however the difference is not significant across the two groups of banks. In a dedicated section, we also document the specific effect on bank stability and we noticed that the policy event had a smaller effect on banks' riskiness.

Another problem of our empirical strategy relates to the identification of the policy event. In our paper, we investigate the extent to which forward guidance has affected bank profitability due to its impact on the level and volatility of interest rates expectations. However, before the ZLB announcement there were several policy events that might have affected bank profitability and strategies. Therefore, as a falsification test, we analyse the impact of the second quantitative (QE2) on bank performance and we noticed that there were no significant changes across the two groups of banks. We also consider an alternative test through the use of forward and lagged variables to make sure that anticipation effects were not at work. A further potential bias of our DiD framework relates to the definition of high deposits and low deposits banks. The level identified might be endogenous as banks might have already changed their business models in anticipation of future evolution of monetary policy. To overcome this concern, we define two alternative indicators using a lower level of deposits before the policy event and a continuous treatment indicator.

from previous announcements, the Federal Open Market Committee (FOMC) announcement of August 23, 2011 explicitly mention the duration in terms of years of the zero-lower bound.

Finally, we also address the potential concern that our results could be driven by small banks which represent a consistent number of institutions in our sample. To this end, we remove small banks from our sample and we repeat the estimations. Our results remain similar.

This study contributes to the existing literature in several ways. First, we provide a clear evidence on the different sensitivity of performance components on short-term interest rate levels and the slope of the yield curve. Second, and most importantly, we contribute to the literature on unconventional monetary policy and bank performance showing that banks adjust their strategies to maintain the targeted performance levels. On our opinion, this is important to understand the implications of unconventional monetary policy measures on bank performance.

The rest of the paper is organized as follows. The next section discusses the related literature. Section 3 outlines the identification strategy and our data and sample characteristics. Section 4 presents the empirical results as well as the robustness tests. Section 5 concludes the paper.

2 Related Literature

According to the modern theory of banking, the two primary functions of banks – issuing short-term deposits and providing long-term loans – expose them to liquidity risk (Diamond and Dybvig (1983); Gorton and Winton (2017); Diamond and Rajan (2001); among others) and interest rate risk (Di Tella and Kurlat (2017); Drechsler et al. (2018)). A decrease in nominal interest rates creates large financial gains for banks, which typically have long-term assets and short-term liabilities. To this end, maturity transformation expose banks to interest rate fluctuations, amplifying and propagating monetary policy shocks. Recent papers (Di Tella and Kurlat (2017); Drechsler et al. (2018)) highlight the specialness of deposits as they make banks less exposed to interest rate movements and makes them more prone to maturity mismatch.

Other papers analyse the interest rate risk exposure of banks with mixed results. Using stock market data, Flannery (1981) finds that bank profits have a lower exposure to interest rates changes. While recent evidence documented English et al. (2018) that bank equity value decreases following unanticipated increases in the level and slope of the yield curve, and the effect is larger for banks with larger maturity mismatched balance sheets. In line with English et al. (2018) also Begenau et al. (2019) finds that banks are heavily exposed to interest rates risk and credit risk. Contrary to these studies and in line with Drechsler et al. (2018) and Di Tella and Kurlat (2017), Rampini et al. (2019) and Hoffmann et al. (2018) find that banks use interest rate derivatives to amplify exposure to

interest rate risk. To this end, the two studies highlight also that only a limited portion of the banking sector use interest rate derivatives for hedging interest rate risk.

Central to our study are also works on the impact of quantitative easing on asset prices and financial institutions behaviour toward risk-taking activities. Empirical studies have demonstrated that Federal Reserve's large-scale asset purchases in conjunction with zero interest rates lowered long-term interest rates of Treasuries, Agency bonds and Agency Mortgage Backed Securities. These effects resulted from reduced term premiums and from lowering the expectations of future short-term interest rates (Bowman et al. (2015); D'Amico et al. (2012); Gagnon et al. (2011); Ihrigh et al. (2018); Krishnamurthy and Vissing-Jorgensen (2011); Swanson and Williams (2014); Wright (2012). Krishnamurthy and Vissing-Jorgensen (2011) clearly explain the different mechanisms at work between QE1 and QE2 and their related effect on long-term interest rates of different assets. More specifically, according to the authors, QE1 MBS purchases works primarily through the reduction of risk premia that drive down corporate credit risk; while the main effect of QE2 treasuries purchases is achieved through the signalling channel. Furthermore, Fed communication that interest rates would remain low for a considerable period of time likely amplified these effects. As interest rates remain low for considerable longer periods, concerns for financial stability would arise. For example, as demonstrated in several empirical studies, banks' lax lending standards and increase risk taking in their lending portfolios (Chakraborty et al. (2019); Rodnyansky and Darmouni (2017); Dell'Ariccia et al. (2017); Kandrac and Schlusche (2016); Kurtzman et al. (2018); Maddaloni and Peydró (2011); Heider et al. (2019); among others). The increasing risk-taking attitude is a result of concerns of lower future profitability, due to the prolonged lower interest rate environment. The increasing attitude toward risk is experienced also outside the banking sector. To this end Chodorow-Reich (2014), Di Maggio and Kacperczyk (2017) document heightened risk-taking for different non-bank financial institutions since the decision of the Fed to set and maintain its policy rate to the zero-lower bound.

While specifically analysing the effect of QE on banks' performance, Mamatzakis and Bermpei (2016) highlight that over a long-time horizon unconventional monetary policy has a negative effect on bank performance. However, this negative association is mitigated for banks with higher deposit funding and asset diversification. On the contrary, using a difference-in-difference approach, Montecino and Epstein (2014) proved that MBS purchase under the first quantitative easing (QE1) had a positive and significant effect on bank profitability, and the effect was prominent for banks with a large proportion of MBS and large asset size. The positive effect was mainly driven by capital gains on assets targeted by the Fed purchases and in part through the reduction of risk premia of banks' market based sources of funding. Using a large cross-country sample over a longer period

of time, Claessens et al. (2018) shows that when interest rates remain low for longer periods of time bank margins are eroded, and this decrease is mainly related to the rigidity of interest expense margins of deposit accounts.

Apart from the effect on net interest margins, expansionary monetary policies could also affect the overall performance through non-interest income sources of revenues. It is well recognized that banks derive part of their profits from cross-selling activities to their depositors, as for example through fiduciary or insurance products. Lower interest rates had positive market valuation effects that prompted investors to shift their saving patterns and banks to reallocate their portfolio toward riskier assets (i.e. bonds and equities instead of cash and Mortgage-Backed-Securities). This in turn raises the demand of trading assets and their prices would result in portfolio gains of banking institutions. A similar positive benefit would happen if banks increase their cross-selling activities, shifting customers from deposits to fiduciary and insurance activities which would benefit from the low interest rate environment. Through this shift banks would maintain the overall performance target even in a low interest rate environment. However, lower interest rates and LSAPs might indicate a decrease in economic activity leading to a deterioration of asset prices and portfolio gains Bauer and Rudebusch (2013); therefore, the relationship is not easily predictable. The vast empirical banking literature on the effects of bank revenue diversification on profitability and stability provides mixed results. According to De Jonghe et al. (2015) revenue diversification entail a bright side arising from the scope of risk reduction within financial institution and the financial system, and a dark side arising from the complexity of combining various financial services. According to the authors the strength of the bright side depends on asset size. Other studies, documented a positive effect of income diversification on banks' profitability and stability through different points of view (Baele et al. (2007); Busch and Kick (2009); Saghi-Zedek (2016); Abedifar et al. (2018); among others). While other interesting studies provide a different view on bank diversification, suggesting that is not beneficial for bank performance and stability (Stiroh (2004); Stiroh and Rumble (2006); Demirgüç-Kunt and Huizinga (2010); De Jonghe (2010); Brunnermeier et al. (2012); among others). Interestingly, most of these studies do not look at the impact of interest rates on bank diversification and stability.

Our paper connects works on the impact of interest rate exposure on banks' profitability and stability and the large literature on bank diversification strategies to create the following picture. In line with Drechsler et al. (2018) our key hypothesis is that banks with higher deposit funding are better able to manage monetary policy shocks, offsetting the negative effects of lower interest rates for longer periods. Under this framework deposits are considered as stable long-term sources of funding and this improves banks' ability to hold long-term assets and reduces the necessity of banks of pursuing risky noninterest

income activities to preserve their targeted profitability. Instead banks with lower deposit funding – lower maturity mismatch – have net interest margins less insulated from monetary policy actions and increase more non-interest income activities to preserve performance targeted after a monetary policy shock. Noninterest income lines of business are characterized by different levels of risk (DeYoung and Torna (2013)), therefore we separately analyze the different sources of noninterest income.

3 Identification strategy and data

3.1 Zero interest rates and bank performance identification

Our main focus is on the effect of the zero lower bound policy on banks' profitability and risk. Since fed funds rates remained at levels close to zero for a prolonged period of time, any identification due to interest rates changes would be difficult. To this end, we explore the importance of the forward guidance from the Fed regarding the duration of the zero-rate policy. In this paper, the duration of the zero lower bound is crucial as it directly determines how long banks' interest related business is subject to profit pressure. In particular, one could imagine that a short-lasting period of zero interest rates would be beneficial as banks could clean up their portfolios and further push lending activities without pressures on future profit margins. The situation in turn, would differ if zero rate policy is maintained for a longer period of time, as the policy action could progressively erode profit margins from interest rate activities.

In U.S. the zero lower bound period began on December 16, 2008, when the Federal Open Market Committee (FOMC) set federal funds rate to zero and the first round of quantitative easing began (QE1). By far the Fed extensively used forward guidance communication by the FOMC about the future path of the federal funds rate and large scale asset purchases of long-term U.S. Treasury bonds and mortgage-backed securities (QE1, QE2 and QE3). The goal of both types of policy interventions was to stimulate the economy through the reduction of longer-term U.S. interest rates. In Table 1 we report the most notable announcements of forward guidance and QE interventions during the 2008-2014 period. As one can see from Table 1 during our period of analysis there have been a long list of policy related events that might have affected financial intermediaries and the financial market.

In our analysis, we focus on the announcement of August 9, 2011. This event was notably relevant as for the first time the FOMC gave explicit (rather than implicit) forward guidance about the likely path of federal funds rate over the next quarters. In that announcement the FOMC stated that it expected to maintain the federal funds rate to zero for almost two years in the future - "at least through mid-2013". On our opinion, a

clear indication on the duration of the ZLB has implications on interest expenses, because it provides a precise information to the financial market on how long interest rates would be set to zero. In this environment interest expenses on deposits are not affected, on the contrary interest expenses on wholesale funding sources are subject to this policy event. We targeted the announcement of August 9, 2011 for other three main reasons. First, according to Swanson (2017) the announcement was surprising for the financial market and was not contaminated by QE components. The fact that is not anticipated by the financial market alleviates potential concerns related to a possible anticipation of financial intermediaries of the policy announcement. We target this announcement for other two main reasons. Second, during the fall of 2008 to the spring of 2009 there was considerable turmoil in financial markets which makes inference difficult, because we cannot be sure that the identified event are important events. The third reason is connected with the differences in asset targeting between QE1 and QE2 programmes that interacted with forward guidance announcements. During the QE1 interventions the Fed purchases MBS, treasury and agency securities with the aim of reducing corporate credit risk (Krishnamurthy and Vissing-Jorgensen (2011)) and encourage banks to clean their lending portfolios; while QE2 works through the signaling channel: the purchase of long-term securities signals to the market an intention of maintaining interest rates lower until the economy recovers. Thus the forwarded announcements of August 2011 and January 2012 provide to financial institutions a clear indication on the duration of the zero lower bound. Moreover, as noted in Rodnyansky and Darmouni (2017), given the different asset targeted (Treasuries instead of Mortgage Backed Securities) QE2 had a lower impact on lending; increasing bank incentives to shift their attention on noninterest income components of revenues.

Differently from us, Montecino and Epstein (2014) specifically focuses on the impact of the zero-lower bound announcement in 2009 showing a positive effect on bank performance mainly explained through realized gains on MBS. In our case, we focus on a period in which fed funds rates were set to zero two years before without particular financial market turmoils.

