The Ecb's Unconventional Monetary Policy Effects on Stock Returns of European Banks

ABSTRACT

The present work analyses the unconventional monetary policies effects in the European banks, considering the unexpected component of the change in the market interest rate. We use an event study for a sample of 47 Eurozone banks from 2000 to 2018. We find a significant impact of ECB unconventional monetary policy surprises on Eurozone bank stock returns; the impact is stronger when the shock is expansionary, and when it takes place in a day without a governing council meeting. Our study contributes to the existent literature considering not only the effect of the unconventional monetary policies in term of unexpected components on the stock returns, but even the interaction between these policies and the characteristics of the banks.

Keywords: unconventional monetary policies; banks' stock returns; event study

1. Introduction

In normal times, the ultimate objectives of the economic policy in term of macroeconomic variables such as output growth, employment, inflation, etc. are achieved through monetary policy instruments and operations that are called "conventional". This means that they are known in advance and the decisions in term of prices (rates) and amount of assets are usually not so quantitatively relevant, and they are usually characterized by smooth adjustments. Understanding the links between monetary and assets prices is very important in order to appreciate the policy transmission mechanism. A considerable amount of academic literature examines the relationship between monetary policy and stock market (see among others, Bernanke and Kuttner, 2005; Delivorias, 2015).

The rapid changes in market conditions in the second half of the 2000s and the financial crisis that ensued have shown that conventional monetary policies are often unable to rapidly restore the equilibrium conditions of the real economics, putting on evidence the necessity to adopt extraordinary monetary measures. These are called "unconventional" monetary policies and they are mainly composed of a sharp variation of the main reference rates and direct operations in the bond markets. The goal is to improve the market conditions increasing the amount of liquidity in the economic system, a reduction in the interest rates and a positive effect on the asset prices. Even regarding the unconventional monetary policies and the impact on stock prices, we find a more recent literature focused on different currency areas where these tools were used.

A relevant part of the studies about the relationship between monetary policy and stock prices is focused on the banking sector, even in comparison with other sectors of the economy, considering the role that they assume in the monetary policy transmission and the particular sensibility to the changes in the financial conditions of the economic system. In addition to estimate how bank stocks are affected by monetary policy, even the characteristics of the banks are relevant and determine a diverse sensitivity grade to the changes in the market conditions. In particular, the traditional role of banks to perform maturity transformation and assets portfolio composition are considered together with other characteristics to analyse the interest rate effect on bank stocks.

Both conventional and unconventional monetary policies are evaluated and mainly demonstrate a significant effect of interest rate changes on bank stock returns respect to other economic sectors.

In our paper, we focus on the unconventional monetary policies in the euro area in the last decade for a sample of European banks considering the unexpected component of the change in the market interest rate. We use an event study (Rosa, 2012; Rogers *et al.*, 2014; Haitsma *et al.*, 2016) and extend it to banks' characteristics (Yin and Yang, 2013). We consider a sample of 47 Eurozone banks, with their historical stock price from 2000 to 2018, and the average value of some characteristics over the same time period. To examine the aggregate banking sector impact, we collect the historical prices of FTSE bank indexes of various countries or areas.

This study contributes to extending the existent literature considering not only the effect of the unconventional monetary policies in term of unexpected components on the stock returns in the banking sector in the euro area, but even the interaction between these policies and the characteristics of the banks. To the best of our knowledge, this last aspect seems to be partially disregarded by the literature, while its deepening would allow to better design the feature of the monetary policy tools.

The remainder of the paper is organized as follows. Section 2 examines the literature about the impact of monetary policy on the stock market, and, in particular, o bank stocks. In the Section 3, we describe the dataset and the methodology. Section 4 presents the results for the aggregate bank index, and then distinguishes the variation of the spread into decreases and increases, into changes and no changes in the policy direction, and into contemporaneous and not contemporaneous conventional policy days. Then, it examines for each category of the characteristics what is the impact on the sensitivity to unconventional monetary policy. We check the robustness of the results using alternative dataset specifications. Section 5 discusses our findings and section 6 concludes the work with our policy implications.

2. Literature Review

Monetary policy and bank stocks

Among of the main articles which study the relationship between monetary policy and stock prices of banks, Flannery and James (1984) and Kwan (1991) find that the maturity composition of assets and liabilities affects the interest rate sensitivity of bank stocks. Chance and Lane (1980) find that, when taking into account the market return, the interest rate does not explain the stock returns of financial institutions. Lynge and Zumwalt (1980) instead find that "bank common stock returns are sensitive to debt returns …[, and they are] more [sensitive] than […] industrial common stock returns". As stated by Booth and Officer (1985), "a possible explanation for the conflicting results is due to differences in procedures for the orthogonalizing changes in interest rates and the market return". Booth and Officer (1985) use "a pooled cross section time series model … [to obtain] more powerful statistical tests of the significance of interest rate influence". The results show that "[bank] stocks show extra-market sensitivity to actual, anticipated and unanticipated changes in short-term interest rates. … [This sensitivity is not found] in the portfolio of non-financial securities, …[so] bank securities are more interest rate sensitive than non-financial securities". Akella and Chen (1990) find that "the interest rate sensitivity of bank stock returns […] depends on the econometric specification and the period considered", and the sensitivity is found only for long term interest rates, rather than for short term rates. Kwan (1991) uses "a random coefficient two-index model for commercial bank stock returns, …[and finds] that commercial bank stock returns are significantly interest rate sensitive. The effect of interest rate changes on bank stock returns is found to be positively related to the maturity mismatch between the bank's assets and liabilities". Elyasiani and Mansur (1998) use a "generalized autoregressive conditionally heteroskedastic in the mean (GARCH-M) methodology to investigate the effect of interest rate and its volatility on the bank stock return generation process …[, to remove] the restrictive assumptions of linearity, independence and constant conditional variance in modeling bank stock returns. Their results show that the interest rate and its volatility directly impact the first and the second moments of bank stock returns distribution, respectively". The paper of Madura and Schnusenberg (2000) has two objectives: to investigate the stock price reaction of commercial banks to announced changes in the relevant policy tool by the Federal Reserve, and how this reaction depends on financial characteristics of these banks. They investigate three operating regimes: interest rate targeting (September 1974-October 1979); reserves targeting (October 1979-August 1987); a new phase of interest rate targeting (August 1987-December 1996). Madura and Schnusenberg regress a portfolio return of commercial banks on the return on the S&P 500 index and on the change in the target rate orthogonalized with respect to the market return. In a second regression, they add the change in the target rate multiplied by a dummy variable equal to 1 if there is a discount rate announcement (target federal funds rate announcement in the reserves targeting period). After that, the change in the target rate is split into positive and negative changes, and the previous two regressions are run for positive and then for negative changes. Their results provide strong evidence of an inverse relation between changes in the Fed's relevant policy tools and bank equity returns during each of the three periods of Fed operating procedures examined. Furthermore, there is evidence on an asymmetric effect of interest rate change: only decreases in the relevant interest rate result in a significant change in bank equity returns in the opposite direction. According to them, these results may be attributed to banks' adjusting deposit rates faster than lending rates in response to reductions in the Fed's relevant policy tool, or to a higher elasticity of loan demand in response to a decrease in interest rates than to an increase in interest rates. Another result is that the simultaneous change of both policy tools does not transmit additional information about the Fed's future intentions. The models applied do not distinguish rate changes between expected and unexpected components. The paper of Yin and Yang (2013) investigates how bank characteristics affect bank stock reactions to changes in the federal funds rate target. The daily return of bank stocks is regressed on the unexpected component of target rate change, and on the S&P 500 daily return orthogonalized with respect to the unexpected target rate changes, which works as a control variable. The regression is run only for days of announcement of change in the federal funds rate target. The method of Bernanke and Kuttner (2005) is used to extract the unexpected component of the target change. The panel data set consists of 401 US banks in the period October 1988 - December 2007. The coefficient of the unexpected target rate change "measures the reaction of bank stock returns to the unexpected changes in the federal funds rate target". The objective is to estimate how this reaction depends on four bank characteristics: bank size, business activity mix, funding sources and bank soundness. Their results provide strong evidence that large banks are more interest rate sensitive than small banks, which "provides at least partial explanation for the demise of large US banks during the 2008 financial crisis, which followed a series of federal funds rate target increases prior to 2008. There is no conclusive evidence about the effect of nonbanking activity. Although more traditional banking business is associated with less sensitivity to monetary shocks, this relationship disappears when controlling for other bank-level variables in the regressions. Furthermore, there is no strong support for the soundness effect with the Z score as a measure of bank soundness. However, when the capital ratio increases to a certain level, the marginal effect of holding more capital diminishes.

Unconventional monetary policy and bank stocks

To the best of our knowledge, few papers treat the specific argument of the impact of unconventional monetary policy on bank stocks. Ashraf *et al.* (2017) use an event study and a VAR to test if the Quantitative Easing (QE) regime changed the impact of the conventional monetary policy on stocks returns of US financial institutions. They use a sample made of daily and weekly returns from 18 December 2002 to 30 November 2011 of 855 financial firms, then divided into two subsamples: the pre-QE period, from 18 December 2002 to 24 December 2008, and the QE period, from 31 December 2008 to 30 November 2011. Summary statistics of conventional and unconventional monetary policy tools and monetary shocks support the argument that there is a regime shift in both monetary policy and aggregate stock return variables across the pre-QE and QE regimes. With the methodology of Bernanke and Kuttner (2005), monetary shocks are split into expected and unexpected components. It is also considered the change in the Fed's total asset holdings in special purchase programs. In a panel regression, the bank stock returns are regressed on these three variables, the dummy QE equal to one during the QE period, and the three variables multiplied by the dummy QE. Regressions are run for seven financial sector sub-industries, and two VAR models are estimated. The first VAR shows the effect of expected and unexpected monetary shocks, EXP and UNEXP, on aggregate stock returns, measured by the returns on the Dow Jones and S&P 500 stock market indexes. It also reports the impact on aggregate market volatility, measured by VIX. The second VAR measures] the impact of monetary policy tools, like the Fed Funds rate, money supply and Fed special asset holdings on the market indexes. Results from the panel regressions show that "monetary shocks and unconventional policy tools have an increased marginal impact on the stock returns of financial firms during the QE period. Moreover, unconventional monetary policy tools are significant factors in explaining the stock returns of financial institutions, including those of both depository and non-depository institutions. In addition, the impact of special asset programs has a positive and significant marginal impact on the stock returns of both depository and non-depository financial firms during the QE period, consistent with the motivations of QE policies of imparting liquidity into the financial system. Results from the VAR models "suggest that, during QE regimes, only changes in the Federal Reserve's total assets held under special programs have an impact on aggregate stock market returns. The evidence is consistent with the hypothesis that, as the Federal Funds rate approaches the zero-bound threshold, it loses its effectiveness as a monetary policy tool, so the Federal Funds rate and monetary measures of central bank policy do not consistently explain stock index returns.

Fiordelisi and Ricci (2016) compare the results for the global systemically important banks (G-SIBs) with those for non-financial corporations. Their model consists of an event study. The dependent variable of the model is the cumulated abnormal return, that is the sum of abnormal returns (actual return minus the return predicted by the market model) around the announcement date. The explanatory variables are dummy variables indicating an announcement in a specific category of policy intervention. Results show that different policy interventions caused different reactions by the market. For G-SIBs, monetary policy interventions, both expansionary and restrictive, have a positive market impact, but for NFCs both expansionary and restrictive measures have a negative impact. Both G-SIBs and NFCs negatively react to the end of support measures, bank failures and bailouts. Moreover, G-SIBs are more sensitive to policy interventions on their own currency area, and some types of interventions have different impact depending on the geographic area.

