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"THE ECB'S UNCONVENTIONAL MONETARY POLICY AND ITS IMPACT ON STOCK RETURNS OF EURO AREA BANKS"

RELATORE:

CH.MO PROF. FRANCESCO ZEN

LAUREANDO: ENRICO GARDIN

MATRICOLA N. 1132573

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ABSTRACT

After the crisis, the European Central Bank introduced a series of unconventional monetary policy measures. There is a wide literature about the impact of the monetary policy on stock prices, and recent literature focused also on the impact of unconventional monetary policy. In addition, a consistent part of the literature examine if the stocks of banks have a different sensitivity to monetary policy with respect to non financial firms. This thesis has the objective to estimate the impact that the ECB's unconventional measures have on Eurozone bank stock returns. We use an event study methodology, and find that there is a significant inverse relation between this new type of policy and stock returns of banks. This relation is stronger when the shock is expansionary, and when it takes place in a day without a governing council meeting. We examine the role of bank characteristics on the sensitivity of bank stocks, finding that the main driver of sensitivity is the bank size, measured by number of employees or total assets. Also other characteristics have a role, but not as clear as that of bank size.

INTRODUCTION

The European Central Bank (ECB) has the primary objective of maintaining price stability, defined as an inflation rate below, but close to, 2% over the medium term. To achieve its objective, it can adopt various monetary policy measures, which can be divided into open market operations, standing facilities and minimum reserve requirements. The main policy tool of the ECB is the interest rate applied on the main refinancing operations (MROs), that is the main refinancing rate. Through several transmission channels, a change in the main refinancing rate can allow to reach the desired price level, and so the price stability.

Briefly, a change in the policy rate is transmitted to money market rates, which affect, among other things, asset prices, which in turn affect consumption and investment choices by individuals and firms, which in turn have an effect on prices of goods and services.

Until the financial crisis, the ECB ensured price stability by increasing and decreasing the main refinancing rate. However, after the financial crisis, the conventional policy tools were not enough, so the ECB introduced a series of monetary policy measures different from the conventional measures, known as unconventional, or non-standard, monetary policy measures.[1]

The aim of this thesis is to estimate the impact of these unconventional monetary policy measures by the ECB on stock returns of Eurozone banks. We will analyze the impact on the aggregate banking sector of the Eurozone, and also outside the Eurozone to detect eventual spillover effects. Then, given that the impact can differ between single banks, we will examine which bank characteristics determine the sensitivity of its stock returns to the unconventional monetary policy surprises.

This thesis is divided into four chapters. In the first chapter, we will see the conventional monetary policy tools of the ECB and how they were used before the crisis. Then, we will see the unconventional monetary policy measures adopted by the ECB from the crisis until now (September 2018).

In the second chapter, we will review the literature about the impact of monetary policy on the stock market. This chapter is divided into four sections, firstly, the impact of conventional monetary policy on stock market, secondly, the impact of unconventional monetary policy on stock market, thirdly, the impact of conventional monetary policy on bank

[1] From the start of the introduction until this point, see Delivorias (2015)

stocks, fourthly, the impact of unconventional monetary policy on bank stocks. For each of these four parts, we will see some of the most cited articles (some articles are not cited a lot, but they are selected for their interesting results or methods). Some articles are examined briefly, and others are examined more in details. The methods used by some of these articles have inspired the methodology used in this thesis.

In the third chapter, we will see the data collected and the methodology used. The basic method is an event study inspired to Haitsma et al. (2016), and some aspects are taken from other articles such as Yin and Yang (2013). To examine the role of characteristics, we take 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.

In the fourth chapter, we will examine the results for the aggregate bank index, and then we will distinguish 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, we will examine for each category of the characteristics what is their impact on the sensitivity to unconventional monetary policy. In addition, we will check the robustness of the results using alternative dataset specifications.

The first and the second chapter are a summary of the content of other sources, so there are no personal contributions in these two chapters. Instead, the third and the fourth chapter are focused on the data, methods and results of the analysis of this thesis, also comparing them with the articles described in the second chapter.

This thesis is structured into three levels. Except the abstract, introduction and conclusions, the four chapters are divided into sections which in turn are eventually divided into subsections.

CHAPTER 1: THE ECB'S MONETARY POLICY

This chapter is divided into two sections. The first section describes the conventional tools of monetary policy of the ECB, that is open market operations, standing facilities, and minimum reserves requirements, and the conduct of the monetary policy from the birth of the monetary union to the crisis. The content of the first section comes from Delivorias (2015).