[Please add Table 1 about here]

3.2 Data

We collected quarterly financial data for each bank from the Federal Financial Institutions Examination Council (FFIEC) call reports and the Uniform Bank Performance Reports (UBPR) over a longer time horizon from 2004Q1 to 2017Q4. We started from the 2004,

because on the FFIEC site the information on UBPR ratios starts from 2002Q4, however we noticed some errors during the year 2003 thus we decided to delete it. We use UBPR ratios to control our calculations made to construct banks' balance sheets variables used in this study. Data from the call reports and the UBPR ratios is on quarterly basis. In the 2017Q4 there were 5721 active commercial banks. For each bank the call reports and the UBPR ratios provides a unique regulatory identifier that allows us to take in consideration changes in the morphology of the banking system along the time. In case of Merger and Acquisition operations the acquiring bank's code is maintained and the target drops from the sample, while in case of failure without any acquiring operation the code is drop from the list. Since, our aim is to determine the effects of an external shock, we require banks to exist in both the pre- and post-shock periods. This requirement reduces the number of our dataset to 4722 commercial banks corresponding to 264,488 observations. We drop banks with negative values of total assets and loans and we remove outliers at the 1 and 99% level to reduce their influence [4]. We follow van Ewijk and Arnold (2014), Stiroh and Rumble (2006), Mergaerts and Vennet (2016) and we use bank level data instead of BHC level data. We do that because we consider the bank an appropriate decision-making unit as regard the distribution of different non-interest income generating activities. Table A.1 in the appendix provides the full list of variables used in our analysis together with their definition and sources, while Table 2 shows the summary statistics for the entire sample period (2014Q1 - 2017Q4). Table 2 Panel A depicts the overall performance (ROA), the net interest income and non-interest activities. Noninterest income activities show higher variation in comparison to the overall performance and the net interest income. We also decompose the noninterest income in three parts: risky fee income, traditional fee income and fiduciary and insurance activities. Risky fee income contains the most volatile and risky noninterest income activities such as trading, securitization and investment banking. Traditional fees contain net servicing fees and service charges on deposit accounts, while fiduciary and insurance activities comprise income related to fees and commissions from sales of insurance products and fiduciary services. The cross-sectional variation in noninterest income across banks is large under all periods: for some institutions the component is close either to zero or close to the mean values. Panel B shows the main statistics of interest rates, while panel C and D plot the main statistics of bank specific and macroeconomic controls.

[Please add Table 2 about here]

[4] Rodnyansky and Darmouni (2017) uses a similar strategy to analyze the effect of QE on bank lending. Specifically, the authors remove banks with lending growth higher and lower than 10% from previous quarters in order to eliminate M&A effects. In our case banks with total lending and asset growth higher than 10% correspond to the 1% and 99% percentile of observations

In Table 3 we show the summary statistics for the control and the treatment group prior and after the Fed ZLB announcement identified. As one can see banks exhibit similar characteristics in terms of size, capitalization and lending composition.

[Please add Table 3 about here]

4 Empirical Results

In this section, we present our empirical results. First, we show the importance of interest rates in explaining bank performance. Next, we look at the effects of the zero-lower bound monetary policy announcements on banks' profitability. Finally, we provide a series of robustness tests that further confirm our results.

4.1 Preliminary evidence on the sensitivity of performance on interest rates changes

We first look at the effects of changes in interest rates on banks' profitability. To do so, we regress a bank's performance in each quarter on the level of short term interest rates, the curve spread, bank specific characteristics and other macroeconomic controls. Specifically, we use the following empirical specification:

$$y_{i,t} = \alpha_i + \beta_1 3MonthRate_{i,t} + \beta_2 CurveSpread_{i,t} + \beta_3 X_{i,t-1} + \beta_4 Macro_{i,t} + \epsilon_{i,t} \qquad (1)$$

Here $y_{i,t}$ is the ROA and its main components: Net interest income over total assets and non-interest income over total assets, i indexes banks, t indexes calendar quarters. α_i are bank fixed effects. 3Month Rate is the quarterly average 3-month government bond yield, Curve Spread is the quarterly average spread between the 10-year government bond yield and 3-month government bond yield. Macro controls for the percentage of GDP growth and the level of inflation. $X_{i,t-1}$ is a vector of four bank-specific covariates, specifically: the natural logarithm of total assets, deposits over total liabilities, total equity capital over total assets and US Treasuries and agency securities over total assets. Size (the natural logarithm of total assets) accounts for a series of heterogeneity across banks: market power and economies of scales. We expect a negative sign for this variables, as some recent studies suggest the presence of diseconomies of scales for larger credit institutions (Chronopoulos et al. (2015)). The second bank-specific variable is the ratio of total equity capital to total assets as a proxy for bank capitalization. Berger (1995) finds a positive relationship between capital and profitability that can be explained by

two hypotheses: bankruptcy cost hypothesis and signalling hypothesis [5]. Moreover a capital endowment effect originates when the interest rate fall mechanically squeezes the return on asset covered by capital (Borio et al. 2015). Empirical works (Demirgüç-Kunt and Huizinga (2010); Gropp and Heider (2010); Berger and Bouwman (2013)) confirms the findings of Berger (1995) arguing that capital improves bank profitability . We also consider liquidity and the amount of deposits to explain banks' performance. We use the ratio of Treasury and Agency securities over total assets as a measure of liquidity, and we hypothesize that liquid banks are those less engaged in lending and have in general lower interest margins (Claessens et al. (2018)), even compressed during the effects of Large scale asset purchase programmes on yields of treasuries and MBS (Krishnamurthy and Vissing-Jorgensen (2011);Gagnon et al. (2011);Ihrigh et al. (2018)). Finally, we control for deposits over total assets. Banks with higher deposits do not hedge interest rate risk or lack to attract other funding sources with higher sensitivities on interest rate changes.

Table 4 reports the results of the estimation of equation 1. To choose the appropriate estimation method, we perform the Hausman specification test. The results of the test confirm the presence of unobserved heterogeneity, as correlation exist between the fixed, bank-specific effects and the independent variables. The modified Wald test indicate the presence of heteroscedasticy. Therefore, we estimate equation 1 using the FE model with the Huber-White sandwich estimator to obtain robust standard errors for cross-sectional heterscedasticity and within panel correlation. The choice of the estimation model is further reinforced by previous works of Claessens et al. (2018) and Altavilla et al. (2017). It is reasonable to assume that there are some fixed effects specific to each individual banks that impacts on bank's profitability. As an example, risk-aversion of an individual bank could remain fairly constant over time and affects the overall bank's performance. We know that some bank specific determinants of profitability are potentially endogenous, due to both omitted variables bias or from a loop of causality between independent and dependent variables. To solve this issue, we also apply an IV regression estimation treating bank specific-variables as endogenous and using the lags of those variables as instruments. However, the assumptions of validity of those instruments were rejected. Thus given the difficulty of finding an appropriate instrument matrix, the longer time-span that we consider and the aim of this preliminary exploration on the effects of monetary policy on bank's profitability we decided to use the FE regression model with one quarter lagged bank-specific variables.

[5]Under the bankruptcy cost hypothesis the optimal bank capital ratio increases in order to reduce the probability of failure and lowering the cost of rising uninsured debt. Banks that pay lower rates on their uninsured debt should obtain higher performances, due to the improvement of the net interest margins. The signalling hypothesis posits that bank signal private information to the market through the increase of capital. Banks that would signal good news to the market increase their capital ratios, as a result banks that expect better future performance maintain higher capital ratios.

Preliminary evidence shows that the overall performance (ROA) is positively related to the level of short-term interest rates. Among the components of the ROA, net interest income are more sensitive to short-term interest rates increases. Non-interest income activities show a different relation with short-term interest rates, suggesting that banks switch their activities from lending to commission based income sources when interest rates are decreasing. At lower rates search for yield is stronger, with banks increasing their fees and commissions related to asset management, lending and deposit services (e.g. credit lines and transaction services) and investment banking (trading and securitization) activities with the aim of reaching the overall targeted performance for maintaining shareholders' value. The positive sign of the steepness of the yield curve in column 2 is expected, given that most banks engage in maturity transformation. This result is consistent with Claessens et al. (2018) and also confirms our hypothesis that Large scale asset purchase programs that reduced the slope of the yield curve (Gagnon et al. (2011);Ihrigh et al. (2018)) had a negative impact on banks' net interest income. The sign of the spread of the yield curve is negative for non-interest income, confirming our hypothesis that in a low interest environment banks switch their strategies towards less noninterest sensitive activities which have a different sensitivity to interest rates. Overall, for our two main variables of interest - short-term interest rates and the steepness of the yield curve - we denote a different sensitivity of net interest-income and non-interest income activities. As suggested in our results, noninterest income activities are negatively associated with interest rates levels, while interest income margins are positively and strongly related to interest rates levels. In terms of bank specific controls, we noticed that a higher exposure on treasuries and agency securities lowers the overall performance; and in particular among its components the level of the net interest income. This is particularly true as yields of those activities were compressed during the asset purchase programmes, and in particular during the QE2, when those securities were targeted by the LSAP. Size has a negative impact of both interest and non-interest income activities, suggesting that diseconomies of scales were present after a certain size. Banks that rely more on deposits have lower non-interest income levels, however the significance is not confirmed in columns (1) and (2). In line with Demirgüç-Kunt and Huizinga (2010), Gropp and Heider (2010) and Berger and Bouwman (2013); among others) better capitalized banks have higher overall performance confirming the bankruptcy and signalling hypotheses. However, the sign and the significance of the coefficient is not further confirmed in columns (2) and (3). Finally, GDP growth and inflation have a positive and significant impact on profitability and both of its components: interest and non-interest income.

[Please add Table 4 about here]

The important takeaway of this paragraph is that noninterest income activities show a different sensitivity to interest rate changes. Therefore it is plausible to speculate that banks change their strategies according to the level of policy interest rates as hypothesized in the introduction section.

4.2 Main results

In order to analyse the impact on banks' profitability of the zero-lower bound forward policy guidance announcement, we employ a DiD setting across groups and time. The DiD approach requires three main assumptions. First, the control group should constitute a valid counterfactual for the treatment. Second, the treatment event has to be exogenous with respect to bank performance. Third before the monetary policy intervention the performance of the treatment group and the control group should move in a similar direction – i.e. parallel trend assumption.

The first assumption requires to create a group of similar banks (control group) that are differently affected by the policy event. Since interest rates were already set to zero it is plausible to hypothesized that banks with an higher reliance on deposit funding were less affected by the policy announcement. As discussed in the literature review section previous works on banks' interest rate risk exposure (Drechsler et al. (2018) and Di Tella and Kurlat (2017); among others) help us to confirm our intuition.

The second assumption requires that the policy action should affect bank performance and not vice versa. The introduction of the ZLB and QE actions aims to encourage banks on supply new loans. Bank performance is not a specific target of the programs but rather a secondary effect. We formally test this assumption with a Granger causality test in a Vector-Auto-Regression framework. To do so, we proceed in this way: (1) we aggregate ROA for each quarter; (2) we determine the optimal lag structure through the Akaike Information Criterion[6]; (3) we apply a bivariate VAR model and we run the Granger Causality test. The idea is the following: if bank performance influences monetary policy decisions, we should find a positive and significant coefficient in the Granger Causality test.

[Please add Table 5 about here]

Results are displayed in Table 5. We show that the spread of the yield curve affects bank performance as proxied through the return on assets, while the effect is not significant for the opposite direction. Suggesting that bank performance is not a variable considered for taking monetary policy actions, but rather as said before is a secondary effect of

[6]The information Criterion suggest that the appropriate number of lags is 2 quarters.

monetary policy actions.

The third assumption of the DiD model relates to the parallel trend assumption. In our setting, the pre-event period starts in Q1 2010 and ends in Q2 2011, while the post event period starts in Q3 2011 and ends in Q3 2012. We hypothesize that interest margins of banks with higher proportion of deposit funding were less sensitive to the Fed ZLB forward guidance announcements. The rationale behind the hypothesis relates to two main reasons: (1) The announcement of the extension of the ZLB for at least 8 quarters had an immediate effect on short-term treasury rates Swanson (2017) which is further transmitted to banks' market based sources of funding [7].(2) An advantage of using deposit ratios to identify the treated group is related to their higher persistency of deposits than alternative funding sources Drechsler et al. (2017) and safe liquid assets holdings[8]. Based on this rationale, we identify banks with lower deposits funding (treated banks) and banks with higher deposit funding (control group). We apply a cut-off of deposit to total assets equal to 75%[9]to distinguish the two groups of banks [10]. In Figure 1 and Figure 2 we plot the two main performance components: interest income and noninterest income across the two groups of banks.