Kobayashi *et al.* (2006) analyse the impact of QE in Japan, adding dummy variables for event days to the CAPM model. The basic model consists of an extension of the CAPM, where the dependent variable is the return of the TOPIX bank index and the explanatory variable is the return of the overall TOPIX index, and dummy variables for each event day are included. Results show that "excess returns of Japanese banks were greater when increases in the BOJ current account balance target were accompanied by non-standard expansionary policies. … [In addition, a bigger positive impact is found for] financially weaker Japanese banks".

3. Dataset and Methodology

We employ an event study, based on Haitsma *et al.* (2016). The basic model is the following [1]:

$$R_t = \alpha + \beta_u Unexp_t + \beta_e Exp_t + \beta_s Spread_t + \beta_x X_t + \varepsilon_t \qquad [1]$$

As event days, Haitsma *et al.* (2016) take the days of governing council meetings as conventional monetary policy days, and as unconventional monetary policy days they take the dates used in Rogers *et al.* (2014). We consider the period 01/01/2000 - 30/09/2018, taking the days of governing council meetings as conventional monetary policy days, and as days of unconventional monetary policy we employ those used by Haitsma *et al.* (2016), and after February 2015 we add days of press releases with news of unconventional monetary policy[1].

The dependent variable "R_t" is the return of an index or of a portfolio of bank stocks.

"$Unexp_t$" and "Exp_t" are the unexpected and the expected components of the one-day change in the policy rate, respectively. In particular, "$Unexp_t$" is the one-day change in the implied future rate of the Eurex continuous 3 months EURIBOR future, where the future rate is 100 minus the future price, "Exp_t" is the difference between the actual change in the policy rate and "$Unexp_t$".

"$Spread_t$" is the one-day change in the spread, that is the one-day change in the difference between the 10-year government bond yield in Italy and in Germany[2]. The policy rate is the main refinancing rate.

"X_t" is a vector of control variables: it includes the same variables of Haitsma *et al.* (2016), that is the one-day return on the MSCI World ex Europe and every dummy variable used in the model.

"ε_t" is the error term.

The main focus of our analysis is on "β_s", the coefficient of Spread, which represents an estimate of the change in basis points of the portfolio returns in response to a change of one basis point on the sovereign spread, representing an unconventional monetary policy surprise[3]. A change in the spread in an event day does not reflect an unconventional monetary policy decision, but a difference between this decision and what was expected.

Since, in general, the models show heteroskedasticity, all regressions are estimated with the robust option for the standard error.

[1] The days of governing council meetings and press releases are taken from the ECB website.

[2] Note that Spread with the initial capital letter refers to the variable, spread refers to the effective sovereign spread.

[3] Spread is set equal to zero before 22/08/2007, the first day of unconventional monetary policy, since a substantial unconventional monetary policy is not available before. Using a dummy variable equal to 1 after that day and interacting it with Spread, we found that Spread is strongly significant in the period following that day, instead it is not significant before.

This model is applied to two different analysis. Firstly, we analyse the impact on the aggregate banking sector of the Eurozone. We then examine how the bank characteristics affect the stocks' sensitivity to monetary policy.

Aggregate banking sector

For the analysis on the aggregate banking sector, we examine three areas: Eurozone, "World", and Europe excluding Eurozone (Europe intends European countries, therefore not only countries of the European Union), looking at both banking sector indexes and whole market indexes. In this way, we can estimate the impact of unconventional monetary policy surprises on Eurozone banks stock returns and compare it with the impact outside the Eurozone and to the impact on the whole market.

In addition, we estimate the impact on single country indexes as a robustness check. For Eurozone we have indexes of Austria, Belgium, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain; for Europe non-Eurozone, we have UK, Czech Republic, Denmark, Sweden, Poland, Switzerland, Norway; for the rest of the world, we have USA, China, Japan, Brazil, India, Mexico, Canada[4].

We collect banks' historical prices available in the period 01/01/2000 to 30/09/2018, from the 11 countries which are on the Eurozone since 1999[5].

We compute the log returns of historical adjusted closing prices, equal to the natural logarithm of the ratio between the adjusted closing price of that day and the adjusted closing price of the day before, that is LN ($price_t/price_{t-1}$).

Insert table 1 here

We collect some characteristics of the banks from Yin and Yang (2013), and from Haitsma *et al.* (2016), summarized in the Table 2.

Insert table 2 here

We then estimate the model for two overall portfolios, that is portfolios with all the banks of the sample, one equally weighted and another "value-weighted" by market capitalization. To see the impact of the characteristics we construct three portfolios, High, Medium and Low, for each characteristic. We compute the percentile 1/3 and 2/3 of each characteristic, the portfolios consist of

[4] All indexes used in this analysis are FTSE indexes, and they are taken from Thomson Reuters Eikon.

[5] Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain.

banks with a value of the characteristic lower or equal than the percentile 1/3 for the portfolio Low, higher than the percentile 1/3 and lower than the percentile 2/3 for the portfolio Medium, higher or equal than the percentile 2/3 for the portfolio High. We compute the average return of each portfolio. This method is applied also by Madura and Schnusenberg (2000).

Data are obtained from Thomson Reuters Eikon, except the BTP/BUND 10 year spread that comes from Bloomberg, and the main refinancing rate from the ECB Statistical Data Warehouse. The date of the change in the main refinancing rate is not the day of the actual change, but the day of the announcement. Days of monetary policy are taken from the ECB website and from Haitsma *et al.* (2016). Results and plots are obtained with the statistical software Stata.

Model's Specifications and dataset

We consider alternative specifications of the model and of the dataset, for both types of analysis. We use dummy variables to check the impact of some events and of some characteristic of the explanatory variables, and we consider variations of the baseline dataset, where we use another Euribor future, we use a different time window, we exclude outliers, and finally we increase the number of banks reducing the time period.

The various model specifications consist of using dummy variables and interacting them with the three explanatory variables. Table 3 describes these dummy variables.

Insert table 3 here

We estimate one model for each type of dummy variable. The explanatory variables of each of these models are the three variables of the basic model multiplied by the dummy and the three variables multiplied by one minus the dummy, with MSCI World ex Europe return and the dummy variable/variables as control variables. The models include a constant.

Therefore, the explanatory variables of the models are: Unexp*D, Unexp*(1-D), Exp*D, Exp*(1-D), Spread*D, Spread*(1-D), MSCI World ex Europe return, D, where D is the dummy variable. For sign and change direction the dummy is different for each variable.

The first model is the basic one, with the variables for conventional and unconventional monetary policy considered for the entire sample period. The second model adds the dummy UN, according to Haitsma *et al.* (2016), and equal to 1 starting from the 22/08/2007, the day of the first unconventional monetary policy measure, and this dummy is interacted with the unexpected and expected rate change, whereas the spread is already multiplied by this dummy, since it is imposed equal to zero before that day, given that unconventional measures were not present before. In this way, the sample is divided into two periods, before and after the start of unconventional measures, where before only the expected and unexpected rate change are the explanatory variables, and after there is also the spread, which represents the unconventional monetary policy shock.

The third model adds the dummy QE to the previous model, equal to 1 starting from the 22/01/2015, the day of the announcement of the start of the QE. Therefore, this model divides the sample into three periods, before the crisis (2000-2007), after the crisis and before the QE (2007-2015) and after the start of QE (2015-2018). This dummy variable is used also by Ashraf *et al.* (2017), with a different model.

The fourth model divides each of the three variables into positive and negative values. The dummy variables *Pu*, *Pe*, *Ps* are equal to 1 when Unexp, Exp and Spread are positive. In this way we can assess if expansionary and restrictive policies have a different impact. This type of dummy variable is used also by Nakazono and Ikeda (2016), with a different model.

The fifth model defines the dummy variables *Cu*, *Ce*, *Cs*, equal to 1 when there is a change in the sign of Unexp, Exp and Spread respectively. In this way, the variables are divided based on whether there is a change in the sign of the variable or not, and so whether there is a change in the direction of the policy, from expansionary to contractionary or *vice versa*. The inspiration for this dummy variable comes from Ehrmann and Fratzscher (2004), which investigate the role of a change in the direction of policy, even if with a different model.

The sixth model considers a dummy, *Cont*, equal to 1 in those days which are both conventional and unconventional event days. This model allows watching whether a contemporaneous announcement of conventional and unconventional monetary policy has a different effect (note that contemporaneous means on the same day). Note that, differently from the dummy for positive values and for sign changes, this dummy is equal for each variable, since it is not referred to a variable, but to event days, as the dummy UN and QE. This dummy variable comes from Madura and Schnusenberg (2000), which use a dummy variable to see if a contemporaneous discount rate and federal funds target rate change has a different impact.

The models with the sign dummy and the change direction dummy are computed also adding the dummy UN and QE, to see if the sign and the sign change matters differently in the three periods. We examine also how results change when we consider the actual change of the conventional policy tool not divided into the expected and unexpected component.

Each model with dummy variables is also computed in the alternative specification where we consider the three variables and the three variables multiplied by the dummy, that is: Unexp, Unexp*D, Exp,

Exp*D, Spread, Spread*D, and control variables. In this way, we try to evaluate if the difference between the coefficients is significant.

Insert table 4 here

Table 4 describes the alternative datasets considered. The dataset Twoday considers a different window for the evaluation of events. The returns are computed as the natural logarithm of the ratio between the adjusted closing price on the day after the announcement and that on the day before, instead of the day of the announcement and the day before. Also, Unexp, Exp, Spread and MSCI World ex Europe return are computed with this two day window. In this way, we capture also market reactions that happen the day after, given that the reaction could be delayed. However, this method increases the influence of omitted variables.

Secondly, the dataset Outliers removes from the sample some event days which are considered outliers. We compute the residuals of the model with the two time dummy, UN and QE (the third model described in the previous subsection), with the capitalization weighted portfolio as the dependent variable, and we remove from the sample the event days with an absolute value of the residual higher than a certain threshold. The threshold chosen is 2.5, resulting in 19 event days eliminated. Bernanke and Kuttner (2005) consider the elimination of outliers, even if computed differently.

Thirdly, the dataset Future considers another continuous Euribor future. We found two continuous Euribor future available, one from Eurex, used in the baseline dataset, and one from Liffe. Comparing the time series of the two futures, the mean and variance are very similar. However, taking the first difference, the future by Eurex has a higher volatility and a slightly higher mean. Bredin *et al.* (2009) use the Euribor future by Eurex.

Fourthly, given that the large sample size (2000-2018) has the drawback to limit the number of banks in the dataset, the dataset Ext2007 restricts the sample size to the period of unconventional monetary policies, starting from 22/08/2007. In this way we obtain a dataset of 70 banks from the countries which constituted the Eurozone on 2007, that is the 11 countries on the Eurozone since its birth considered in the baseline dataset, plus Greece, and Slovenia, which joined later. This allows having more banks in the dataset, even if we do not control for the conventional monetary policy in the pre-crisis period. Finally, the two datasets Twodayfut and Ext2007fut are the datasets Twoday and Ext2007 with the Liffe future instead of the Eurex future.