In the second section, we will see the unconventional monetary policies decided by the ECB from the crisis until now (September 2018). The second section is divided into six subsections, the first describes the unconventional monetary policies from the crisis until the forward guidance, the second describes the first series of TLTROs, the third describes the quantitative easing (QE), the fourth describes the second series of TLTROs, the fifth describes the adjustments of the QE program, and the sixth lists other unconventional monetary policy decisions. The content of the first and the third subsections comes from Delivorias (2015), instead the content of the other subsections comes from the ECB website. The source of the content of each subsection is indicated in footnote in each subsection title.

1.1: THE ECB'S CONVENTIONAL MONETARY POLICY

1.1.1: Open market operations[2]

Open market operations are the most commonly used tool for managing the liquidity situation in the market and signaling the Bank's stance on monetary policy. The main open market operations are the following:

- Main refinancing operations (MROs) are regular, open market, reverse transactions executed by the Eurosystem for the purpose of providing banks with appropriate liquidity. The transactions are conducted through weekly standard tenders, in which banks can bid for liquidity, and normally have a maturity of one week;
- Longer-term refinancing operations (LTROs) are regular, open market operations, executed by the Eurosystem to provide long-term liquidity to the banking system. They are carried out through monthly standard tenders and normally have a maturity of three months;

[2] See Delivorias (2015)

- Fine-tuning operations (FTOs) are operations carried out on an ad hoc basis, aimed at increasing or decreasing liquidity in the money market and at steering interest rates, in order to smooth the effects of unexpected liquidity fluctuations in the market;
- Structural operations are executed at the initiative of the ECB to adjust the structural position of the Eurosystem vis-à-vis the financial sector. They can be conducted using reverse transactions, outright operations or the issuance of ECB debt certificates (for examples, including the Covered Bond Purchase Programmes, the Asset Backed Securities Purchase Programme and the Securities Market Programme). Their frequency can be regular or non-regular and their maturity is not standardised.

The Eurosystem can conduct these open market operations in five ways.

Usually, it enters into reverse transactions (operations where the Eurosystem buys or sells eligible assets under repurchase agreements or undertakes credit operations with eligible assets used as collateral). These transactions can be used in all open-market operations but are mainly used for MROs and LTROs.

Otherwise, the Eurosystem can:

- perform outright transactions, operations where the Eurosystem buys or sells eligible assets outright on the market;
- issue ECB debt certificates, whereby the ECB issues debt certificates at a discount with the aim of adjusting the structural position of the Eurosystem vis-à-vis the financial sector so as to create or enlarge a liquidity shortage in the market;
- engage in foreign exchange swaps, whereby the Eurosystem buys/sells euros against a foreign currency and, at the same time, sells/buys them back in a forward transaction on a specified repurchase date;
- collect fixed term deposits, whereby the Eurosystem invites counterparties to place remunerated fixed-term deposits without collateral with the NCB in the Member State in which the counterparty is established.

1.1.2: Standing facilities[3]

Standing facilities are monetary policy operations which aim to provide and absorb overnight liquidity and signal general monetary policy stance. It is worth noting that, contrary to open market operations which are initiated by the ECB, standing facilities are initiated by

[3] See Delivorias (2015)

the counterparties, i.e. the credit institutions. Two standing facilities are available:

- The marginal lending facility which allows banks to borrow overnight funds from their national central banks, against eligible collateral;
- The deposit facility, which allows banks to make overnight deposits with their national central banks.

The interest rate on the marginal lending facility is normally higher (and the interest rate on the deposit facility lower) than the corresponding money market rate. As a result, credit institutions normally only use the standing facilities in the absence of alternatives. For examples, during the recent financial crisis, suspicions concerning the liquidity and solvency of a number of banks prompted many credit institutions to keep more central bank reserves than required and to deposit the additional reserves in the deposit facility instead of lending them out to other banks.

The rate on the marginal lending facility and the rate on the deposit facility normally provide a ceiling and a floor, respectively, for the overnight rate in the money market. By setting rates on the standing facilities, the Governing Council effectively determines the corridor within which the overnight money market rate can fluctuate.

1.1.3: Minimum reserves[4]

All euro-area banks are required to hold a certain amount of minimum reserves on current accounts with their respective NCBs. These amounts are calculated in relation to specific items on the balance sheets of the banks, such as deposits.