[Please add Figure 1 about here]

[Please add Figure 2 about here]

As one can see, before the event announcement the performance of the both interest income (Figure 1) and noninterest income (Figure 2) across the two groups of banks was relatively stable, while it changes trajectory after the identified Fed announcement. This pattern ensures that our difference-in-difference framework satisfies the parallel trend assumption [11]. The changing trajectory across the two groups is especially relevant for noninterest income sources of revenues, after the announcement treated banks that ex-

[7]Deposits were already constrained to zero interest rates level.

[8]We control the level of deposits both before and after the event across the two groups and we noticed that their levels were quite persistent. In the case we noticed a higher variation of deposit ratios after the policy event there would be a violation to the parallel-trend assumption, which is a key assumption in our identification strategy. Before the event the level of deposits over total assets is 72.81% for the treatment group and 86.24% for the control group, while after the event the ratio is 72.81% for the treatment group and 86.45% for the control group.

[9]75% corresponds to the 25th lower percentile

[10]In a further robustness check we also use a continuous treated variable and a different cut-off.

[11]We further test the parallel trend assumption in the robustness test section. Specifically, we test for the presence of pre-trends in the data using forward variables. In the literature we find also a verbal motivation for the lack of pre-trends in the data: Drechsler et al. (2017) highlight that deposits have zero maturity and hence the impact of monetary policy changes are not incorporated until their actual realization, even if these changes are anticipated.

perienced a larger pressure on interest income moved aggressively to noninterest income sources to maintain their overall performance.

Estimations of the DiD are displayed in Table 6. We first take the broader picture and we employ the difference-in-difference strategy to the overall performance (ROA) indicator, finding that treated banks increased more their performance after the policy event in comparison to control banks. Among the components of the overall performance, we noticed that net interest margins of treated banks benefited less of the policy announcement (Panel B). In the next section we analyse the reason of the lower expansion of net interest margins across treated and control banks: cost of funding or income reduction through the breakdown of the net interest margin components. In panel C we analyse the patterns across the event of the noninterest income revenues and we noticed a larger increase for treated banks, suggesting that those banks aggressively change their strategies from interest income towards fee income generating sources. Noninterest income is driven mainly by capital gains, fees and commissions. The first determinant in particular should benefit from a decline in interest rates, as lower yields are reflected in higher asset prices. However, it is important to note that changes in valuation of securities held by banks are reflected in the profit and loss account only if capital gain/loss are realized. Since the share of securities held at market value is relatively small is not surprising that the estimated coefficient is mainly related to changes in fees and commissions from the broader set of services offered.

[Please add Table 6 about here]

Our analysis needs to account for the fact that treated group of banks have different characteristics than the control group. To tackle this issue, we employ the Abadie-Imbens matching estimator (Abadie and Imbens (2011)) which minimize the distance between a vector of observed covariates across treated and control banks to find the matched control banks[12].The Abadie-Imbens estimator produces exact matches on categorical variables and less exact matches on continuous variables. We create a matching estimator based on time (categorical variable) and continuous bank balance sheet variables: capital, size, real estate loans to total assets, provisioning to total assets and US treasury and agency securities over total assets. Results of the inferences based on the Abadie-Imbens matching estimator are reported Table 6 (Matching Estimator (ATT)) and further confirms our results.

[12]The rationale behind the propensity score matching estimator is the following: if for any treated observation, we can find a non-treated one that is as similar as possible in terms of observable characteristics than the difference in the outcome between the treated and the matched control should be due to the treatment itself. Correlations between treatment status and bank characteristics are shown in table A.2 in the appendix

We also implement OLS linear regressions to examine whether ZLB announcements affects bank performance and its main components. The regression specification takes the following form:

$$Y_{i,t} = \alpha + \beta_1 Treated_i * Post_t + \beta_2 X_{i,t-1} + \phi_t + \epsilon_{i,t} \quad (2)$$

Where $Y_{i,t}$ is the ROA and its main components: net interest income and non-interest income, i indexes banks, t indexes calendar quarters. Treated is a dummy variables that takes value 1 if a bank has deposits over total assets lower than 75% and 0 otherwise; Post is a dummy variable that takes the value 1 after 2011Q3 and 0 before that period. $X_{i,t-1}$ is a vector of control variables that includes: the quarterly average 3-month government bond yield (3Month Rate), the quarterly average spread between the 10-year government bond yield and 3-month government bond yield (Curve Spread); the natural logarithm of total assets (Size), total equity capital over total assets (Equity over assets) and US Treasuries and agency securities over total assets (Treas&Agency securities over assets).

Results of equation (2) are presented in Table 7. The estimates reported in column 1 excludes all control variables and quarter fixed effects, column 2 and 3 report OLS estimates with control variables and fixed effects as specified, column 4 reports FE estimates with fixed effects as specified. Panel A shows the regression results with ROA as dependent variable, Panel B shows the regression results with Net interest income as dependent variable, while Panel C displays the results with Non-interest income as dependent variable. Estimates in column (1) have the same sign and significance to those obtained in Table 6 with the matching estimator confirming our main results. In column (2) and (3) we add control variables and time fixed effects as specified . The magnitude and significance of our main variable of interest (Treat*Post) are similar to those obtained in Table 6. Bank specific covariates are significant and in line with the literature and the estimates obtained in our investigation on the sensitivity of performance and its components on interest rates. Our results remain qualitatively similar, when we use the FE estimator instead of the OLS estimator.

[Please add Table 7 about here]

4.3 Net interest income breakdown

In this section we decompose the net interest income into its main two components: interest income and interest expenses, in order to analyse the different sensitivity of asset income and funding expenses on the unconventional monetary policy action. To do so, we use interest income and interest expenses as dependent variable of equation 2. Results

of the estimation are shown in Panel A and B of Table 8. In panel A we regress interest income and we noticed that the effect is no longer relevant. In particular, when we add control variables and time fixed effect in the OLS regression the significance of the coefficient disappears; suggesting that there were no effects on interest income across the two groups after the ZLB announcement. In panel B, we use interest expenses as dependent variable and we noticed that the reduction on net interest income across the two groups of banks is mainly driven by the higher sensitivity of wholesale funding sources on monetary policy actions. As a matter of fact, treated banks – bank with lower levels of deposits – experienced an increase of funding cost in comparison to control banks that constrained those banks to shift their strategies toward noninterest income to preserve the targeted profitability. The result is somehow expected decision to maintain interest rates to a zero-lower level might cast doubts for investors on bank profitability rising the risk premia of market based funding instruments. For deposits instruments the reaction should be lower because the ZLB was introduced two years before, thus the level of interest rates was already binding. Furthermore, as discussed before, deposits exhibit a lower reaction than market based sources of funding to changes in interest rates expectations. The result is in line with Di Tella and Kurlat (2017) and Drechsler et al. (2018) asserting that interest expenses for banks with higher deposit ratios are less sensitive to monetary policy shocks, this can be explained by the endowment effect and/or market power on deposit markets (Drechsler et al. (2017)).

Finally, in Panel C we employ a triple interaction term to analyse the impact of asset maturity on net interest income. The idea is that banks with longer asset maturity experienced a lower reaction to the policy event and thus are less exposed to the policy event. Although the coefficient of the triple interaction is negative and significant is lower in magnitude in respect to that observed in Table 7 suggesting that treated banks with higher asset maturities are better able to hedge the impact of monetary policy announcement. The rates on those assets are set at origination and locked in until maturity, this makes market interest income less sensitive to short rate changes. This result is in line to those obtained in Drechsler et al. (2017).

[Please add Table 8 about here]

4.4 Effect on different components of Noninterest income

Banks earn noninterest income through a multitude of products with different risk-return characteristics. The breakdown of noninterest income into its main categories is a key ingredient to understand the impact of the shift toward fee generating products on bank

profitability and stability. To this end, we construct three different noninterest income lines of business: fiduciary and insurance activities, traditional fees and risky fee income; and through the same difference in difference framework[13] we analyse the shift toward these different activities after the ZLB announcement.

[Please add Table 9 about here]

Panel A of Table 9, presents difference in differences matching estimators for the first line of business: fiduciary and insurance activities measured in percentage of total assets. Banks involved in this activity offer to their clients asset management products (i.e. investment funds and vehicles) or insurance products against a fee upfront. This type of activity entails a lower level of financial risk for banks, however attractive wealthy clients require reputational capital and skills that do not automatically turn out in profits. Both banks categories (treatment and control) increased their profits related to fiduciary and insurance activities after the ZLB announcement. The larger increase can be related to a shift in demand of investment fund and insurance products. Lower interest rates in conjunction with quantitative easing policies had positive market valuation effects that prompted investors to shift their saving patterns. Investors in search of return gains, switch from risk free assets to mutual fund asset vehicles, thus banks increasingly turned to this line of activities as a way to improve profits in a low-interest rate environment. Our results support this hypothesis with both banks in the treatment and control group increasing their exposure on fiduciary and insurance activities. The shift toward this activity is higher for banks with lower levels of deposits, confirming our assertions that this line of business requires particular skills that are not automatically established for all banks.

In panel B, we analyze the pattern of traditional fees around the event. Traditional fees include charges on deposit accounts, income and fees from automated teller machines, debt and credit card fees. Banks with greater income from traditional fees might have clients that are more financially active, or they can exert market power in the deposit market through the charge of higher fees (Abedifar et al. (2018)). For this line of business, which entails a lower risk and return characteristic we do not find a relevant increase across the two group of banks after the ZLB policy announcement. The matching estimator suggests that control banks earned higher fees on traditional fee income services in comparison of treated banks, probably because of their higher market power in the deposit market. Panel C of Table 9 presents the difference in differences matching estimators for investment bank and securitization activities. The category contains a multitude or risky fee income

[13] We apply the same strategy explained in section 4.2. In this case the outcome variables of the diff-in-diff estimation are the three different lines of fee income.

activities that were responsible for multiple bank defaults during the global financial crisis (DeYoung and Torna (2013)). Specifically, the category includes: trading, securitization and investment banking, advisory and underwriting fees. Although we denote a slightly increase of risky fee income after the event for both categories, we do not find evidence of an increase in the difference of this activities across the two groups of banks. For reasons of space, regression results of the different components of noninterest income are displayed in Table A.3 in the appendix and further confirm results shown in Table 9.

4.5 Effect on bank stability

Our results indicate that after the policy event banks increase their fee income activities. Therefore, a logic follow-up question relates to the impact of the increase in noninterest income on bank stability and risk. We empirically test this effect through the following regression specification:

$$ZScore_{i,t} = \alpha + \beta_1 Treated_1 + \beta_2 Post_t + \beta_3 Treated_i * Post_t + \beta_4 X_{i,t-1} + \phi_t + \epsilon_{i,t} \quad (3)$$

Where: $ZScore_{i,t}$ is (ROA+Equity over Assets) over σROA, Treated is a dummy variables that takes value 1 if a bank has deposits over total assets lower than 75% and 0 otherwise; Post is a dummy variable that takes the value 1 after 2011Q3 and 0 before that period. $X_{i,t-1}$ is a vector of control variables and $\epsilon_{i,t}$ are time fixed effects.

Results of the estimation of equation 3 are shown in Table 10. In column 1 we exclude control variables and time fixed effects, while in columns 2 and 3 we add control variables and time fixed effects as specified. First of all, it is interesting to note the coefficient of Post, which is negative and significant for regressions in column 2 and 3. This indicate that, overall banks increased their risk of default after the ZLB announcement. This, however could be driven by a multitude of effects, such as for example risk-taking activities in the lending portfolio and increased uncertainty in the market for wholesale funding. As we cannot infer to much from this level effect, we are, however, interested in the interaction term that measures whether the ZLB is likely to affect the two groups of banks. The coefficient is positive and significant, but have a smaller magnitude. A positive sign indicates that the treatment group reduced their default probability after the ZLB announcement. Given the smaller magnitude of the coefficient we cannot affirm that diversification into noninterest income is beneficial for bank stability.