These alternative datasets are considered in both types of analysis, except the extended datasets (Ext2007 and Ext2007fut) which can be applied only to the analysis of bank characteristics.

In order to conduct all the variables to the same unit of measure, stock returns and MSCI World ex Europe returns are multiplied by 100, and the spread, which is originally expressed in basis points, is divided by 100. In this way, all variables are in percentage points.

4. Main findings

Insert table 5 here

Insert table 6 here

The Table 5 shows that Spread is significant for all three areas, for both bank and market indexes. However, as expected, there is a clearly stronger impact on Eurozone rather than on the rest of Europe and the entire World. The Table 5 also reports the difference between coefficients for banking sector and the whole market. This difference shows an additional impact on banking sector with respect to the whole market. We compute the difference between coefficients for the banking sector and the whole market for single country indexes (only if both coefficients are significant). For all European countries this difference is positive, both inside and outside the Eurozone. For some non-European countries, it is slightly negative, and it ranges between -0.31 of China and 1.96 of USA. In the post QE period (Table 6) the impact of unconventional monetary policy surprises seems no more significant, but even the change in the impact is not significant, suggesting that the small sample size does not allow to establish a clear result.

We consider the model with the dummy for positive and negative values of variables, so the change in the spread is divided into increases and decreases, that is contractionary and expansionary unconventional monetary policy surprises. In total, we have 62 increases and 70 decreases of the spread, so the expansionary measures are more than the contractionary ones.

Insert table 7 here

The Table 7 shows that both expansionary and contractionary unconventional monetary policy surprises have a significant impact on index returns, but there is a stronger impact of expansionary unconventional monetary policy surprises than of contractionary ones, mainly in Eurozone but also outside. Results are supported by regressions of single country indexes.

We then consider the model with the dummy for a change in the sign of the variable. A day with a type of action (contractionary or expansionary) different from that of the previous event day is considered separately from a day with a type of action equal to the previous event day. We have 68 values of Spread with a change in the direction and 64 with no change in the direction.

Insert table 8 here

The Table 8 shows that there is a significantly negative impact in both cases, for all three areas and for both bank and market indexes. We find no evidence of a different impact of unconventional monetary policy surprises when there is a change in the direction, at least in Eurozone, given that we find a significant impact for the World market index, probably driven by the highly significant impact on USA market index.

We then consider the specification with the dummy equal to 1 during days of both conventional and unconventional monetary policy, to see if a contemporaneous announcement has a different impact. Among the event days, there are 21 days that are both conventional and unconventional monetary policy days. The low number of contemporaneous policy days could make the estimates not very reliable.

Insert table 9 here

The findings (Table 9) show that the impact of unconventional monetary policy surprises on Eurozone is different between the three types of event days. The strongest impact is during event days which are not governing council meeting days, then during governing council meeting days which are not unconventional monetary policy days, and finally the lower impact is during governing council meeting days which are also unconventional monetary policy days.

Conventional monetary policy

The two variables of conventional monetary policy ("Unexp" and "Exp"), are not significant for all our three main bank indexes in the baseline model. Among market indexes, we find a significant coefficient for "Unexp" for the World index. Only few single country market indexes have significant coefficients, supporting this result, with a significant coefficient on the equation for USA market index which may be the reason for the significant coefficient in the World market index (Table 10).

Insert Table 10 here

For Eurozone there is a bigger impact of “Unexp” on banks than on the whole market, and a different sign of the impact of “Exp” between bank and market indexes. Moreover, among the coefficients of “Unexp” for bank indexes, the Eurozone index has the highest absolute value, and conversely among market indexes it has the lowest absolute value. About the coefficients of “Exp”, for both bank and market indexes, the Eurozone index has the lowest absolute value.

We found a significant coefficient only for the World and not for Eurozone or Europe; this suggests that there is an impact on the world market, but this is driven not by Eurozone’s impact but by an impact on USA. The alternative models for Eurozone bank index show a significant coefficient for “Unexp” only when there is no change in the direction of policy. The results do not change much when considering alternative datasets.

Robustness check: alternative datasets

We check the robustness of the results considering four alternative dataset specifications: one with the Liffe Euribor future instead of the Eurex, two with the two-day window (one with the Eurex and one with the Liffe future), and the dataset with the exclusion of outliers.

The use of the Liffe future does not change the main results. However, for the alternative datasets with the two-day window and with the exclusion of outliers, the difference between coefficients of positive and negative values of Spread is not significant, contrary to the baseline findings. Similarly, with these datasets there is no more a significantly different impact of Spread when there is a contemporaneous conventional monetary policy.

Therefore, with the alternative datasets the impacts of the sign of Spread and of the contemporaneous conventional monetary policy disappear. This robustness check does not support our previous results, suggesting that it is preferable to keep all event days, to get a comprehensive result, and to use a one-day window, to avoid the influence of omitted variables.

The coefficients of Spread are almost always strongly significant, that is with a *p*-value equal to zero or very close to zero, for all dataset specifications. This implies that there is an impact of Spread on stock returns, not only for banks but also for the market, even if the impact is stronger on banks. Instead, the difference between the coefficients of positive and negative values of Spread, and for the types of monetary policy, are significant in the baseline specification, but with a *p*-value which is not zero, but lower than 0,1, so significant at 10% level. Therefore, alternative specifications could make the *p*-value higher than 0,1 if it is only slightly lower than 0,1.

Insert Table 11 here

For all datasets and for both bank and market indexes, the Eurozone indexes have always a higher coefficient in absolute value than the other indexes (Table 11). This suggests that, even if there is an impact of ECB unconventional monetary policy also outside the Eurozone, as expected the impact on Eurozone is stronger. Using the Liffe future instead of the Eurex future does not change much the coefficients. The exclusion of outliers reduces the impact of about one unity for Eurozone bank index, and in general the impact is slightly lower, even if again strongly significant; the two-day window in general increases the impact.

The impact of banks' characteristics

For each category of characteristics, we present four results. Firstly, the table with the coefficients of Spread, that is the estimate of the impact of unconventional monetary policy surprises, for the three portfolios High, Medium and Low for each characteristic. The categories of the characteristics are bank size, activity mix, bank soundness, funding sources, market data, and government securities. In addition, the tables show the trend of these coefficients, that is if the absolute value of the coefficients is increasing or decreasing with respect to the characteristic. Therefore, the trend is increasing (decreasing) if the High portfolio has a bigger (lower) sensitivity than the Medium, which in turn has a bigger (lower) sensitivity than the Low. If it is neither increasing nor decreasing, it is written max (min) if Medium has the maximum (minimum) absolute value. All coefficients are negative and strongly significant (*p*-value never exceed 0,001).

Given that all coefficients are negative, an increasing trend implies decreasing coefficients and vice versa. We check the robustness of results looking if results change in the alternative model specifications.

For each characteristic we test if the coefficients of Spread estimated for the three portfolios are significantly different from each other. For each characteristic we estimate the three equations of the portfolios High, Medium and Low with the method SURE (seemingly unrelated regressions), instead of estimating each equation with OLS separately (Madura and Schnusenberg, 2000). This allows to test the equality of the coefficients across equations. In the tables we have the *p*-values of the test for the equality of the coefficients, High=Medium, High=Low, Medium=Low, and High=Medium=Low for each characteristic.

Regression results and *p*-values of the tests are obtained for the baseline dataset (47 banks, 2000-2018) and for the extended dataset (70 banks, 2007-2018). Both results are obtained for the baseline model (without dummy variables).

We then estimate the baseline model for each single bank of the dataset, and take their coefficients of Spread, which represent their sensitivity to unconventional monetary policy surprises. For each characteristic we display the scatter plot of the sensitivity with respect to the value of the characteristic, together with the linear and quadratic prediction plots. Given that plots of the baseline and extended dataset lead to similar conclusions, we display the plots of the extended dataset, since it comprises more banks. A decreasing (increasing) trend of the scatter plot means an increasing (decreasing) sensitivity, given that coefficients are normally negative (all significant coefficients are negative). For each characteristic we regress the bank sensitivity on the value of the characteristics, according to Flannery and James (1984).

Insert Table 12 here

The Table 12 shows that the impact on bank size is increasing for all three measures, providing evidence that the sensitivity is stronger for biggest banks. The impact increases more from Low to Medium than from Medium to High. The models estimated with the actual change of conventional policy tool, instead of separating the expected and unexpected components, support the results. The results from the extended dataset are all in line with those from the baseline dataset, with coefficients slightly different, but with the trend always increasing.

Insert Table 13 here

In the baseline dataset (Table 13), for capitalization portfolios the impacts on High and Medium portfolios are not significantly different, suggesting that, once reached a certain level of capitalization, the impact does not vary much when capitalization increases. However, with the extended dataset, also these two portfolios have significantly different impacts. In general, this test confirms the increasing impact of bank size.

Insert Figure 1 here

The scatter plots on the Figure 1 and the Table 14 confirm the findings: the banks' sensitivity increases with respect to the characteristic. The number of employees and total assets are strongly related to bank sensitivity to unconventional monetary policy surprise. For market capitalization, there is an impact only below a certain level of market capitalization.

Insert Table 14 here

Insert Table 15 here

The Table 15 shows that, for the net interest income portfolios, the impact is maximum for the Medium portfolio, and the coefficients of the High and Low portfolios are similar. From the models with dummy variables, we find again a maximum value for the Medium portfolio, with two exceptions. Firstly, the impact becomes increasing in the post-QE period. Secondly, the impact is decreasing when there isn't a direction change, even if the difference between coefficients is low. Results with the actual change of the policy rate are similar. The extended dataset provides an opposite result, with the Medium portfolio having the minimum impact. About the loan to asset ratio the higher the percentage of loans on the bank's assets, the lower the sensitivity to unconventional monetary policy surprises. Results of the models with dummy variables are in line with the baseline, since for all specifications the impact is decreasing. The extended dataset provides the same decreasing trend, with lower coefficients of all three portfolios.

Insert Table 16 here

The Table 16 and the Figure 2 shows that, for portfolios based on loans, the differences between coefficients are all strongly significant, for both baseline and extended dataset. This suggests that banks with a low net interest income have a similar sensitivity of those with a high net interest income, but in the middle the sensitivity is significantly higher. Results differ with the extended dataset, where the Medium portfolio has a minimum value instead of a maximum, and the Medium and Low portfolios do not have a significantly different coefficient. This could suggest an increasing trend, where the sensitivity do not vary significantly from Low to Medium, but it increases significantly from Medium to Low.

Insert Figure 2 here

Insert Table 17 here

The regression results in Table 17 support the findings from portfolios: the net interest income share to the total operating income does not affect the sensitivity of the banks to unconventional monetary policy, and the evidence about the loan to asset ratio is not clear, since portfolios and SURE test suggest a decreasing sensitivity, but the plot do not support this finding.

Insert Table 18 here

Insert Table 19 here

Insert Figure 3 here

Insert Table 20 here

Tables 18, 19, Figure 3, and Table 20 indicate that the bank soundness does not affect the sensitivity to unconventional monetary policy surprises.

Insert Table 21 here

Insert Table 22 here

Insert Figure 4 here

Insert Table 23 here

Tables 21, 22, Figure 4, and Table 23 reveal that there is no clear relationship between the two measures of funding sources and bank sensitivity, something previously found also for the capital to asset ratio, another measure of funding sources.