[Please add Table 10 about here]

4.6 Robustness tests

The key assumption in a difference in difference setting is the parallel trend assumption, which says that conditional on the control variables, treated and controls did not differ systematically before the treatment, and would have continued on the same trend in absence of the event. To provide further evidence that this assumption is plausible in this setting, we test for pre-trends in the data using the following regression:

$$Y_{i,t} = \alpha + \beta_1 Treated_i * Post_{t+k} + \beta_2 X_{i,t-1} + \phi_t + \epsilon_{i,t} \quad (4)$$

Equation 4 is similar to our main regression specification (equation 2) but it is forward-looking. Here, k takes value 1 or 2, which means that *Post* is forwarded by one or two quarters. With this variable (*Post*), we test whether the dependent variable was evolving differently before the main event (the ZLB announcement of August, 2011). The evidence of pre-trends in the data might signal the presence of reverse causality and/or omitted variable bias in our main specification (equation 2). Table 11 provides the results of the OLS estimates of equation 4 using ROA, Interest income and non interest income as dependent variables. The results confirm that there were not pre-trends in the data one quarter and two quarter before the policy announcement. As shown in Table 11, the coefficients $Treated_i * Post_{t+k}$ are not statistically significant in all of the specifications. The result is somehow expected as Drechsler et al. (2017) also pointed out that deposits have zero maturity and hence the impact of monetary policy changes are not incorporated until their actual realization, even if these changes are anticipated.

[Please add Table 11 about here]

Another concern of our empirical setting is related to the identification of the main event. The purchase of long-term treasury assets in QE2 serves as a commitment to keep interest rates low. Furthermore, the Fed announcement regarding QE2 implicitly contains an expectation that federal fund rates will be kept low for a further prolonged period of time[14]. We test the impact of the Fed QE2 announcement on bank performance with the same strategy adopted before. Specifically, we isolate the 2009Q3 – 2011Q2 time window and we identify 2009Q3 – 2010Q2 as the pre-event period and 2010Q3 – 2011Q2 as the post announcement period. Then we apply our main DiD strategy

[14] In the 10/8/2010 FOMC statement, the committee announces: "The committee will keep constant the Federal reserve's holding of securities at their current level by reinvesting principal payments from agency debt and agency mortgage-backed securities in longer-term Treasury securities". Furthermore, in 21/9/2010 the FOMC announces: "The committee will continue to monitor the economic outlook and financial developments and is prepared to provide additional accommodation if needed to support the economic recovery".

with the parametric matching estimator. This falsification test can help to rule out the possibility that the announcement of the explicit duration of the zero-lower bound does not contain incremental information for financial markets. Moreover, it allows to be sure that banks do not change their strategies in the period before the announcement of the duration of the ZLB. The results of the falsification test are shown in Table 12. Based on those results differences across the two groups are not relevant, confirming that before the explicit announcement of the duration of the ZLB there were no changes in bank strategies across the two groups of banks.

[Please add Table 12 about here]

In our main estimates, we define banks with deposits over total liabilities lower than 75% as our treatment group in the DiD framework. In Table 13, we consider alternative deposit ratios. In panel A of Table 13 we define banks with deposits over total liabilities lower than 70% as treated banks and we estimate equation 2 with the full set of covariates and time fixed effects. Results confirm our main estimations shown in table Table 6 and Table 7. In panel B we estimate equation 2 with a continuous treatment indicator. In this case we interact deposits over total liabilities with the dummy variable post that takes value 1 after the ZLB announcement. In this case, coefficients change sign and remains statistically significant. The different sign is expected, because banks with higher deposits are control group banks in the previous estimations. In the previous results we argue that banks with higher deposit ratios had a lower impact on interest income margins and shifted less their activities toward noninterest income products[15].

[Please add Table 13 about here]

Finally, we rule out the possibility that our results are mainly driven by small banks. The U.S. banking sector is dominated by small banks with higher reliance on deposits and lower profit diversification. As banks become larger their funding strategy and income structure tend to change. To rule out that our results are not driven by small banks, we remove banks with total assets lower than 100 Million of Dollars[16] and we replicate the parametric matching estimator. Estimations are reported in Table 14 and further confirm our main results.

[15]Another interesting robustness test would be separating households and corporate deposits. As suggested in **?** the zero-lower bound has a stronger effect for banks with more household deposits. However, call report data do not differentiate between household and corporate deposits and thus we cannot rule out this test.

[16]The threshold corresponds to the 25% lower percentile of bank total assets. In Abedifar et al. (2018) small banks are those with less than $100 million in total assets.

[Please add Table 14 about here]

To further rule out concerns on asset size, we repeat the estimation focusing on banks with asset size greater than 500 million of dollars. Furthermore, we restrict our sample on banks with assets greater than 500 million of dollars and a share of noninterest income to total operating income above the median value. Results of the tests are reported in appendix A Table A.4.

5 Conclusions

This paper analyses the impact of the Fed communication regarding the duration of the ZLB on bank performance and strategies toward noninterest income activities. A prolonged period of lower interest rates cause deterioration of interest income margins, constraining banks to shift their strategies in the direction of noninterest sources of revenues to reach the targeted performance. However, expanding banking activities can impair the stability of the financial sector if banks engage in high risky noninterest income activities, such as for example securitization and investment banking activities.

Using quarterly data on U.S. commercial banks and employing a difference in difference methodology, we find that low deposits banks are more exposed to the policy event and exhibit a higher reduction of net interest income. This result confirms our assertion that deposits are considered as stable long-term sources of funding and this improves banks' ability to offset monetary policy shocks. On the contrary, banks with lower levels of deposits funding were subject to an increase of interest expenses that constrained those banks to change their strategies toward fee income activities to preserve the desired performance targeted. The changing strategy is mainly explained through an increase in fiduciary and insurance related products that are characterized by a lower level of riskiness. Shift toward noninterest income activities did not impair bank stability in the analysed period. Results remain robust after a number of robustness checks. Specifically, we rule out concerns regarding the identification of the event, the exposure variable (the level of deposits) and the potential bias related to the presence of small banks with lower levels of noninterest income activities.

Our findings contribute to the understanding of how unconventional monetary policy affects bank performance and strategies. To our view, this is an important finding as it shows that unconventional monetary policy interventions shape also strategies of banks through their secondary main source of revenue, which can entail additional risks for the financial sector. Our results suggest that banks fare relatively well even after a prolonged period of policy rates set to zero. Despite this we should be cautious in formulating our

policy recommendations. If noninterest returns enjoyed by banks are sustainable over the long run we can affirm that monetary transmission mechanism is effective at the ZLB. However, positive returns in noninterest income components may not be sustainable over the long run arising concerns in terms of margin erosion that might ultimately undermines capitalization. Moreover, if banks increase their exposure on risky fee income activities the stability of the financial sector might be impaired.

References

Abadie, A. and Imbens, Guido, W. (2011). Bias-corrected matching estimators for average treatment effects. *Journal of Business & Economic Statistics*, 29(1):1–11.

Abedifar, P., Molyneux, P., and Tarazi, A. (2018). Non-interest income and bank lending. *Journal of Banking & Finance*, 87:411 – 426.

Acharya, V. V., Eisert, T., Eufinger, C., and Hirsch, C. (2019). Whatever It Takes: The Real Effects of Unconventional Monetary Policy. *The Review of Financial Studies*, 32(9):3366–3411.

Altavilla, C., Boucinha, M., and Peydró, J, L. (2017). Monetary policy and bank profitability in a low interest rate environment. *ECB Working Paper Series, No. 2105*.

Baele, L., De Jonghe, O., and Vander Vennet, R. (2007). Does the stock market value bank diversification? *Journal of Banking & Finance*, 31(7):1999 – 2023.

Bauer, M, D. and Rudebusch, G, D. (2013). The signaling channel for federal reserve bond purchases. *International Journal of Central Banking*, 10(3).

Begenau, J., Piazzesi, M., and Schneider, M. (2019). Banks' risk exposure. *NBER Working Paper No. 21334*.

Berger, A. and Bouwman, C. (2013). How does capital affect bank performance during financial crises? *Journal of Financial Economics*, 109(1):146 – 176.

Berger, A. N. (1995). The relationship between capital and earnings in banking. *Journal of Money, Credit and Banking*, 27(2):432–456.

Bowman, D., Londono, J. M., and Sapriza, H. (2015). U.s. unconventional monetary policy and transmission to emerging market economies. *Journal of International Money and Finance*, 55:27 – 59.

Brunnermeier, M, K., Dong, G, N., and Palia, D. (2012). Banks non-interest income and systemic risk. *AFA 2012, Chicago Meetings Paper*.

Busch, R. and Kick, T. (2009). Income diversification in the german banking industry. *Deutsche Bundesbank Discussion Paper series 2: Banking and Financial Studies, 9*.

Chakraborty, I., Goldstein, I., and Mackinlay, A. (2019). Monetary stimulus and bank lending. *Journal of Financial Economics*.

Chodorow-Reich, G. (2014). Effects of unconventional monetary policy on financial institutions. *Brookings Papers on Economic Activity (Spring)*, pages 155–204.

Chronopoulos, D. K., Liu, H., McMillan, Fiona, J., and Wilson, J. O. (2015). The dynamics of us bank profitability. *The European Journal of Finance*, 21(5):426–443.

Claessens, S., Coleman, N., and Donnelly, M. (2018). "low-for-long" interest rates and banks' interest margins and profitability: Cross-country evidence. *Journal of Financial Intermediation*, 35:1 – 16.

D'Amico, S., English, W., López-Salido, D., and Nelson, E. (2012). The federal reserve's large-scale asset purchase programmes: Rationale and effects. *The Economic Journal*, 122(564):F415–F446.

De Jonghe, O. (2010). Back to the basics in banking? a micro-analysis of banking system stability. *Journal of Financial Intermediation*, 19(3):387 – 417. Risk Transfer Mechanisms and Financial Stability.

De Jonghe, O., Diepstraten, M., and Schepens, G. (2015). Banks' size, scope and systemic risk: What role for conflicts of interest? *Journal of Banking & Finance*, 61:S3 – S13. Global Trends in Banking, Regulations, and Financial Markets.

Dell'Ariccia, G., Laeven, L., and Suarez, G. A. (2017). Bank leverage and monetary policy's risk-taking channel: Evidence from the united states. *The Journal of Finance*, 72(2):613–654.

Demirgüç-Kunt, A. and Huizinga, H. (2010). Bank activity and funding strategies: The impact on risk and returns. *Journal of Financial Economics*, 98(3):626 – 650.

DeYoung, R. and Torna, G. (2013). Nontraditional banking activities and bank failures during the financial crisis. *Journal of Financial Intermediation*, 22(3):397 – 421.

Di Maggio, M. and Kacperczyk, M. (2017). The unintended consequences of the zero lower bound policy. *Journal of Financial Economics*, 123(1):59 – 80.

Di Tella, S. and Kurlat, P. (2017). Why are banks exposed to monetary policy? *NBER Working Paper No. 24076*.

Diamond, D. W. and Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *Journal of Political Economy*, 91(3):401–419.

Diamond, D. W. and Rajan, R. G. (2001). Liquidity risk, liquidity creation, and financial fragility: A theory of banking. *Journal of Political Economy*, 109(2):287–327.

Drechsler, I., Savov, A., and Schnabl, P. (2017). The Deposits Channel of Monetary Policy. *The Quarterly Journal of Economics*, 132(4):1819–1876.

Drechsler, I., Savov, A., and Schnabl, P. (2018). Banking on deposits: maturity transformation without interest rate risk. *NBER Working Paper No. 24582*.

English, W. B., Van den Heuvel, S. J., and Zakrajšek, E. (2018). Interest rate risk and bank equity valuations. *Journal of Monetary Economics*, 98:80 – 97.

Flannery, M. J. (1981). Market interest rates and commercial bank profitability: An empirical investigation. *The Journal of Finance*, 36(5):1085–1101.

Gagnon, J., Raskin, M., Remache, J., and Sack, B. (2011). The financial market effects of the federal reserve's large-scale asset purchases. *International Journal of Central Banking*, 7:3 – 43.

Gorton, G. and Winton, A. (2017). Liquidity provision, bank capital, and the macroeconomy. *Journal of Money, Credit and Banking*, 49(1):5–37.

Gropp, R. and Heider, F. (2010). The Determinants of Bank Capital Structure*. *Review of Finance*, 14(4):587–622.

Heider, F., Saidi, F., and Schepens, G. (2019). Life below Zero: Bank Lending under Negative Policy Rates. *The Review of Financial Studies*.

Hoffmann, P., Langfield, S., Pierobon, F., and Vuillemey, G. (2018). Who Bears Interest Rate Risk? *The Review of Financial Studies*, 32(8):2921–2954.

Ihrigh, J., Klee, E., Li, C., Wei, M., and Kachovec, J. (2018). Expectations about the federal reserve's balance sheet and the term structure of interest rates. *International Journal of Central Banking*, 14(2):341 – 391.

Kandrac, J. and Schlusche, B. (2016). Expectations about the federal reserve's balance sheet and the term structure of interest rates. *SSRN working paper*.

Krishnamurthy, A. and Vissing-Jorgensen, A. (2011). The effects of quantitative easing on interest rates: channels and implications for policy. *NBER Working Paper*, 0(17555):2121–2165.

Kurtzman, R., Luck, S., and Zimmermann, T. (2018). Did qe lead banks to relax their lending standards? evidence from the federal reserve's lsaps. *Journal of Banking & Finance*.

Maddaloni, A. and Peydró, J.-L. (2011). Bank risk-taking, securitization, supervision, and low interest rates: Evidence from the euro-area and the u.s. lending standards. *The Review of Financial Studies*, 24(6):2121–2165.

Mamatzakis, E. and Bermpei, T. (2016). What is the effect of unconventional monetary policy on bank performance? *Journal of International Money and Finance*, 67:239 – 263.

Mergaerts, F. and Vennet, R. V. (2016). Business models and bank performance: A long-term perspective. *Journal of Financial Stability*, 22:57 – 75.

Montecino, J. and Epstein, G. (2014). Have large scale asset purchases increased bank profits? *Institute for New Economic Thinking Working Paper Series No.5*.

Rampini, A., Viswanathan, S., and Vuillemey, G. (2019). Banking on deposits: maturity transformation without interest rate risk. *NBER Working Paper No. 25698*.

Rodnyansky, A. and Darmouni, O. M. (2017). The Effects of Quantitative Easing on Bank Lending Behavior. *The Review of Financial Studies*, 30(11):3858–3887.

Saghi-Zedek, N. (2016). Product diversification and bank performance: Does ownership structure matter? *Journal of Banking & Finance*, 71:154 – 167.

Stiroh, K. (2004). Diversification in banking: Is noninterest income the answer? *Journal of Money Credit and Banking*, 36(5):853–882.

Stiroh, K. and Rumble, A. (2006). The dark side of diversification: The case of us financial holding companies. *Journal of Banking & Finance*, 30(8):2131 – 2161.

Swanson, E. T. and Williams, J. C. (2014). Measuring the effect of the zero lower bound on medium- and longer-term interest rates. *American Economic Review*, 104(10):3154–85.

Swanson, E, T. (2017). Measuring the effects of federal reserve forward guidance and asset purchases on financial markets. *NBER Working Paper No. 23311*.

van Ewijk, Saskia, E. and Arnold, Ivo, J. (2014). How bank business models drive interest margins: evidence from us bank-level data. *The European Journal of Finance*, 20(10):850–873.

Wright, J. H. (2012). What does monetary policy do to long-term interest rates at the zero lower bound? *The Economic Journal*, 122(564):F447–F466.

A Appendix A: Auxiliary tables

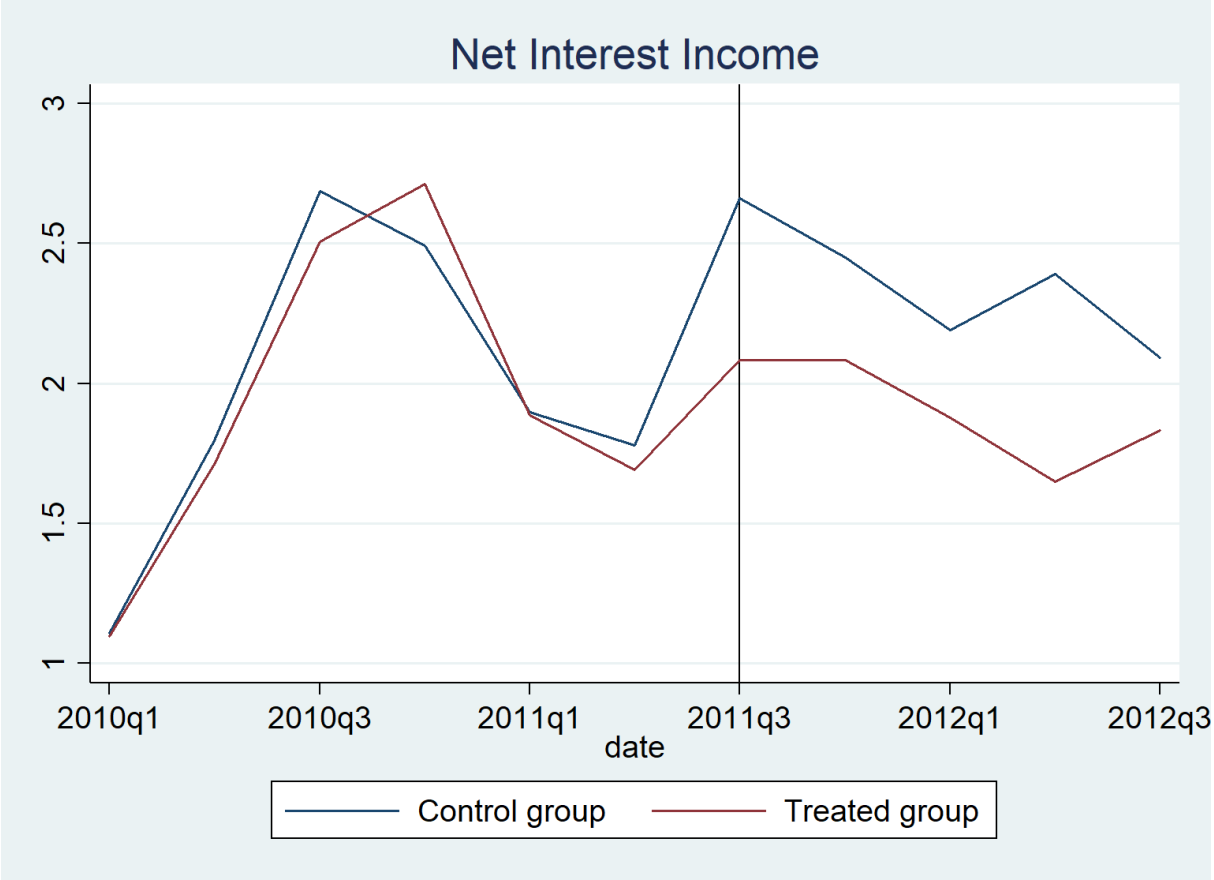
This section provides the additional tables. In Table A.1 we report the description of the variables used, together with their definition and sources. For an easier replication of our work, we report the call report codes used to construct our database.

In Table A.2 we display the correlation between treatment indicators and initial bank characteristics, while in Table A.2 we show the regression coefficients of the results reported in Table 9.

Finally, in Table A.3 we provide a further robustness check in which we replicate our main results on a sub-sample of medium and large banks with total assets greater than 500 Million of Dollars.

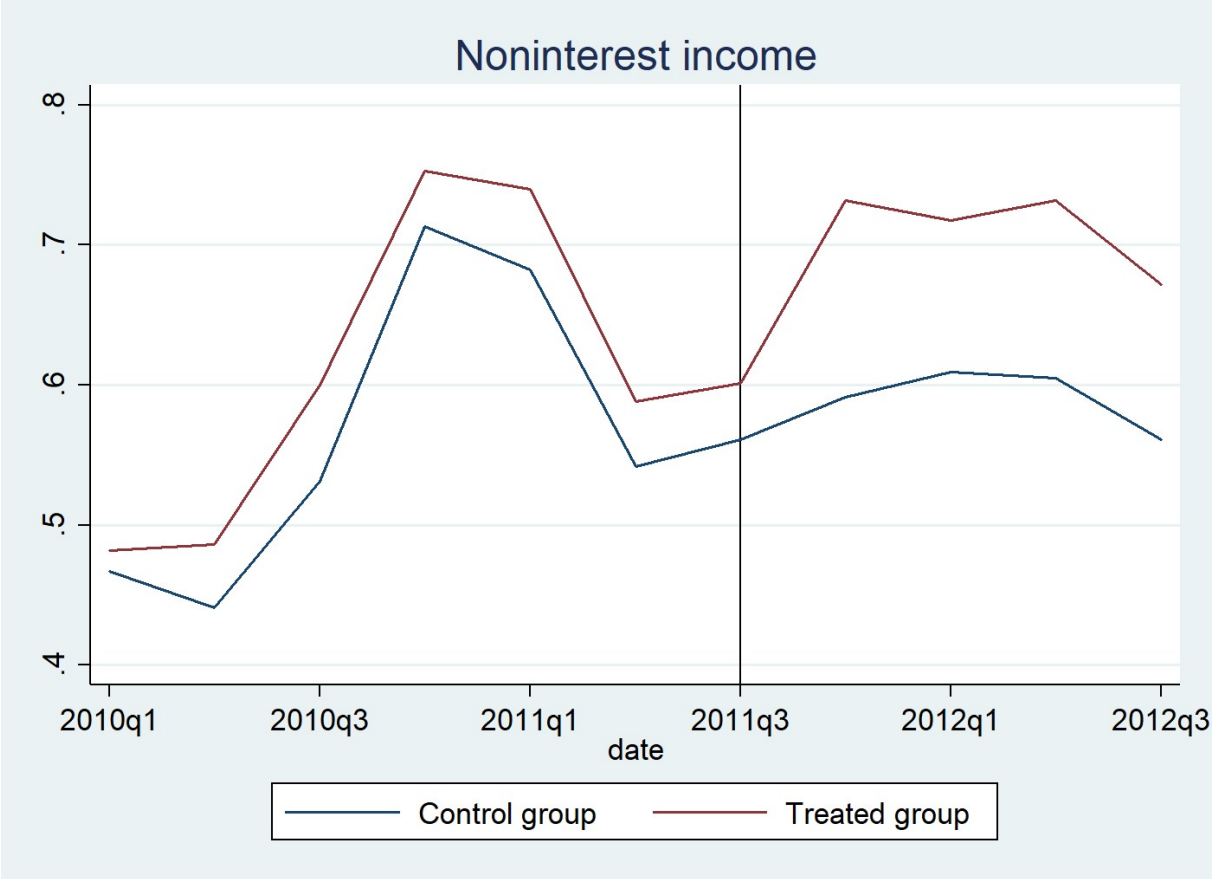
Figures

Figure 1: Net interest income



This figure shows the average net interest income of the control group (blue line) and of the treated group (red line) over the period 2010Q1-2012Q3. Zero lower bound announcement is the date of the FED communication event identified (2011Q3).

Figure 2: Noninterest income



This figure shows the average noninterest income of the control group (blue line) and of the treated group (red line) over the period 2010Q1-2012Q3. Zero lower bound announcement is the date of the FED communication event identified (2011Q3).

Tables

Table 1: Main FOMC Announcements

Date	Event
December 16, 2008	Fed target rate reduced to 0-0.25% and QE1 announcement
January 28, 2009	FOMC statement, QE1 starts
March 18, 2009	FOMC statement, QE1 additional expansion of QE1 and zero rates for "an extended period of time"
September 23, 2009	FOMC statement – QE1 will finish at the end of Q1 2010
August 10, 2010	FOMC statement – Announcement of QE2
September 21, 2010	FOMC statement – FED announced additional accommodation if needed
August 9, 2011	FOMC statement – Announcement of zero lower bound through 2013.
January 25, 2012	Zero rates at least until 2014
September 13, 2012	FOMC statement – Announcement of the zero lower bound "at least through mid-2015", and purchase of mortgage backed securities (QE3)
December 18, 2013	FOMC statement – Fed announces it will start to taper longer-term treasuries and mortgage backed securities.
October 29, 2014	FOMC statement – End of QE3 without raising fed funds rates

This table reports the dates and the announcements following the FOMC meetings in which the Fed: decided to change the Fed target rate, provided policy guidance about the adoption of the zero interest rate policy and announced the Large Scale Asset Purchase Programmes.