Insert Table 24 here

Insert Table 25 here

Insert Figure 5 here

Insert Table 26 here

The market data chosen for this analysis are the market to book ratio and the price to earnings ratio. The Tables 24, 25, Figure 5, and Table 26 do not find evidence of an impact of the two-market data on the sensitivity.

Insert Table 27 here

Insert Table 28 here

Insert Figure 6 here

Insert Table 29 here

Given that asset purchase programs are targeted to buy mainly government securities, the banks which hold them in their portfolio are sensitive to these actions. The interest on government securities is a measure of the government securities held by a bank. The Tables 27, 28, Figure 6 and Table 29 show a clearer impact of bank size than government securities. This could suggest that the measure of government securities has an impact only through its correlation with bank size.

Correlation matrix of sensitivity and characteristics

The Tables 30 and 31 display a high correlation between employees and assets (0.97, and 0.93 for the extended dataset), and both are highly correlated with the sensitivity. This suggests that the bank size, expressed either in terms of number of employees or total assets, is the characteristic more correlated to the bank sensitivity, among the characteristics examined. In addition, interest on government securities has a high correlation with these two characteristics, in fact larger banks can hold more government securities, and so they earn more interest.

Other strong correlations are found for market capitalization with employees and assets, even if only in the baseline dataset, and for interest on government securities with market capitalization. There is also a high correlation (-0.71) between debt to equity and market to book ratio, but in the extended dataset it decreases a lot (-0.46).

Insert Table 30 here

Insert Table 31 here

Multiple regressions

We compute regressions of the bank sensitivity on the six categories of characteristics, considering all the various combinations of characteristics for each category. We have 3 characteristics for bank size, 2 for activity mix, 1 for bank soundness, 2 for funding sources, 2 for market data, 1 for government securities, for a total of 24 regressions.

Insert Table 32 here

The results show that for bank size, activity mix and government securities, findings are in line with previous results. Instead, for capital to asset ratio and market data, we find some evidence of an impact; for funding sources, the evidence is not clear, as for the previous findings.

Comparison with conventional monetary policy

Insert Table 33 here

Our results put on evidence that the conventional monetary policy in general has not the same trend in the two periods and for the two components of the policy rate, Unexp and Exp (Table 33). The only characteristic where we find always the same trend is market capitalization. In general, the trend of conventional monetary policy can be different from those for unconventional monetary policy, but they are never really contrasting results, for example we never find a clear decreasing trend of one type of policy and a clear increasing trend for the other type.

Insert Table 34 here

Insert Table 35 here

In general, the trends obtained with the alternative dataset specifications do not differ much with respect to the baseline dataset, providing robustness to our results. An equally weighted portfolio of Eurozone banks reacts to a 1 basis point change in the spread with an opposite change of the returns of about 8 basis points on a daily basis, and a capitalization weighted portfolio instead reacts with an opposite change of 10 to 13 basis points on a daily basis (Tables 34 and 35).

5. Discussion of findings

The Table 36 summarizes the results of the main studies about the impact of monetary policy for the characteristics examined in this paper. The columns show the characteristics, whether they are referred to firms in general or to banks, the article, the policy type (C=conventional, U=unconventional) and the impact found. Among the articles in the table, only Haitsma *et al.* (2016) focus on Eurozone, the others on USA. The Table 37 summarizes the results of our work.

Insert Table 36 here

Insert Table 37 here

The present paper provides strong evidence that larger banks are more affected by unconventional monetary policy. Haitsma *et al.* (2016), which focus on firms in general, find instead no impact of size. According to Ehrmann and Fratzscher (2004), the conventional monetary policy affects less the larger firms, but according to Madura and Schnusenberg (2000) and Yin and Yang (2013), for banks it works oppositely, with larger banks more affected.

According to Yin and Yang (2013), "large firms are better collateralized and thus more immune than small firms [to monetary policy]. […] However, […] the size factor works differently for banks, …[since] large banks rely more on the federal funds market for financing", therefore large banks are more sensitive to conventional monetary policy. Our findings for conventional monetary policy are consistent with this article, and our findings for unconventional monetary policy suggest that also this type of policy has more effect on large banks.

Yin and Yang (2013) hypothesize that nonbanking activity is more interest rate sensitive with respect to the normal banking activity, so banks which rely more on nonbanking activity should be more sensitive. They find that, despite an initial evidence of an impact, this impact disappears when controlling for other bank characteristics. Our findings for unconventional monetary policy provide evidence of no impact of net interest income, and for loan to asset ratio the evidence from portfolios is that the trend is decreasing, even if there is low support to this finding from the other results. According to them, we find no clear role of the capital to asset ratio on the impact of unconventional monetary policy, as found for the conventional monetary policy.

Yin and Yang (2013) find a decreasing impact of deposits to liabilities ratio. Haitsma *et al.* (2016) find that firms with a high debt to equity ratio, that is highly indebted firms, are more sensitive to unconventional monetary policy surprises. We find no clear evidence of an impact of measures of funding sources. Therefore, the measures of funding sources seem to not explain the sensitivity of banks, but they explain that of firms in general.

Haitsma *et al.* (2016) find a decreasing impact on firms of the price to earnings and market to book ratios; our results suggest that this impact is not present on banks.

The unconventional monetary policies consist mainly of asset purchases and long-term refinancing. The asset purchases affect the asset side of the balance sheet, the long-term refinancing affect the liabilities side. Therefore, the fact that larger banks are affected more can be interpreted similarly to Yin and Yang (2013), which say that large banks rely more on short term funding from the central bank, and this could be valid also for longer term funding.

About asset purchases, large banks hold more assets, and if larger banks hold a higher proportion of assets subject to asset purchase programs, this could make banks more sensitive to these operations.

The finding that banks with a lower loan to asset ratio are more sensitive to unconventional monetary policy can be explained by the fact that if banks hold fewer loans in their asset portfolio, this means that they invest more in other types of assets, maybe including the assets of the purchase programs, and so they are more sensitive to unconventional monetary policies. However, there is no strong support to the role of the loan to asset ratio from the robustness check.

Haitsma *et al.* (2016) found that firms are more sensitive if more indebted, supporting the credit channel of monetary policy; our work finds no clear evidence of the role of funding sources for banks. Highly indebted firms are more sensitive to monetary policy because the change in interest rates, which derives from monetary policy, causes a change in their cost of funding. The fact that for banks of our sample there is no effect could be interpreted as the ability of banks to transmit the interest rate changes to firms to which they lend, that is the change in the cost of funding of banks is transmitted to firms through a change in the rate they charge on lending.

We find evidence of a bigger impact of spread decreases, that is expansionary monetary policy. Madura and Schnusenberg (2000) find that a decrease in the interest rate has more impact than an increase, and they interpret this result as the bank "adjusting deposit rates faster than lending rates", and so with an interest rate decrease they cut deposit rates faster than they cut lending rates, gaining from deposits faster than what they lose from loans.

Conversely, when interest rates increase, the deposit rates increase faster than lending rates, and they lose from deposits faster than what they gain from loans.

Another possible explanation suggested by Madura and Schnusenberg (2000) is "a higher elasticity of loan demand in response to a decrease in interest rates than to an increase", meaning that when the interest rates decrease, the loans demanded increase since they are more convenient, but when the interest rate increase there are still borrowers who need funds, and they are willing to pay a higher rate. The latter interpretation could be applied to our results. The unconventional monetary policies change the long-term interest rates, and so the price of loans, and if the elasticity of loan demand is higher for interest rate decreases than for increases, it means that banks gain more from decreases than from increases.

About different types of event days, the evidence suggests that the type of surprise affecting more the returns is an action during a non-meeting day, followed by an absent action, in turn followed by an action during a meeting. This could mean that the market is more surprised when an action takes place in a non-meeting day than during a meeting, and the market is more surprised from an absent action than from an action.

Our findings about the QE period are not clear. We find surprisingly that the unconventional monetary policy surprise is no more significant after the start of QE, but the impact is not significantly different from the pre-QE period. We could expect that the QE program made the unconventional monetary policy actions clearer, leading to a different impact, but we do not find a clear evidence about that, also because of the limited number of event days after the start of QE.

6. Conclusions

Through an event study methodology, and with the support of other methods to check the robustness of the results, we find that the unconventional monetary policy surprise has a negative and strongly significant impact on stock returns. The impact on banking sector is stronger than on the market in general, and even if there are also other countries significantly affected, the impact on Eurozone is stronger than on other countries, as can be expected.

We observe a significantly bigger impact of expansionary than contractionary unconventional monetary policy surprises. In addition, an unconventional monetary policy surprise has a bigger impact if it does not happen in a governing council meeting day. No additional impact is found from a change in the policy direction.

We also tried to understand which bank characteristics affect the response to unconventional monetary policy; we find that the main driver of the sensitivity is the bank size: bigger banks are more sensitive to unconventional monetary policy surprises.

We find evidence for the impact of some other characteristics, even if not as clear and as strong as the bank size. According to the portfolio analysis, the banks with a lower loan to asset ratio are more sensitive. The measures of funding sources and bank soundness seem not clearly correlated with the bank sensitivity. The market to book and price to earnings ratios, which are the two-market data, have not a role on determining the bank sensitivity. As expected, banks which earn more interest on government securities have a higher sensitivity.

In conclusion, there is a significant impact of ECB unconventional monetary policy surprises on Eurozone bank stock returns, bigger than on the whole market and on the rest of the world. The impact is stronger when the shock is expansionary, and when it takes place in a day without a governing council meeting. Bank size seems the main characteristic which determines the sensitivity of bank stock returns to unconventional monetary policy surprises, but it is not the only one.