Table 2: Summary statistics

Term	Mean	Std. Dev.	Min	Max
Variables of interest				
ROA	0.026	0.018	-0.037	0.057
Net interest income	0.021	0.012	-0.028	0.049
Non-interest income	0.007	0.048	-0.085	0.046
Risky Non-interest income	0.001	0.006	-0.036	0.008
Traditional fees	0.002	0.009	0	0.009
Fiduciary and insurance	0.002	0.004	-0.001	0.008
Interest rates				
3Month Rate	0.012	0.016	0.003	0.059
Curve Spread	0.019	0.010	-0.041	0.036
Bank specific covariates				
Size	5.241	0.599	2.301	9.330
Equity over Assets	0.108	0.084	0.070	0.377
Deposits over liabilities	0.825	0.109	0.081	0.920
Treas & Agency Sec over assets	0.159	0.127	0.004	0.577
Macroeconomic controls				
Gdp growth	0.019	0.053	-0.025	0.038
Inflation	0.006	0.015	-0.031	0.038

This table provides the summary statistics: mean, standard deviation, minimum and maximum values of the variables used in this paper. The sample consist of US commercial banks over the 2004-2017 period.

Table 3: Descriptive statistics of control and treatment group prior and after the Fed ZLB announcement

Control Group			**Pre -**					**Post -**		
Bank Profitability	Obs.	Mean	Std. Dev.	Min	Max	Obs.	Mean	Std. Dev.	Min	Max
Net Interest Income %	18,649	1.951	1.026	0.664	3.840	16,431	2.291	0.996	0.600	3.900
Non Interest Income %	18,649	0.378	0.491	-0.051	0.785	16,431	0.464	0.659	-0.133	0.888
Risky Non-Interest Income %	18,649	0.043	0.247	-0.462	0.633	16,431	0.073	0.380	-0.674	0.744
Fiduciary and Insurance %	18,649	0.030	0.128	-0.067	0.424	16,431	0.037	0.148	-0.090	0.519
Traditional Fees %	18,649	0.188	0.243	-0.033	0.503	16,431	0.203	0.272	-0.773	0.511
Bank Specific covariates										
Size	18,649	5.175	0.439	3.812	7.295	16,431	5.210	0.441	3.602	7.751
Equity Over Assets	18,649	0.103	0.024	0.061	0.197	16,431	0.105	0.023	0.098	0.198
Treas & Agency Sec.	18,649	0.154	0.117	0.009	0.523	16,431	0.160	0.121	0.007	0.535
Loans over Assets	18,649	0.617	0.139	0.231	0.812	16,431	0.587	0.143	0.194	0.792
RE Loans over Assets	18,649	0.436	0.160	0.069	0.774	16,431	0.421	0.159	0.063	0.757
LLP over assets	18,649	0.010	0.006	0.002	0.030	16,431	0.010	0.006	0.002	0.033
Average Maturity of Loans	18,641	4.124	2.637	0.167	19.329	16,408	4.098	2.616	0.167	19.338
Z-score	18,649	0.092	0.020	0.019	0.241	16,431	0.097	0.019	0.015	0.237
Treated Group			**Pre -**					**Post -**		
Bank Profitability	Obs.	Mean	Std. Dev.	Min	Max	Obs.	Mean	Std. Dev.	Min	Max
Net Interest Income %	4,875	1.876	1.029	0.602	4.390	3,307	2.170	1.032	0.607	4.606
Non Interest Income %	4,875	0.670	0.744	-0.886	1.207	3,307	0.791	0.997	-0.682	1.655
Risky Non-Interest Income %	4,875	0.091	0.510	-0.172	0.874	3,307	0.143	0.682	-0.467	0.854
Fiduciary and Insurance %	4,875	0.260	0.154	-0.016	0.651	3,307	0.558	0.251	-0.007	0.907
Traditional Fees %	4,875	0.168	0.268	-0.526	0.445	3,307	0.187	0.362	-0.488	0.451
Bank Specific covariates										
Size	4,875	5.375	0.503	3.934	7.955	3,307	5.402	0.509	4.133	7.742
Equity Over Assets	4,875	0.120	0.046	0.032	0.211	3,307	0.129	0.048	0.031	0.220
Treas & Agency Sec.	4,875	0.160	0.124	0.007	0.558	3,307	0.167	0.126	0.005	0.571
Loans over Assets	4,875	0.618	0.149	0.194	0.875	3,307	0.586	0.153	0.154	0.872
RE Loans over Assets	4,875	0.459	0.170	0.050	0.732	3,307	0.438	0.173	0.046	0.723
LLP over assets	4,875	0.011	0.006	0.001	0.032	3,307	0.011	0.006	0.001	0.034
Average Maturity of Loans	4,872	4.084	2.644	0.167	19.229	3,305	4.167	2.676	0.195	19.145
Z-score	4,875	0.105	0.036	0.029	0.447	3,307	0.115	0.037	0.032	0.344

This table shows the descriptive statistics of control and treatment group prior and after the Fed ZLB announcement. The Pre- stands for the period prior to the announcement (2010Q1 - 2011Q2), while Post- stands for the period post announcement (2011Q3 - 2012Q3). See Table A.1 for the definition of the variables used.

Table 4: Preliminary evidence

	ROA	Net-Interest income	Non-interest income
	(1)	(2)	(3)
3Month Rate	0.086***	0.064***	-0.012**
	(0.016)	(0.064)	(0.048)
Curve Spread	0.021	0.036***	-0.002**
	(0.023)	(0.064)	(0.004)
Size	0.316	-0.071***	-0.017***
	(0.193)	(0.020)	(0.064)
Equity over Assets	0.055**	0.034*	0.013
	(0.024)	(0.001)	(0.021)
Deposits over liabilities	-0.081	-0.002	-0.004**
	(0.06)	(0.002)	(0.002)
Treas & Agency Sec over assets	-0.289*	-0.843***	-0.08
	(0.174)	(0.054)	(0.076)
Gdp growth	0.129*	0.136**	0.027
	(0.008)	(0.020)	(0.020)
Inflation	0.301***	0.067***	0.013***
	(0.416)	(0.010)	(0.068)
R-Square	0.083	0.028	0.075
Observations	259,476	259,476	259,476
Banks	4,723	4,723	4,723

This table shows the FE estimation results of equation (1). See Table 2 for the definition of the explanatory variables. *, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively. Robust standard errors are shown in brackets.

Table 5: Granger Causality Test: Interest rates and bank profitability

Hypothesis Tested	Chi2 Statistics
Curve Spread - ROA	14.503***
	(0.001)
ROA - Curve Spread	3.404
	(0.182)

Granger causality test in a Vector Autoregressive Framework. The lag structure is determined through the information criterion. Column (1) display the hypothesis tested, while column (2) the Chi2 statistics with their level of significance. Prob > chi2 are provided in brackets. ***denotes significance at 1% level, ** at the 5% level, *** at 10% level, respectively.

Table 6: Difference in difference in performance around the announcement

	Before	After
Panel A: ROA		
Control	0.769	0.882
Treated	0.851	1.001
Difference (T-C)	0.082***	0.118***
	(0.012)	(0.014)
Difference in differences		0.036**
		(0.018)
Matching Estimator (ATT)		0.067***
		(0.022)
Panel B: Net-Interest Income		
Control	1.933	2.274
Treated	1.876	2.172
Difference (T-C)	-0.057***	-0.102***
	(0.014)	(0.018)
Difference in differences		-0.045*
		(0.023)
Matching Estimator (ATT)		-0.079**
		(0.044)
Panel C: Noninterest income		
Control	0.395	0.424
Treated	0.673	0.791
Difference (T-C)	0.278***	0.367***
	(0.047)	(0.055)
Difference in differences		0.089***
		(0.07)
Matching Estimator (ATT)		0.112*
		(0.017)

This table shows the difference-in-difference matching estimators for ROA, interest income and non-interest income over total assets. Treated banks are those with deposits over total liabilities lower that 75%. The sample consist of 21367 control banks observations before the event and 18876 after the event. 6270 treated bank observations before the event and 4321 after the event. Control banks are matched banks using the Abadie and Imbens matching estimator (ATT). The covariates are: capital, size, real estate loans to total assets, provisioning to total assets and US treasury and agency securities over total assets and time. Robust standard errors are reported in parentheses. ***denotes significance at 1% level, ** at the 5% level, *** at 10% level, respectively. Results are displayed in percentage.

Table 7: Regression results

Panel A: ROA	(1)	(2)	(3)	(4)
Treat* Post	0.174***	0.041**	0.033**	0.027*
	(0.013)	(0.013)	(0.014)	(0.017)
Equity over Assets		0.092***	0.109***	0.043***
		(0.013)	(0.013)	(0.011)
Treas & Agency Sec over assets		-0.125***	-0.118***	-0.054
		(0.028)	(0.028)	(0.115)
Size		0.028***	0.028***	0.077*
		(0.006)	(0.006)	(0.015)
3Month Rate		0.150*	0.071	0.274
		(0.083)	(0.161)	(0.371)
Curve Spread		-0.065***	-0.065***	-0.065***
		(0.055)	(0.088)	(0.007)
Time FE	N	N	Y	Y
Adj. R2	0.003	0.024	0.058	0.042
Panel B: Net-Interest Income				
Treat* Post	-0.108***	-0.224***	-0.062***	-0.020**
	(0.017)	(0.018)	(0.08)	(0.078)
Equity over Assets		0.093***	0.109***	0.156**
		(0.010)	(0.010)	(0.056)
Treas & Agency Sec over assets		-1.261***	-1.170***	-1.237***
		(0.034)	(0.019)	(0.011)
Size		-0.052***	-0.052***	-0.123***
		(0.009)	(0.006)	(0.021)
3Month Rate		0.806***	0.539***	0.543***
		(0.09)	(0.068)	(0.021)
Curve Spread		-0.526***	-0.929***	-0.960***
		(0.054)	(0.051)	(0.039)
Time FE	N	N	Y	Y
Adj. R2	0.001	0.137	0.793	0.644
Panel C: Noninterest income				
Treat* Post	0.119***	0.030*	0.036*	0.031*
	(0.147)	(0.128)	(0.127)	(0.167)
Equity over Assets		0.159***	0.158***	0.075*
		(0.020)	(0.020)	(0.039)
Treas & Agency Sec over assets		-1.177***	-1.140***	-0.223***
		(0.190)	(0.189)	(0.070)
Size		0.113***	0.114***	0.084*
		(0.021)	(0.020)	(0.015)
3Month Rate		0.310	0.151**	0.125***
		(0.035)	(0.058)	(0.037)
Curve Spread		-0.133***	-0.242***	-0.214***
		(0.016)	(0.037)	(0.065)
Time FE	N	N	Y	Y
Adj. R2	0.005	0.076	0.081	0.109

This table presents the OLS (columns: 1, 2 and 3) and FE (column 4) estimates of equation (2) using ROA, net interest income and noninterest income as dependent variables. The estimation period starts in Q1 2010 and ends in Q3 2012. Treated is a dummy variable that takes value 1 for banks with deposits over liabilities lower than 75%. Post is a dummy variable that takes value 1 after Q3 2011. See Table 2 for the definition of the other explanatory variables. Regressions include time fixed effects as specified. *, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively. Robust standard errors are shown in brackets.

Table 8: Net interest income breakdown

	(1)	(2)	(3)
Panel A: Interest Income			
Treat* Post	-0.010***	-0.002**	-0.002
	(0.011)	(0.010)	(0.001)
Bank Controls	N	Y	Y
Time FE	N	N	Y
Adj. R2	0.016	0.180	0.188
Panel B: Interest expenses			
Treat* Post	0.028**	0.033*	0.029*
	(0.024)	(0.017)	(0.020)
Bank Controls	N	Y	Y
Time FE	N	N	Y
Adj. R2	0.002	0.167	0.176
Panel C: Net Interest Income and asset maturity			
Treat* Post*asset maturity	-0.006***	-0.012***	-0.014**
	(0.017)	(0.018)	(0.05)
Bank Controls	N	Y	Y
Time FE	N	N	Y
Adj. R2	0.003	0.137	0.656

This table presents the OLS estimates for the breakdown of net interest income. In panel A and B we estimate equation (2) using interest income and interest expenses, respectively. The estimation period starts in Q1 2010 and ends in Q3 2012. Treated is a dummy variable that takes value 1 for banks with deposits over liabilities lower than 75%. Post is a dummy variable that takes value 1 after Q3 2011. In panel C, we use a triple interaction term in which we interact asset maturity with treated and post dummy variables. Bank controls are those used in table 7 and used in regression 2. Regressions include time fixed effects as specified. *, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively. Robust standard errors are shown in brackets.