The event study allows to estimate the impact on the same day of the monetary policy surprise, but it cannot evaluate a long-term impact, therefore we don't know if the impact found will persist and, if so, for how long. This approach also allows to reduce the impact of omitted variables taking only those days when there are monetary policy measures, in this way the monetary policy should be the main element affecting stock returns

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Tables

Table 1: Banks on the baseline dataset

	Name	Exchange	Country
1	AIB Group	Dublin	Ireland
2	Alandsbanken A	Helsinki	Finland
3	Banca Carige	Milan	Italy
4	Banca Finnat Euramerica	Milan	Italy
5	Banca Monte dei Paschi	Milan	Italy
6	Banca Popolare di Sondrio	Milan	Italy
7	Banca Profilo	Milan	Italy
8	Banco BPI	Euronext.liffe Lisbon	Portugal
9	Banco BPM	Milan	Italy
10	Banco Comercial Portugues 'R'	Euronext.liffe Lisbon	Portugal
11	Banco di Sardegna RSP	Milan	Italy
12	Banco Santander	Mercado Continuo Espanol	Spain
13	Bank FUR Tirol und Vorarlberg	Vienna Stock Exchange	Austria
14	Bank of Ireland Group	Dublin	Ireland
15	Banco Intercontinental Espanol 'R'	Mercado Continuo Espanol	Spain
16	Banque Nationale de Belgique	Euronext.liffe Brussels	Belgium
17	Banco Bilbao Vizcaya Argentaria	Mercado Continuo Espanol	Spain
18	Banca Piccolo Credito Valtell	Milan	Italy
19	Banks Bank	Vienna Stock Exchange	Austria
20	Banco di Desio E Della Brianza	Milan	Italy
21	Banque Nationale de Paris Paribas	Euronext.liffe Paris	France

	Name	Exchange	Country
22	Bper Banca	Milan	Italy
23	Commerzbank	Deutsche Boerse AG	Germany
24	Credit Agricole Morbihan	Euronext.liffe Paris	France
25	Crcam Ille-Village CCI	Euronext.liffe Paris	France
26	Crcam Nord CCI	Euronext.liffe Paris	France
27	Credit Agricole Ile de France	Euronext.liffe Paris	France
28	Credit Agricole Toulouse	Euronext.liffe Paris	France
29	Credit Agricole Touraine	Euronext.liffe Paris	France
30	Credit Foncier de Monaco	Euronext.liffe Paris	France
31	Credito Emiliano	Milan	Italy
32	Deutsche Bank	Deutsche Boerse AG	Germany
33	Dexia	Euronext.liffe Brussels	Belgium
34	Enercity Par	Deutsche Boerse AG	Germany
35	Erste Group Bank	Vienna Stock Exchange	Austria
36	ING Groep	Euronext.liffe Amsterdam	Netherlands
37	Intesa Sanpaolo	Milan	Italy
38	KBC Group	Euronext.liffe Brussels	Belgium
39	Mediobanca Banca di Credito Financial	Milan	Italy
40	Merkur Bank	Deutsche Boerse AG	Germany
41	Natixis	Euronext.liffe Paris	France
42	Oberbank	Vienna Stock Exchange	Austria
43	Permanent TSB Group Holdings	Dublin	Ireland
44	Societe Generale	Euronext.liffe Paris	France
45	Unicredit	Milan	Italy
46	Van Lanschot Kempen	Euronext.liffe Amsterdam	Netherlands
47	Volksbank Vorarlberg Participation	Vienna Stock Exchange	Austria

Table 1 shows the 47 banks of the sample, with the exchange where they are listed and the country where they are located.

Table 2: Banks' characteristics

Characteristics (Acronym)	Category	Source
Employees (Emp)	Bank size	Yin and Yang (2013)
Total assets (Asset)	Bank size	Yin and Yang (2013)
Market capitalization (Cap)	Bank size	Haitsma *et al.* (2016)
Net Interest Income/Operating income (Nii)	Activity mix	Yin and Yang (2013)
Loans/Assets (Loan)	Activity mix	Yin and Yang (2013)
Capital/Assets (Cta)	Bank soundness	Yin and Yang (2013)
Deposits/Liabilities (Dep)	Funding sources	Yin and Yang (2013)
Debt to equity (D/E)	Funding sources	Haitsma *et al.* (2016)
Market to book ratio (M/B)	Market data	Haitsma *et al.* (2016)
Price to earnings ratio (P/E)	Market data	Haitsma *et al.* (2016)
Interest on Government securities (Gov)	Government bonds on bank's portfolio	-

Table 3: Dummy variables

Event/Characteristic	Dummy name	Equal to 1 when…
Crisis	UN	From 22/08/2007 to the end
QE start	QE	From 22/01/2015 to the end
Sign	Pu, Pe, Ps	Unexp, Exp and Spread are positive
Change direction	Cu, Ce, Cs	Unexp, Exp and Spread have a sign different from the previous value
Contemporaneous	Cont	The event day is both a conventional and an unconventional monetary policy day

Table 4: Description of alternative datasets

Dataset name	Description
Baseline	47 banks, 2000-2018, Eurex future, one day return, all 248 event days
Twoday	47 banks, 2000-2018, Eurex future, two days return, all 248 event days
Outliers	47 banks, 2000-2018, Eurex future, one day return, 229 event days (19 outliers excluded)
Future	47 banks, 2000-2018, Liffe future, one day return, all 248 event days
Ext2007	70 banks, 2007-2018, Eurex future, one day return, all 248 event days
Twodayfut	47 banks, 2000-2018, Liffe future, two days return, all 248 event days
Ext2007fut	70 banks, 2007-2018, Liffe future, one day return, all 248 event days

Table 5: Results from the baseline specification

	Bank index	Market index	Δ
Eurozone	**-13.93**	**-6.61**	7.32
Europe without Eurozone	**-6.57**	**-3.75**	2.82
World	**-4.78**	**-3.24**	1.54

If coefficients are in bold, they are significant at the 10% level. Almost always coefficients of Spread are negative, so when we say that the impact increases in reality the coefficient decreases, we refer to the absolute value.

Table 6: Results in the pre and post QE periods

	Bank Index			**Market Index**		
	Pre QE	**Post QE**	**Δ**	**Pre QE**	**Post QE**	**Δ**
Eurozone	**-14.05**	-5.58	8.47	**-6.65**	**-4.24**	2.41
Europe without Eurozone	**-6.74**	-5.65	1.09	**-3.80**	-3.21	0.59
World	**-4.85**	-3.98	0.87	**-3.33**	-2.42	0.91
If coefficients are in bold, they are significant at the 10% level. Almost always coefficients of Spread are negative, so when we say that the impact increases in reality the coefficient decreases, we refer to the absolute value.						

Table 7: Results for increases and decreases of the spread

	Bank Index			**Market Index**		
	Positive	**Negative**	**Δ**	**Positive**	**Negative**	**Δ**
Eurozone	**-9.27**	**-17.99**	**8.72**	**-3.74**	**-8.15**	**4.41**
Europe without Eurozone	**-3.46**	**-6.96**	3.50	**-1.43**	**-4.37**	**2.94**
World	**-2.72**	**-5.93**	**3.21**	**-2.18**	**-3.92**	**1.74**
If coefficients are in bold, they are significant at the 10% level. Almost always coefficients of Spread are negative, so when we say that the impact increases in reality the coefficient decreases, we refer to the absolute value.						

Table 8: Results for no change and change of direction

	Bank Index			**Market Index**		
	No change direction	**Change Direction**	**Δ**	**No change direction**	**Change Direction**	**Δ**
Eurozone	**-12.48**	**-14.74**	2.26	**-6.32**	**-6.91**	0.59
Europe without Eurozone	**-8.77**	**-6.25**	-2.52	**-4.50**	**-3.73**	-0.77
World	**-6.70**	**-4.46**	-2.24	**-4.73**	**-2.92**	**-1.81**
If coefficients are in bold, they are significant at the 10% level. Almost always coefficients of Spread are negative, so when we say that the impact increases in reality the coefficient decreases, we refer to the absolute value.						

Table 9: Results for one and two types of monetary policy

	Bank Index			**Market Index**		
	No contemporaneous	**Contemporaneous**	**Δ**	**No contemporaneous**	**Contemporaneous**	**Δ**
Eurozone	**-16.79**	**-9.89**	**-6.90**	**-7.92**	**-4.68**	**-3.24**
Europe without Eurozone	**-7.80**	**-4.76**	-3.04	**-4.50**	**-2.72**	-1.78
World	**-5.84**	**-3.34**	**-2.50**	**-3.85**	**-2.45**	**-1.40**
If coefficients are in bold, they are significant at the 10% level. Almost always coefficients of Spread are negative, so when we say that the impact increases in reality the coefficient decreases, we refer to the absolute value.						

Table 10: Results for conventional monetary policy

	Bank Index		**Market Index**	
	Unexp	**Exp**	**Unexp**	**Exp**
Eurozone	-1.88	0.17	-0.16	-0.21
Europe without Eurozone	-1.03	-0.25	1.02	-0.30
World	0.68	0.65	**2.47**	0.38
If coefficients are in bold, they are significant at the 10% level. Almost always coefficients of Spread are negative, so when we say that the impact increases in reality the coefficient decreases, we refer to the absolute value.				

Table 11: Results from different datasets

	Baseline		Future		Outlier		Twoday		Twodayfut	
	Bank	**Market**	**Bank**	**Market**	**Bank**	**Market**	**Bank**	**Market**	**Bank**	**Market**
Eurozone	-13.93	-6.61	-13.91	-6.64	-12.73	-6.07	-17.10	-7.59	-17.08	-7.55
Euexez	-6.57	-3.75	-6.66	-3.80	-5.64	-3.47	-8.02	-3.89	-7.95	-3.88
World	-4.78	-3.24	-4.77	-3.25	-4.35	-3.01	-6.36	-3.96	-6.33	-4.01
Europe	-9.21	-5.00	-9.26	-5.05	-8.10	-4.57	-11.47	-5.55	-11.42	-5.53
EqW	-8.47		-8.43		-8.04		-10.80		-10.81	
CapW	-13.28		-13.24		-12.20		-16.88		-16.83	

This table presents the coefficients for different datasets: bank and market indexes for Eurozone, Europe without Eurozone (Euexez), World, Europe, and the two portfolios equally weighted (EqW) and capitalization weighted (CapW). All coefficients are strongly significant, with a *p*-value equal to zero, at least when the *p*-value is rounded to the fourth decimal digit.

Table 12: Bank size: portfolio coefficients

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	**Medium**	**Low**	**trend**	**High**	**Medium**	**Low**	**trend**
Emp	-13.85	-9.93	-1.72	Increasing	-12.52	-7.66	-1.38	Increasing
Assets	-13.39	-10.76	-1.40	Increasing	-11.81	-8.16	-2.05	Increasing
Cap	-12.27	-10.94	-2.34	Increasing	-12.26	-8.30	-1.46	Increasing

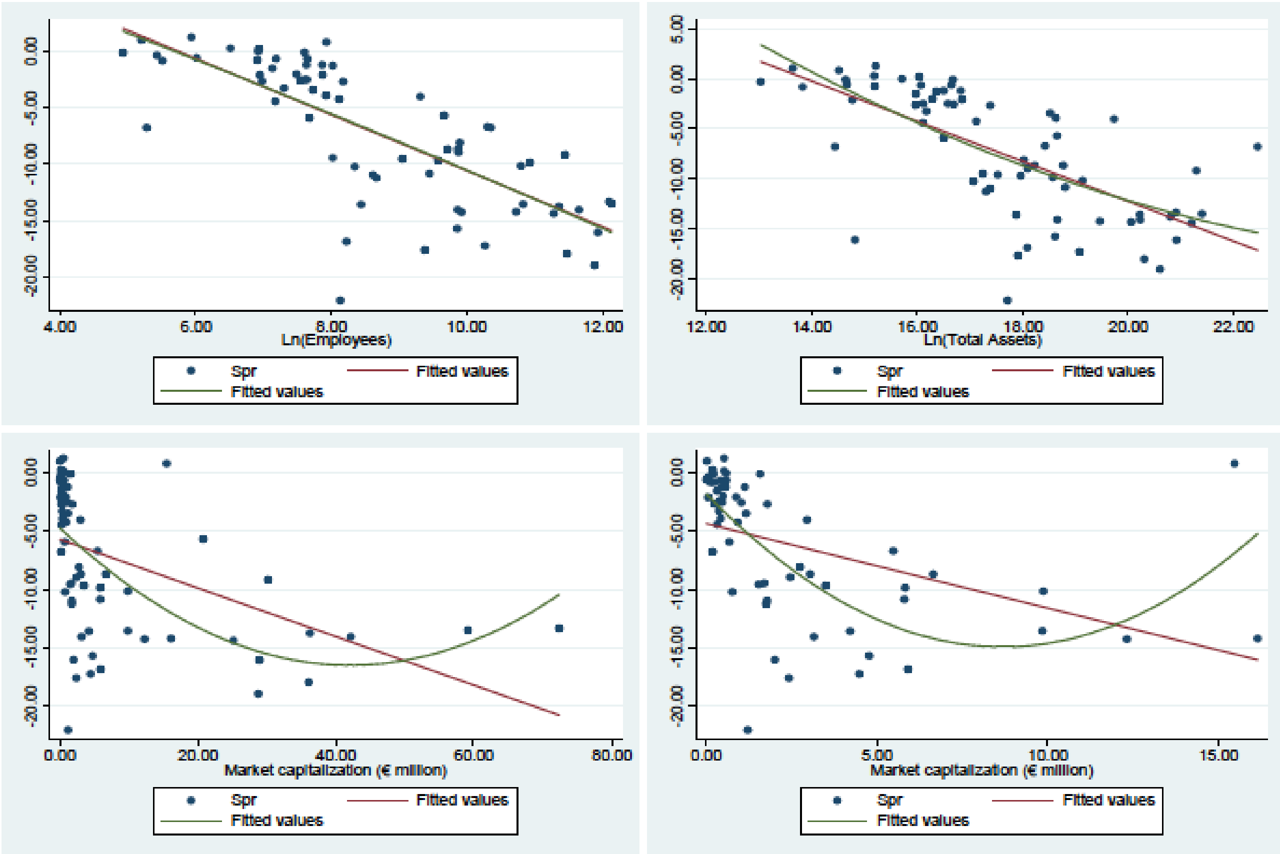
The bank size is measured by the number of employees, total assets, and market capitalization. If not specified, we discuss the results of the baseline dataset, and then say if results from the extended dataset support or contrast the baseline results. When High, Medium and Low are written with initial capital letter, we refer to the portfolios constructed with banks with a high, medium and low value of the characteristic.