Table 9: Difference in difference in noninterest income components around the announcement

	Before	After
Panel A – Fiduciary and insurance		
Control	0.037	0.046
Treated	0.296	0.609
Difference (T-C)	0.260***	0.563***
	(0.045)	(0.053)
Difference in differences		0.304***
		(0.069)
Matching Estimator		0.239*
		(0.169)
Panel B – Traditional Fees		
Control	0.193	0.208
Treated	0.178	0.193
Difference (T-C)	-0.015***	-0.015**
	(0.006)	(0.007)
Difference in differences		-0.01
		(0.009)
Matching Estimator		-0.054***
		(0.013)
Panel C – Risky fee income		
Control	0.043	0.075
Treated	0.107	0.151
Difference (T-C)	0.064***	0.076***
	(0.007)	(0.008)
Difference in differences		0.013
		(0.010)
Matching Estimator		0.013
		(0.019)

This table shows the difference-in-difference matching estimators for three different business lines of noninterest income: fiduciary and insurance activities, traditional fees and risky fee income. See table 2 for the definition of the target variables used. Treated banks are those with deposits over total liabilities lower that 75%. The sample consist of 21367 control banks observations before the event and 18876 after the event. 6270 treated bank observations before the event and 4321 after the event. Control banks are matched banks using the Abadie and Imbens matching estimator (ATT). The covariates are: capital, size, real estate loans to total assets, provisioning to total assets and US treasury and agency securities over total assets and time. Robust standard errors are reported in parentheses. ***denotes significance at 1% level, ** at the 5% level, *** at 10% level, respectively. Results are displayed in percentage of total assets.

Table 10: Impact on bank stability

	(1)	(2)	(3)
Treat	0.013***	0.015***	0.014***
	(0.005)	(0.005)	(0.005)
Post	0.004	-0.024***	-0.115**
	(0.002)	(0.006)	(0.036)
Treat* Post	0.005***	0.007***	0.005***
	(0.008)	(0.008)	(0.008)
Bank Controls	N	Y	Y
Time FE	N	N	Y
Adj. R2	0.016	0.180	0.210

This table presents the OLS estimates of equation (3). The estimation period starts in Q1 2010 and ends in Q3 2012. Treated is a dummy variable that takes value 1 for banks with deposits over liabilities lower than 75%. Post is a dummy variable that takes value 1 after Q3 2011. Bank controls are those specified in regression 2, excluding equity over assets ratio. Regressions include bank controls and time fixed effects as specified. *, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively. Robust standard errors are shown in brackets.

Table 11: Evidence of pre-trends in the data

	(1) ROA	(2) ROA	(3) Interest income	(4) Interest income	(5) Noninterest income	(6) Noninterest income
$Treat * Post_{t+1}$	-0.002		-0.008		0.017	
	(0.018)		(0.007)		(0.012)	
$Treat * Post_{t+2}$		-0.013		0.011		0.024
		(0.020)		(0.008)		(0.015)
Control Variables	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Adj. R2	0.038	0.017	0.675	0.655	0.130	0.112

This table for pre-test in our target performance variables through OLS estimates of equation (3) using ROA, net interest income and noninterest income as dependent variables. The estimation period starts in Q1 2010 and ends in Q3 2012. Control variables are those identified in equation (2). Regressions include time fixed effects as specified. *, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively. Robust standard errors are shown in brackets.

Table 12: Falsification test – QE2 announcement

	Before	After
Panel A: ROA		
Control	0.828	0.818
Treated	0.824	0.847
Difference (T-C)	-0.004	0.029*
	(0.015)	(0.016)
Difference in differences		0.032
		(0.022)
Matching Estimator		0.036
		(0.025)
Panel B: Interest Income		
Control	2.196	2.212
Treated	2.206	2.242
Difference (T-C)	0.010	0.030
	(0.019)	(0.021)
Difference in differences		0.020
		(0.028)
Matching Estimator		-0.020
		(0.030)
Panel C: Non-interest income		
Control	0.449	0.436
Treated	0.585	0.598
Difference (T-C)	0.136***	0.162***
	(0.011)	(0.011)
Difference in differences		0.025
		(0.016)
Matching Estimator		-0.040
		(0.020)

This table shows the difference-in-difference matching estimators for ROA, interest income and non-interest income over total assets. Treated banks are those with deposits over total liabilities lower that 75%. The event is the announcement of QE2. The sample consist of 13547 control banks observations before the event and 14609 after the event. 5116 treated bank observations before the event and 4044 after the event. Control banks are matched banks using the Abadie and Imbens matching estimator (ATT). The covariates are: capital, size, real estate loans to total assets, provisioning to total assets and US treasury and agency securities over total assets and time. Robust standard errors are reported in parentheses. ***denotes significance at 1% level, ** at the 5% level, *** at 10% level, respectively. Results are displayed in percentage.

Table 13: Alternative definitions of the deposit ratio

	(1) ROA	(2) NIM	(3) Noninterest income
Panel A: Different Threshold – 70% of deposits over liabilities			
Treated*Post	0.032*	-0.115***	0.072**
	(0.038)	(0.041)	(0.739)
Control Variables	Y	Y	Y
Time FE	Y	Y	Y
R-squared	0.03	0.790	0.084
Panel B: Continuous treatment			
Deposits*Post	-0.014*	0.053***	-0.094**
	(0.012)	(0.012)	(0.039)
Control Variables	Y	Y	Y
Time FE	Y	Y	Y
R-squared	0.03	0.793	0.095

This table presents the OLS estimates of equation (2) using ROA, net interest income and noninterest income as dependent variables. The estimation period starts in Q1 2010 and ends in Q3 2012. In panel A treated is a dummy variable that takes value 1 for banks with deposits over liabilities lower than 70%. In panel B Deposits is the ratio of deposits over total liabilities. Post is a dummy variable that takes value 1 after Q3 2011, in both panel A and B. Control variables are those identified in equation (2). Regressions include time fixed effects as specified. *, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively. Robust standard errors are shown in brackets.

Table 14: Difference in difference in performance around the announcement – without small banks

	Before	After
Panel A: ROA		
Control	0.769	0.908
Treated	0.818	0.961
Difference (T-C)	0.051***	0.053***
	(0.013)	(0.015)
Difference in differences		0.003*
		(0.020)
Matching Estimator (ATT)		0.062**
		(0.023)
Panel B: Interest Income		
Control	1.923	2.267
Treated	1.875	2.176
Difference (T-C)	-0.047***	-0.091***
	(0.018)	(0.021)
Difference in differences		-0.043*
		(0.027)
Matching Estimator (ATT)		-0.231***
		(0.030)
Panel C: Noninterest income		
Control	0.435	0.531
Treated	0.721	1.076
Difference (T-C)	0.286***	0.545***
	(0.018)	(0.021)
Difference in differences		0.259*
		(0.027)
Matching Estimator (ATT)		0.221**
		(0.019)

This table shows the difference-in-difference matching estimators for ROA, interest income and non-interest income over total assets. Treated banks are those with deposits over total liabilities lower that 75%. The sample consist of 13285 control banks observations before the event and 12137 after the event. 4754 treated bank observations before the event and 3345 after the event. Control banks are matched banks using the Abadie and Imbens matching estimator (ATT). The covariates are: capital, size, real estate loans to total assets, provisioning to total assets and US treasury and agency securities over total assets and time. Robust standard errors are reported in parentheses. ***denotes significance at 1% level, ** at the 5% level, *** at 10% level, respectively. Results are displayed in percentage.

Table A.1: List of variables used with their definition and data source

Term	Definition	Data source
Panel A:	**Variables of interest**	
ROA	Net operating income after taxes and securities gains or losses, plus the provision for possible loan and lease losses, less net loan and lease losses divided by average assets.	Call Reports
Net interest income	The ratio of Net interest income as a percentage of total assets. Call Report codes: RIAD 4074 and RCON2170	Call Reports
Non-interest income	Total noninterest income divided by total assets. Call report codes: RIAD 4079 and RCON2170	Call Reports
Risky Non-interest income	The sum of trading revenues, fee and commissions for brokerage activities and net gains (losses) on loans over total assets. Call report codes: RIADA220, RIADC886, RIAD5416 and RCON2170	Call Reports
Traditional fees	Service charges over total assets. Call report codes: RIAD4080 and RCON2170	Call Reports
Fiduciary and insurance	The sum of revenues from fiduciary activities, fees and commission for annuity sale, Insurance & Reinsurance underwriting and Income for other insurance activities over total assets. Call reports codes: RIAD4070, RIADC887, RIADC386, RIADC387 and RCON2170	Call Reports
Panel B:	**Interest rates**	
3Month Rate	The quarterly average US 3-month sovereign bond yield.	Bloomberg
Curve Spread	The difference between the quarterly average US 10-year and the 3-month sovereign bond yield.	Bloomberg
Panel C:	**Bank specific covariates**	
Size	The natural logarithm of total assets. UBPR code: UBPR2170	Call Reports
Equity over Assets	The ratio of total equity as a percentage of total assets. Total equity includes average of all preferred and common stock, surplus, undivided profits and capital reserves and cumulative foreign currency translation adjustments. UBPR code: UBPRJ243	Call Reports
Deposits over liabilities	The ratio of total deposits over total liabilities. Total deposits include all deposit categories (demand deposits, All NOW & ATS Accounts, Money market deposit accounts, other saving deposits, time deposits at or below insurance limit, fully insured brokered deposits, time deposits above insurance limit and deposits in foreign offices). UBPR code: UBPRE370	Call Reports
Treas & Agency Sec over assets	The ratio of total treasury and agency securities as a percentage of total assets. UBPR code: UBPRE120	Call Reports
Panel D:	**Macroeconomic controls**	
Gdp growth	The quarter percentage change in US gross domestic product.	Federal Reserve bank of St. Louis
Inflation	The quarterly percentage of US inflation.	Federal Reserve bank of St. Louis

Table A.2: Correlation between treatment indicators and initial characteristics

	(1)	(2)	(3)
Size	0.082***	0.166***	-0.334***
	(0.003)	(0.003)	(0.060)
Loans over assets	0.0019**	0.0019**	-0.047**
	(0.001)	(0.001)	(0.002)
Equity over Assets	0.038***	0.038***	-0.088***
	(0.006)	(0.006)	(0.009)
Treas & Agency Sec over assets	0.142***	0.142***	-0.272***
	(0.022)	(0.022)	(0.031)
Number of banks	4,540	4,540	4,540
Adj. R2	0.070	0.115	0.251

This table shows the OLS estimations using the treatment indicators as dependent variables and different bank characteristics as independent variables. In column 1 we regress a dummy variable that takes value 1 if deposits over total liabilities are lower than 75%, zero otherwise. In column 2 the dependent variable is a dummy variable that takes value 1 if deposits over total liabilities are lower than 80%, zero otherwise. In column 3 the dependent variable is deposits over total liabilities. Definition of the control variables is provided in table 2. *, **, *** indicates statistical significance at the 10%, 5%, 1% level, respectively. Robust standard errors are shown in brackets.

Table A.3: Regression results: noninterest income breakdown

	(1) Fiduciary and insurance	(2) Traditional fees	(3) Risky fee income
Treated*Post	0.116***	-0.023***	0.136***
	(0.033)	(0.029)	(0.042)
Control Variables	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
R-squared	0.049	0.252	0.054

This table presents the OLS estimates of equation (2) using Fiduciary and insurance income, traditional fees and risky fee income as dependent variables. The estimation period starts in Q1 2010 and ends in Q3 2012. Treated is a dummy variable that takes value 1 for banks with deposits over liabilities lower than 75%. Post is a dummy variable that takes value 1 after Q3 2011. Control variables are those use in equation 2. Regressions include time fixed effects as specified. *, **, *** indicates statistical significance at the 10%, 5%, 1% level, respectively. Robust standard errors are shown in brackets.

Table A.4: Estimates for large banks and for large diversified banks

	(1) ROA	(2) NIM	(3) Noninterest income
Panel A: Large banks			
Treated*Post	0.047*	-0.146***	0.061**
	(0.027)	(0.022)	(0.028)
Control Variables	Y	Y	Y
Time FE	Y	Y	Y
R-squared	0.059	0.784	0.156
Panel B: Large diversified banks			
Treated*Post	0.056**	-0.012***	0.073**
	(0.027)	(0.022)	(0.035)
Control Variables	Y	Y	Y
Time FE	Y	Y	Y
R-squared	0.067	0.805	0.150

This table presents the OLS estimates of equation (2) using ROA, net interest income and noninterest income as dependent variables. The estimation period starts in Q1 2010 and ends in Q3 2012. In panel A and B treated is a dummy variable that takes value 1 for banks with deposits over liabilities lower than 75% and Post is a dummy variable that takes value 1 after Q3 2011. In panel A, the sample is restricted to medium and large banks with total assets greater than 500Million of Dollars. In panel B, the sample is restricted to medium and large banks with total assets greater than 500Million of Dollars and Noninterest income to operating income above the median values. Control variables are those identified in equation (2). Regressions include time fixed effects as specified. *, ** and *** indicate statistical significance at the 10%, 5% and 1% level, respectively. Robust standard errors are shown in brackets.

CEFIN Working Papers ISSN (online) 2282-8168

78 *Portfolio choice: Evidence from new-borns,* by Arnaboldi, F. and Gioia, F. (October 2019).
77 *Behind the success of dominated personal pension plans: sales force and financial literacy factors,* by Marotta, G. (October 2019).
76 *Short-term household income mobility before and after the Great Recession: A four country study,* by Casabianca, E.J. and Giarda, E. (June 2019).
75 *The impact of Fundamental Review of Trading Book: A preliminary assessment on a stylized portfolio,* by Pederzoli, C. and Torricelli, C. (February 2019).
74 *Security-voting structure and equity financing in the Banking Sector: 'One Head-One Vote' versus 'One Share-One Vote',* by Ferretti, R., Pattitoni, P. and Castelli, A. (January 2019).
73 *The Financial Decisions of Immigrant and Native Households: Evidence from Italy,* by Bertocchi, G., Brunetti, M. and Zaiceva, A. (January 2019).
72 *Why choosing dominated personal pension plans: sales force and financial literacy effects*, by Marotta, G. (July 2018).
71 *Spending Policies of Italian Banking Foundations,* by Pattarin, F. (July, 2018).
70 *The Forecasting Performance of Dynamic Factors Models with Vintage Data,* by Di Bonaventura, L., Forni, M. and Pattarin, F. (July 2018).
69 *Housing Market Shocks in Italy: a GVAR Approach,* by Cipollini, A. and Parla, F. (April, 2018).
68 *Customer Complaining and Probability of Default in Consumer Credit*, by Cosma, S., Pancotto, F. and Vezzani, P. (March, 2018).
67 *Is Equity Crowdfunding a Good Tool for Social Enterprises?,* by Cosma, S., Grasso, A.G., Pagliacci, F. and Pedrazzoli, A. (February, 2018).
66 *Household Preferences for Socially Responsible Investments,* by Rossi. M.C., Sansone, D., Torricelli, C. and van Soest, A. (February2018).
65 *Market-Book Ratios of European Banks: What does Explain the Structural Fall?,* by Ferretti, R.,Gallo, G., Landi, A. and Venturelli. V. (January 2018).
64 *Past Income Scarcity and Current Perception of Financial Fragility*, by Baldini, M., Gallo, G. and Torricelli, C. (December 2017).
63 *How does Financial Market Evaluate Business Models? Evidence from European Banks,* by Cosma, S., Ferretti, R.,Gualandri, E., Landi, A. and Venturelli, V. (May 2017)
62 *Individual Heterogeneity and Pension Choices. How to Communicate an Effective Message?*, by Gallo, G., Torricelli, C. and van Soest, A. (April 2017)
61 *The Risk-Asymmetry Index,* by Elyasiani, E., Gambarelli L. and Muzzioli, S.(December 2016)
60 *Strumenti per il sostegno finanziario di famiglie e microimprese: il caso italiano (Policies to help financially vulnerable Italian households and micro-businesses),* by Cotterli, S. (December 2016)
59 *A test of the Behavioral versus the Rational model of Persuasion in Financial Advertising,* by Ferretti, R., Pancotto, F. and Rubaltelli, E. (May 2016)
58 *Financial connectedness among European volatility risk premia,* by Cipollini, A., Lo Cascio, I. and Muzzioli, S. (December 2015)
57 *The effectiveness of insider trading regulations. The case of the Italian tender offers,* by Ferretti, R., Pattitoni, P. and Salinas, A. (September 2015)
56 *Introducing Aggregate Return on Investment as a Solution for the Contradiction between some PME Metrics and IRR,* by Altshuler D. and Magni, C.A. (September 2015)
55 *'It's a trap!' The degree of poverty persistence in Italy and Europe,* by Giarda, E. and Moroni, G. (September 2015)
54 *Systemic risk measures and macroprudential stress tests. An assessment over the 2014 EBA exercise*. by Pederzoli, C. and Torricelli,C. (July 2015)
53 *Emotional intelligence and risk taking in investment decision-making,* by Rubaltelli, E., Agnoli, S., Rancan, M.and Pozzoli, T. (July 2015)

52 *Second homes: households' life dream or wrong investment?*, by Brunetti, M. and Torricelli, C. (May 2015)

51 *Pseudo-naïve approaches to investment performance measurement,* by Magni, C.A. (February, 2015)

50 *Monitoring systemic risk. A survey of the available macroprudential Toolkit,* by Gualandri, E. and Noera, M. (November 2014).

49 *Towards a macroprudential policy in the EU: Main issues,* by Gualandri, E. and Noera, M. (November 2014).

48 *Does homeownership partly explain low participation in supplementary pension schemes?,* by Santantonio, M., Torricelli, C., and Urzì Brancati M.C., (September 2014)

47 *An average-based accounting approach to capital asset investments: The case of project finance,* by Magni, C.A. (September 2014)

46 *Should football coaches wear a suit? The impact of skill and management structure on Serie A Clubs' performance,* by Torricelli, C., Urzì Brancati M.C., and Mirtoleni, L. (July 2014)

45 *Family ties: occupational responses to cope with a household income shock,* by Baldini, M., Torricelli, C., Urzì Brancati M.C. (April 2014)

44 *Volatility co-movements: a time scale decomposition analysis,* by Cipollini, I., Lo Cascio I., Muzzioli. S. (November 2013)

43 *The effect of revenue and geographic diversification on bank performance,* by Brighi, P., Venturelli, V. (October 2013)

42 *The sovereign debt crisis: the impact on the intermediation model of Italian banks,* by Cosma,S., Gualandri, E. (October 2013)

41 *The financing of Italian firms and the credit crunch: findings and exit strategies,* by Gualandri, E., Venturelli, V. (October 2013)

40 *Efficiency and unbiasedness of corn futures markets: New evidence across the financial crisis,* by Pederzoli, C., Torricelli, C. (October 2013)

39 *La regolamentazione dello short selling: effetti sul mercato azionario italiano (Short selling ban: effects on the Italian stock market)*, by Mattioli L., Ferretti R. (August 2013)

38 *A liquidity risk index as a regulatory tool for systematically important banks? An empirical assessment across two financial crises*, by Gianfelice G., Marotta G., Torricelli C. (July 2013)

37 *Per un accesso sostenibile delle Pmi al credito (A sustainable access to credit for SMEs),* by Marotta, G. (May 2013)

36 *The unavoidable persistence of forum shopping in the Insolvency Regulation*, by Mucciarelli, F.M. (April 2013)

35 *Rating Triggers, Market Risk and the Need for More Regulation,* by Parmeggiani, F. (December 2012)

34 *Collateral Requirements of SMEs: The Evidence from Less–Developed Countries*, by Hanedar, E.H. Broccardo, E. and Bazzana, F. (November 2012)

33 *Is it money or brains? The determinants of intra-family decision power*, by Bertocchi, G., Brunetti, M. and Torricelli, C. (June 2012)

32 *Is financial fragility a matter of illiquidity? An appraisal for Italian households*, by Brunetti, M, Giarda, E. and Torricelli, C. (June 2012)

31 *Attitudes, personality factors and household debt decisions: A study of consumer credit,* by Stefano Cosma and Francesco Pattarin (February 2012)

30 *Corridor implied volatility and the variance risk premium in the Italian market,* by Silvia Muzzioli (November 2011)

29 *Internal Corporate Governance and the Financial Crisis: Lessons for Banks, Regulators and Supervisors,* by Gualandri, E., Stanziale, A. and Mangone, E. (November 2011)

28 *Are defined contribution pension schemes socially sustainable? A conceptual map from a macroprudential perspective,* by Marotta, G. (October 2011)

27 *Basel 3, Pillar 2: the role of banks' internal governance and control function*, by Gualandri, E. (September 2011)

26 *Underpricing, wealth loss for pre-existing shareholders and the cost of going public: the role of private equity backing in Italian IPOs*, by Ferretti, R. and Meles, A. (April 2011)

25 *Modelling credit risk for innovative firms: the role of innovation measures*, by Pederzoli C., Thoma G., Torricelli C. (March 2011)

24 *Market Reaction to Second-Hand News: Attention Grabbing or Information Dissemination?*, by Cervellati E.M., Ferretti R., Pattitoni P. (January 2011)

23 *Towards a volatility index for the Italian stock market*, by Muzzioli S. (September 2010)

22 *A parsimonious default prediction model for Italian SMEs*, by Pederzoli C., Torricelli C. (June 2010)

21 *Average Internal Rate of Return and investment decisions: a new perspective,* by Magni C.A. (February 2010)

20 *The skew pattern of implied volatility in the DAX index options market,* by Muzzioli S. (December 2009)

19 *Accounting and economic measures: An integrated theory of capital budgeting,* by Magni C.A. (December 2009)

18 *Exclusions of US-holders in cross-border takeover bids and the principle of equality in tender offers*, by Mucciarelli F. (May 2009).

17 *Models for household portfolios and life-cycle allocations in the presence of labour income and longevity risk*, by Torricelli C. (March 2009)

16 *Differential evolution of combinatorial search for constrained index tracking*, by Paterlini S, Krink T, Mittnik S. (March 2009)

15 *Optimization heuristics for determining internal rating grading scales*, by Paterlini S, Lyraa M, Pahaa J, Winker P. (March 2009)

14 *The impact of bank concentration on financial distress: the case of the European banking system*, by Fiordelisi F, Cipollini A. (February 2009)

13 *Financial crisis and new dimensions of liquidity risk: rethinking prudential regulation and supervision*, by Landi A, Gualandri E, Venturelli V. (January 2009)

12 *Lending interest rate pass-through in the euro area: a data-driven tale*, by Marotta G. (October 2008)

11 *Option based forecast of volatility: an empirical study in the Dax index options market*, Muzzioli S. (May 2008)

10 *Lending interest rate pass-through in the euro area*, by Marotta G. (March 2008)

9 *Indebtedness, macroeconomic conditions and banks' losses: evidence from Italy*, by Torricelli C, Castellani S, Pederzoli C. (January 2008)

8 *Is public information really public? The role of newspapers*, Ferretti R, Pattarin F. (January 2008)

7 *Differential evolution of multi-objective portfolio optimization*, by Paterlini S, Krink T. (January 2008)

6 *Assessing and measuring the equity gap and the equity*, by Gualandri E, Venturelli V. (January 2008)

5 *Model risk e tecniche per il controllo dei market parameter*, Torricelli C, Bonollo M, Morandi D, Pederzoli C. (October 2007)

4 *The relations between implied and realised volatility, are call options more informative than put options? Evidence from the Dax index options market*, by Muzzioli S. (October 2007)

3 *The maximum LG-likelihood method: an application to extreme quantile estimation in finance*, by Ferrari D., Paterlini S. (June 2007)

2 *Default risk: Poisson mixture and the business cycle*, by Pederzoli C. (June 2007)

1 *Population ageing, household portfolios and financial asset returns: a survey of the literature*, by Brunetti M. (May 2007)