Table 13: Bank size: SURE Test

Baseline	**High=Medium**	**High=Low**	**Medium=Low**	**High=Medium=Low**	**Trend**
Emp	0.0003***	0.0000***	0.0000***	0.0000***	Increasing
Assets	0.0201**	0.0000***	0.0000***	0.0000***	Increasing
Cap	0.2667	0.0000***	0.0000***	0.0000***	Increasing
Extended	**High=Medium**	**High=Low**	**Medium=Low**	**High=Medium=Low**	**Trend**
Emp	0.0000***	0.0000***	0.0000***	0.0000***	Increasing
Assets	0.0006***	0.0000***	0.0000***	0.0000***	Increasing
Cap	0.0005***	0.0000***	0.0000***	0.0000***	Increasing

Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively

Figure 1: Plots for Employees, Assets, and Capitalization (all and less than 20€ millions)



The first and second plots show a decreasing trend for the plots based on number of employees and total assets, both expressed in natural logarithm as done by Yin and Yang (2013). The third and fourth plot are for market capitalization, but the fourth plot is restricted to banks with a capitalization lower than €20 million. The decreasing trend seems more evident for banks with a lower market capitalization: there is a non-significant difference between Medium and High portfolios in the baseline dataset. The correlations of the sensitivity are: -0,74 (-0,75 for the extended dataset) with employees, -0,73 (-0,68 for the extended dataset) with total assets, -0,50 (-0,16 for the extended dataset) with market capitalization.

Table 14: Bank size: Results of the regression of the sensitivity on a characteristic

	Baseline	Extended
Emp	-2.477***	-2.486***
Assets	-2.312***	-1.996***
Cap	-0.2***	-0.0264
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively		

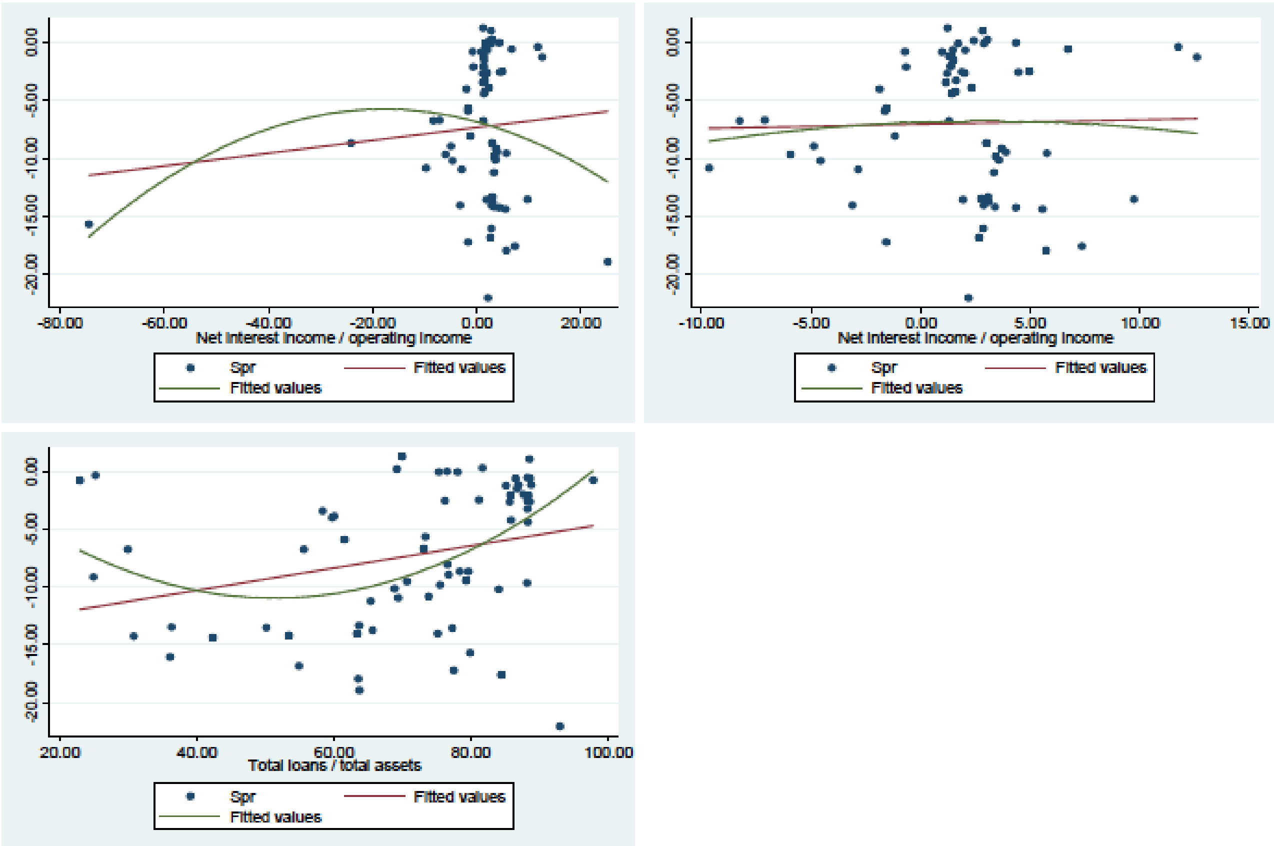
Table 15: Activity mix: portfolio coefficients

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	Medium	Low	trend	High	Medium	Low	trend
Nii	-7.85	-10.81	-7.59	Max	-9.26	-5.63	-6.95	Min
Loan	-5.14	-8.35	-12.21	Decreasing	-3.99	-7.35	-10.58	Decreasing
The activity mix is the portion of the normal banking activity on the total activity. It is measured by the net interest income divided by total operating income, and the total loans divided by total assets.								

Table 16: Activity mix: SURE Test

Baseline	High=Medium	High=Low	Medium=Low	High=Medium=Low	Trend
Nii	0.0023***	0.7786	0.0008***	0.0013***	Max
Loan	0.0001***	0.0000***	0.0001***	0.0000***	Decreasing
Extended	**High=Medium**	**High=Low**	**Medium=Low**	**High=Medium=Low**	**Trend**
Nii	0.0000***	0.0073***	0.1453	0.000***	Min
Loan	0.0000***	0.0000***	0.0001***	0.000***	Decreasing
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively					

Figure 2: Plots for Net Interest Income (all and restricted), and Loans



The first plot is for the net interest income (NII), and it suggests that this measure is not correlated with the spread sensitivity. This is confirmed by the second plot, which restrict the banks to those with an absolute value of this measure lower than 20. These two plots confirm the non-clear relation between this measure and the sensitivity found before. The third plot is for the loan to asset ratio, it does not give strong support to the decreasing sensitivity (and so an increasing coefficient), since it seems not very correlated. An increasing coefficient means that banks with a higher ratio have a higher coefficient, but some banks with a high ratio have a coefficient lower than some with a low ratio. The correlations of the sensitivity with these two measures are 0,15 and 0,26 for the NII and loan to asset ratio respectively (0,10 and 0,29 with the extended dataset), supporting the low relation with the NII, but contrasting the strong relation found for loans portfolios.

Table 17: Activity mix: results of the regression on the sensitivity on a characteristic

	Baseline	Extended
Nii	0.154	0.0556
Loan	0.0949*	0.0964**
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively		

Table 18: Bank soundness: portfolio coefficients

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	Medium	Low	trend	High	Medium	Low	trend
Cta	-7.95	-8.99	-8.49	Max	-7.80	-7.062	-7.059	Increasing
The bank soundness is measured with the ratio between total capital and total assets, which is also an indicator of funding sources, since it is inversely related to the leverage.								

Table 19: Bank soundness: SURE Test

Baseline	High=Medium	High=Low	Medium=Low	High=Medium=Low	Trend
Cta	0.1871	0.6179	0.5408	0.3686	Max
Extended	**High=Medium**	**High=Low**	**Medium=Low**	**High=Medium=Low**	**Trend**
Cta	0.2548	0.4422	0.9972	0.5106	Increasing
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively					

Figure 3: Plot for Capital to Asset Ratio (Cta)

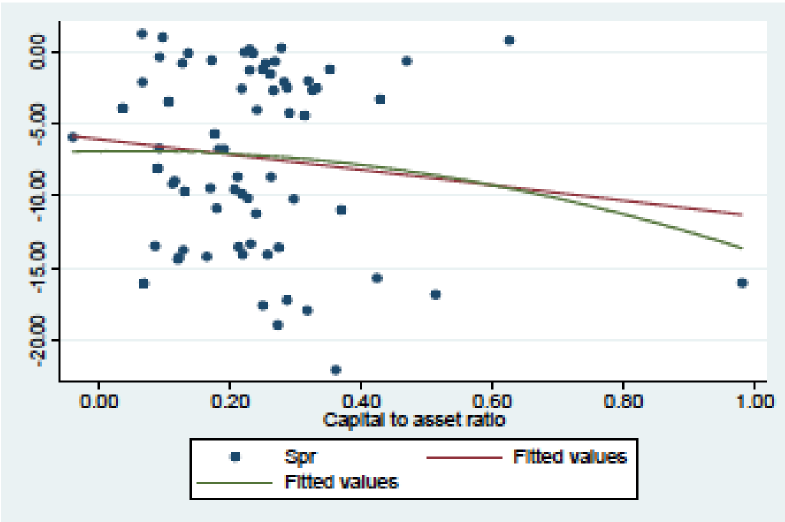


Table 20: Bank soundness: results of the regression of the sensitivity on a characteristic

	Baseline	Extended
Cta	-4.875	-5.325
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively		

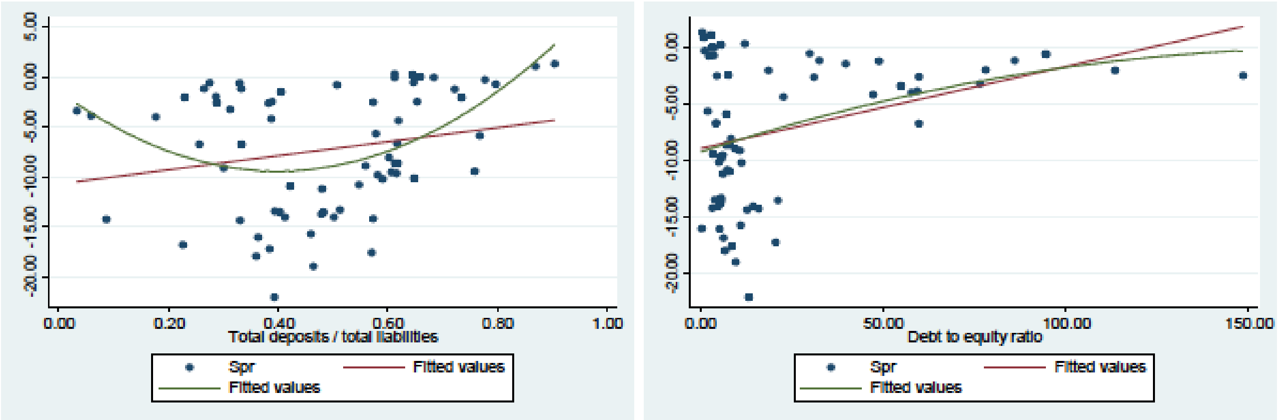
Table 21: Funding Sources: portfolio coefficients

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	Medium	Low	trend	High	Medium	Low	trend
Dep	-4.09	-13.02	-9.42	Max	-3.74	-11.68	-6.69	Max
D/E	-6.33	-12.08	-7.23	Max	-4.58	-10.80	-6.85	Max
The funding sources are measured by two quantities, that is the deposits to liabilities ratio and the debt to equity ratio.								

Table 22: Funding sources: SURE test

Baseline	High=Medium	High=Low	Medium=Low	High=Medium=Low	Trend
Dep	0.0000***	0.0000***	0.0395**	0.0000***	Max
D/E	0.0000***	0.3585	0.0000***	0.0000***	Max
Extended	**High=Medium**	**High=Low**	**Medium=Low**	**High=Medium=Low**	**Trend**
Dep	0.0000***	0.0000***	0.0001***	0.0000***	Max
D/E	0.0000***	0.0226**	0.0000***	0.0000***	Max
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively					

Figure 4: Plots for Deposits/Liabilities and Debt/Equity (all and restricted)



The plots do not show a strong relationship for all two measures. The plot for deposits (first plot) does not show a clear relation. For the plot about debt to equity ratio (second plot), banks with a low ratio can have a high or low sensitivity, but those with a high ratio have a relatively low sensitivity. In addition, the correlations of the sensitivity with deposits and debt to equity are 0.36 and 0.33 respectively (0.22 and 0.36 with the extended dataset), that is positive correlations, but not very high.

Table 23: Funding sources: results of the regression of the sensitivity on a characteristic

	Baseline	**Extended**
Dep	13.74**	7.019*
D/E	0.00016**	0.0723***
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively		

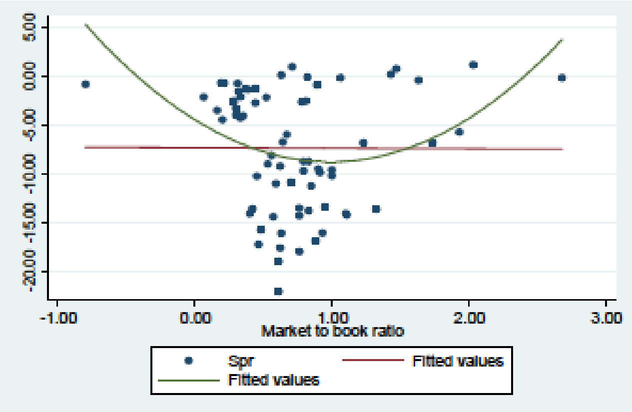
Table 24: Market data: portfolio coefficients

	Baseline (47 banks, 2000-2018)				**Extended (70 banks, 2007-2018)**			
	High	**Medium**	**Low**	**trend**	**High**	**Medium**	**Low**	**trend**
M/B	-9.27	-10.96	-5.33	Max	-7.45	-9.98	-4.73	Max
P/E	-8.28	-9.47	-7.72	Max	-9.04	-7.84	-5.01	Max

Table 25: Market data: SURE test

Baseline	**High=Medium**	**High=Low**	**Medium=Low**	**High=Medium=Low**	**Trend**
M/B	0.0977*	0.0069***	0.0000***	0.0000***	Max
P/E	0.0914*	0.5927	0.0248**	0.0220**	Max
Extended	**High=Medium**	**High=Low**	**Medium=Low**	**High=Medium=Low**	**Trend**
M/B	0.0018***	0.0146**	0.0000***	0.0000***	Max
P/E	0.0214**	0.0000***	0.0002***	0.0000***	Increasing
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively					

Figure 5: Plots for M/B, and P/E



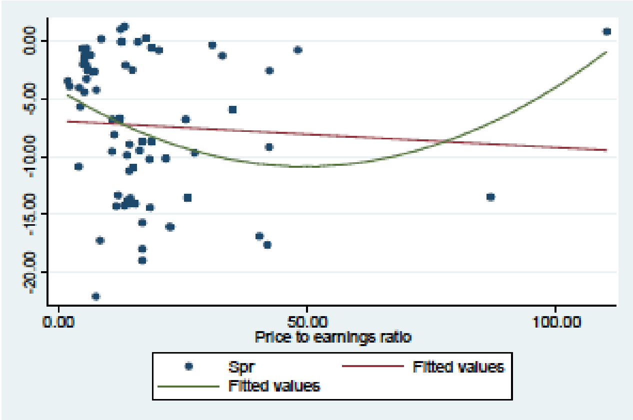


Table 26: Market data: results of the regression of the sensitivity on a characteristic

	Baseline	**Extended**
M/B	-2.704	-0.0683
P/E	0.0959	-0.0229
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively		

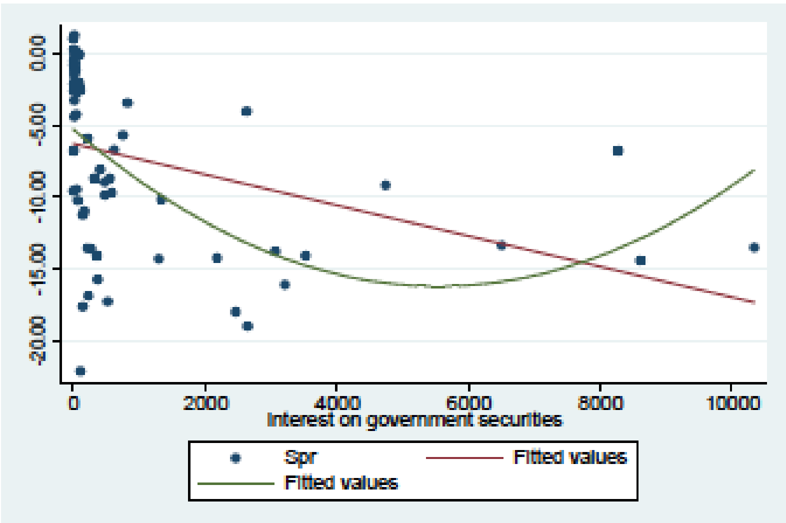
Table 27: Government securities: portfolio coefficients

	Baseline (47 banks, 2000-2018)				**Extended (70 banks, 2007-2018)**			
	High	**Medium**	**Low**	**trend**	**High**	**Medium**	**Low**	**trend**
Gov	-12.86	-11.63	-1.86	Increasing	-11.39	-9.02	-1.89	Increasing

Table 28: Government securities: SURE test

Baseline	**High=Medium**	**High=Low**	**Medium=Low**	**High=Medium=Low**	**Trend**
Gov	0.2604	0.0000***	0.0000***	0.0000***	Increasing
Extended	**High=Medium**	**High=Low**	**Medium=Low**	**High=Medium=Low**	**Trend**
Gov	0.0461**	0.0000***	0.0000***	0.0000***	Increasing
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively					

Figure 6: Plot for government securities (Gov)



The plot shows a decreasing coefficient (and so an increasing sensitivity), even if only after a certain level. When the value is low, the sensitivity depends on other bank characteristics, so it can be high or low. The correlation between the sensitivity and this characteristic is -0.38 (-0.38 also for the extended dataset), so not very high but also not very low.

Table 29: Government securities: results of the regression of the sensitivity on a characteristic

	Baseline	Extended
Gov	-0.00138***	-0.00107***
Significance codes: *** indicate statistical significance at 1%, ** at 5% and * at 10%, respectively		

Table 30: Correlation matrix between sensitivity (Spr) and characteristics, baseline dataset

Base	Spr	Emp	Asset	Cap	Nii	Loan	Cta	Dep	D/E	M/B	P/E	Gov
Spr	1	-0.74	-0.73	-0.50	0.15	0.26	-0.07	0.36	0.33	-0.21	-0.14	-0.38
Emp	-0.74	1	0.97	0.78	-0.08	-0.32	-0.19	-0.27	-0.20	0.12	0.07	0.70
Asset	-0.73	0.97	1	0.76	-0.04	-0.40	-0.22	-0.41	-0.15	0.06	0.06	0.71
Cap	-0.50	0.78	0.76	1	0.07	-0.44	-0.31	-0.16	-0.27	0.20	0.23	0.89
Nii	0.15	-0.08	-0.04	0.07	1	-0.15	-0.15	-0.03	0.09	0.06	0.16	0.11
Loan	0.26	-0.32	-0.40	-0.44	-0.15	1	0.43	0.45	0.25	-0.21	-0.36	-0.49
Cta	-0.07	-0.19	-0.22	-0.31	-0.15	0.43	1	-0.19	0.23	-0.22	-0.14	-0.38
Dep	0.36	-0.27	-0.41	-0.16	-0.03	0.45	-0.19	1	-0.41	0.28	0.09	-0.22
D/E	0.33	-0.20	-0.15	-0.27	0.09	0.25	0.23	-0.41	1	-0.71	-0.37	-0.19
M/B	-0.21	0.12	0.06	0.20	0.06	-0.21	-0.22	0.28	-0.71	1	0.15	0.08
P/E	-0.14	0.07	0.06	0.23	0.16	-0.36	-0.14	0.09	-0.37	0.15	1	0.37
Gov	-0.38	0.70	0.71	0.89	0.11	-0.49	-0.38	-0.22	-0.19	0.08	0.37	1

Table 31: Correlation matrix between sensitivity (Spr) and characteristics, extended dataset

Ext	Spr	Emp	Asset	Cap	Nii	Loan	Cta	Dep	D/E	M/B	P/E	Gov
Spr	1	-0.75	-0.68	-0.16	0.10	0.29	-0.12	0.22	0.36	-0.01	-0.06	-0.38
Emp	-0.75	1	0.93	0.36	-0.03	-0.29	-0.09	-0.23	-0.20	-0.09	0.11	0.63
Asset	-0.68	0.93	1	0.50	-0.01	-0.36	-0.21	-0.41	-0.07	-0.09	-0.03	0.73
Cap	-0.16	0.36	0.50	1	0.05	-0.25	-0.08	-0.14	0.04	0.16	0.06	0.67
Nii	0.10	-0.03	-0.01	0.05	1	-0.13	-0.18	0.02	0.06	0.05	0.07	0.11
Loan	0.29	-0.29	-0.36	-0.25	-0.13	1	0.37	0.26	0.32	-0.34	-0.36	-0.55
Cta	-0.12	-0.09	-0.21	-0.08	-0.18	0.37	1	-0.32	0.16	-0.06	0.10	-0.28
Dep	0.22	-0.23	-0.41	-0.14	0.02	0.26	-0.32	1	-0.52	0.31	0.22	-0.23
D/E	0.36	-0.20	-0.07	0.04	0.06	0.32	0.16	-0.52	1	-0.46	-0.35	-0.11
M/B	-0.01	-0.09	-0.09	0.16	0.05	-0.34	-0.06	0.31	-0.46	1	0.15	0.10
P/E	-0.06	0.11	-0.03	0.06	0.07	-0.36	0.10	0.22	-0.35	0.15	1	0.38
Gov	-0.38	0.63	0.73	0.67	0.11	-0.55	-0.28	-0.23	-0.11	0.10	0.38	1

Table 32: Significant coefficients for the overall regressions

	Baseline			Extended		
	Significant	**Total**	**Ratio**	**Significant**	**Total**	**Ratio**
Emp	8	8	100%	8	8	100%
Asset	8	8	100%	8	8	100%
Cap	8	8	100%	0	8	0%
Nii	0	12	0%	0	12	0%
Loan	0	12	0%	4	12	33.33%
Cta	14	24	58.33%	20	24	83.33%
Dep	6	12	50%	1	12	8.33%
D/E	9	12	75%	12	12	100%
M/B	5	12	41.67%	1	12	8.33%
P/E	4	12	33.33%	3	12	25%
Gov	8	24	33.33%	19	24	79.17%
The Table shows for each characteristic how many times the coefficient is significant at 10% level, how many times the characteristic is used, and the percentage of significant coefficients, for both baseline and extended dataset. A somewhat similar procedure is used by Yin and Yang (2013), they examine four categories and use two characteristics for each category. This method provides a robustness check to the regressions on a single characteristic, since it allows watching whether, controlling for the characteristics of other categories, the characteristic is still significant or not.						

Table 33: Unconventional and conventional monetary policy, trends of characteristics

	Spr	Unexp	Unexp 0	Unexp 1	Exp	Exp 0	Exp 1
Emp	Increasing	Increasing	Increasing	Max	Max	Increasing	Max
Asset	Increasing	Increasing		Increasing	Increasing	Increasing	Increasing
Cap	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing
Nii	Max	Increasing	Increasing	Max	Min	Max	Increasing
Loan	Decreasing	Decreasing	Decreasing	Max	Max	Min	Decreasing
Cta	Max	Decreasing	Decreasing	Min	Decreasing	Max	Decreasing
Dep	Max	Max	Max	Max	Max	Decreasing	Max
D/E	Max	Decreasing	Decreasing	Max	Max	Decreasing	Decreasing
M/B	Max	Increasing	Increasing	Min	Min	Max	Min
P/E	Max	Increasing	Min	Min	Min	Max	Decreasing
Gov	Increasing	Increasing	Increasing	Min	Max	Min	Increasing
The Table shows, for each characteristic, the trend of the coefficients of Spread and of Unexp and Exp, from the baseline model, and also of Unexp and Exp in the pre- and post-crisis periods. Unexp 0 and Exp 0 are the pre-crisis coefficients, Unexp 1 and Exp 1 the post-crisis coefficients.							

Table 34: Trends from the alternative datasets

	Baseline	Future	Twoday	TwodayFut	Ext2007	Ext2007Fut	Outliers
Emp	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing
Asset	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing
Cap	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing
Nii	Max	Max	Max	Max	Min	Min	Max
Loan	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing	Decreasing
Cta	Max	Max	Decreasing	Decreasing	Increasing	Increasing	Max
Dep	Max	Max	Max	Max	Max	Max	Max
D/E	Max	Max	Max	Max	Max	Max	Max
M/B	Max	Max	Max	Max	Max	Max	Max
P/E	Max	Max	Max	Max	Increasing	Increasing	Max
Gov	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing	Increasing
The Table shows the trend of the coefficients for the baseline model (without dummy variables), for each characteristic and for each dataset. The rows show the characteristics, the columns show the various alternative datasets.							

Table 35: Coefficients of the overall portfolios for the various datasets

	All	AllW
Baseline	-8.47	-13.28
Future	-8.43	-13.24
Twoday	-10.80	-16.88
Ext2007	-7.31	-10.53
TwodayFut	-10.81	-16.83
Ext2007Fut	-7.22	-10.43
Outliers	-8.04	-12.20
The Table shows the coefficients of Spread on the equation for the two overall portfolios, equally weighted (All) and capitalization weighted (AllW), for each dataset.		

Table 36: Characteristics results from the literature

Bank Characteristics	Firm/Bank	Source	Type	Impact
Activity mix (Nii, Loan)	Bank	Yin and Yang (2013)	C	None
Cta	Bank	Madura and Schnusenberg (2000)	C	Decreasing
Cta	Bank	Yin and Yang (2013)	C	None
D/E	Firm	Haitsma *et al.* (2016)	U	Increasing
D/E	Firm	Ehrmann and Fratzscher (2004)	C	Decreasing
Dep	Bank	Yin and Yang (2013)	C	Decreasing
M/B	Firm	Haitsma *et al.* (2016)	U	Decreasing
P/E	Firm	Haitsma *et al.* (2016)	U	Decreasing
P/E	Firm	Ehrmann and Fratzscher (2004)	C	Increasing
Size (Cap)	Firm	Haitsma *et al.* (2016)	U	None
Size (Emp, Market value)	Firm	Ehrmann and Fratzscher (2004)	C	Decreasing
Size (Market value)	Bank	Madura and Schnusenberg (2000)	C	Increasing
Size (Emp, Assets)	Bank	Yin and Yang (2013)	C	Increasing

Table 37: Summary of characteristics results from our work

Bank characteristics	Impact	Robustness
Emp	Increasing	Strong
Asset	Increasing	Strong
Cap	Increasing	High
Nii	None	Strong
Loan	Decreasing	Medium
Cta	None	Strong
Dep	None	Medium
D/E	None	Medium
M/B	None	Medium
P/E	None	Medium
Gov	Increasing	High

Annex

Descriptive Statistics

The tables below show some descriptive statistics. The Table A.1 shows the mean, standard deviation, minimum, maximum, and number of non-zero values, of the returns of the capitalization weighted portfolio (AllW), the explanatory variables Unexp, Exp, Spread and the control MSCIret (return of the MSCI World ex Europe). The Table A.2 is the correlation matrix of these variables, and the Table A.3 is the correlation matrix for the post-crisis sample. The Table A.4 shows the number of event days, total, pre- and post-crisis, pre- and post-QE, of conventional and unconventional monetary policy, with the first and last day. The variables are defined only on event days.

Table A.1: Mean, standard deviation, minimum, maximum, and non-zero values

	Mean	Std Dev	Min	Max	Non-zero
AllW	0.13	2.40	-10.28	17.18	248
Unexp	0.00	0.05	-0.27	0.29	209
Exp	-0.01	0.14	-0.81	0.33	212
Spread	0.00	0.09	-0.46	0.56	132
MSCIret	0.01	1.22	-4.88	3.49	248

The Table A.1 shows that the volatility of the bank portfolio is higher than that of the explanatory variables. In particular, Unexp, Exp and Spread have a very low volatility compared to that of AllW and MSCIret. In addition, the means of the explanatory variables are zero or close to zero, instead the portfolio has a positive mean, equal to 0.13. The higher volatility of AllW is reflected into higher absolute values of the minimum and the maximum. The last column shows that, for some of the 248 days, the value of Unexp and Exp is zero. The number of non-zero values for Spread is 132, that is exactly the number of post-crisis days: this suggests that there is always a change in the spread in the post-crisis period event days (in the pre-crisis period Spread is set to 0).

Table A.2: Correlation of the full sample

CorrFS	AllW	Unexp	Exp	Spread	MSCIret
AllW	1	-0.04	0.17	-0.58	0.51
Unexp	-0.04	1	-0.24	0.08	0.12
Exp	0.17	-0.24	1	-0.08	0.23
Spread	-0.58	0.08	-0.08	1	-0.15
MSCIret	0.51	0.12	0.23	-0.15	1

Table A.3: Correlation table post-crisis

CorrFS	AllW	Unexp	Exp	Spread	MSCIret
AllW	1	-0.11	0.28	-0.63	0.55
Unexp	-0.11	1	-0.41	0.11	-0.07
Exp	0.28	-0.41	1	-0.11	0.31
Spread	-0.63	0.11	-0.11	1	-0.20
MSCIret	0.55	-0.07	0.31	-0.20	1

The Table A.2 shows that the strongest correlations are AllW with MSCIret (0.51) and AllW with Spread (-0.58). The fact that there are no strong correlations between explanatory variables (the highest correlation in absolute value is -0.24 between Exp and Unexp) is good for the model specification. The relatively high correlations of AllW with MSCIret and Spread is reflected, as we will see in the results of the model, in significant coefficients only for these two variables, in general. Restricting the sample to only the post-crisis period (Table A.3), almost all correlations increase in absolute value, suggesting a greater dependence of bank stock returns to monetary policy in the crisis period.

Table A.4: Event days

	Event days	First day	Last day
Total	248	5 January 2000	13 September 2018
Pre-crisis	116	5 January 2000	2 August 2007
Post-crisis	132	22 August 2007	13 September 2018
Post-crisis pre QE	97	22 August 2007	4 December 2014
Post QE	35	22 January 2015	13 September 2018
Conventional	235	5 January 2000	13 September 2018
Unconventional	34	22 August 2007	14 June 2018

The Table A.4 discloses that the dummy for the crisis splits the sample period in two almost equal parts, 116 and 132 days. Instead, the dummy QE split the post-crisis period in two different parts, but the problem is that we have only 35 days in the post-QE periods, a small sample size which could make the estimates for this period not very reliable.

Among the 248 total event days, 235 are conventional monetary policy days, that is governing council meeting days. The unconventional monetary policy days are 34, of which 13 (that is 248-235) are exclusively unconventional days, and the remaining 21 are also conventional monetary policy days. In the conventional monetary policy days, which are not also unconventional days, obviously only in the post-crisis period, there could be an impact of the unconventional monetary policy surprise, even if it is not an unconventional day. This is due to the definition of unconventional monetary policy surprise, that is a difference between the actions and what was expected. If the market expected an action of unconventional monetary policy, but this action didn't happen, this generates a surprise and so a reaction by the market, even if no unconventional action was taken (Nakazono and Ikeda, 2016). Differently from pre- and post-crisis and pre- and post-QE days, the days of conventional and unconventional monetary policy are not a continuous portion of total days. This implies that the days are not all the days that go from the first and last day indicated in the Table A.4.