According to the ECB, by means of those reserves, central banks are able to stabilize money-market interest rates by giving institutions an incentive to smooth the effects of temporary liquidity fluctuations, and also to create or enlarge 'the structural liquidity shortage of the banking system', i.e. the need and demand of banks for central bank credit. This need, in turn, gives the ECB the possibility to steer money market rates through open market operations, since the ECB allocates liquidity to the banks at a price that matches its policy intentions and therefore influences the money market interest rates.

[4] See Delivorias (2015)

1.1.4: Conduct of monetary policy[5]

In April 1999, in the context of the transition to the Monetary Union, the Governing Council lowered the ECB's main refinancing rate by 0.5% (from 3% to 2.5%) to counter receding inflationary pressures.

From November 1999 to October 2000, the Governing Council decided to raise the key interest rates to contain inflationary pressures created by strong economic growth, rising import prices and high monetary growth.

Between May 2001 and June 2003, the Governing Council cut the key interest rates to protect the economy from the impact of slower economic growth, adjustments in financial markets (the dot com crash in the US) and geopolitical uncertainty. Given that this last intervention helped contain price pressures and that the state of the economy did not deteriorate markedly, the Governing Council decided to leave the key ECB interest rates unchanged until December 2005.

Starting in January 2006 and until the financial crisis (mid-2007), the Governing Council raised the key interest rates from 2% to 4.25% in order to counter the inflationary pressures created by faster growth and the expansion of the supply of money and credit in the euro area.

1.2: THE ECB'S UNCONVENTIONAL MONETARY POLICY

1.2.1: From the crisis to the forward guidance[6]

Starting from the birth of the Monetary Union (1999) until the European debt crisis (2009), the ECB ensured price stability by increasing or decreasing the rate for its main refinancing operations. But with the crisis it was not enough, and alternative measures had to be identified.

The financial structure of the euro area differs from that of other large economies such as the US in that banks play a crucial role in the financing of the economy and in the monetary transmission mechanism. Large corporations can find substitutes for bank lending,

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[5] See Delivorias (2015)

[6] See Delivorias (2015)

but this is difficult for SMEs (small and medium-sized enterprises), which constitute almost 99% of all enterprises in the euro area. This affects the way that monetary policy is implemented. The ECB's main operations consist of refinancing operations. This contrasts with the US, where Fed's operations consist mainly of outright purchases and sales of assets in the open market, in line with US economy's greater reliance on capital markets.

The collapse of Lehman Brothers in September 2008 created uncertainty among financial and credit institutions concerning each other's financial health. This uncertainty accentuated pressures that had already existed since the summer of 2007, specifically pressures related to significant balance sheet exposures of numerous euro area banks to the US subprime housing market. This situation eventually led to a near freeze in interbank lending and to the collapse of activities in a large number of financial market segments, and threatened to severely limit the financing of the real economy.

The first priority of the ECB was to accommodate the funding needs of banks. To do so, it decided to drastically reduce its key interest rates within a seven-month period from October 2008 to May 2009, and to complement this measure with Enhanced Credit Support, a set of four non-standard, temporary policy measures described below:

1. Temporary extension of the maximum maturity of the LTROs from three to twelve months. The objective was to keep the money market interest rates at low levels by reducing uncertainty in the markets and to provide a longer liquidity planning horizon to banks, in order to revive interbank lending and encourage banks to continue providing credit to the economy.
2. Currency swap agreements: the Eurosystem temporarily provided liquidity in foreign currencies, most notably in US dollars. The crisis at this stage was still predominantly a US crisis, therefore many European banks faced a massive shortfall in US dollar funding. The Eurosystem used reciprocal currency arrangements with the Federal Reserve System to provide funding in US dollars against Eurosystem eligible collateral with various maturities but a fixed interest rates, which reduced market uncertainty.
3. Collateral eligibility requirements: to facilitate the swap agreements seen above, and to allow banks to use a wider range of assets to obtain central bank liquidity, the list of eligible collateral accepted in Eurosystem refinancing operations was extended to include, for example, asset backed securities.
4. First Covered Bond Purchase Programme: on 2 July 2009, the Eurosystem launched its first Covered Bond Purchase Programme (CBPP1) with the aim of reviving the covered

bond market, a primary source of financing for European banks, which had virtually dried up in terms of liquidity and issuance. The Eurosystem committed to purchasing covered bonds denominated in euros and issued in the euro area for a total value of €60 billion, that is 2.5% of the total outstanding amount of covered bonds, in the period between June 2009 and June 2010.

In January 2010, markets were expecting a possible Greek sovereign default. Also Ireland, Portugal, Spain and Italy were facing difficult economic situations, such as a housing crisis that evolved into a financial crisis in Spain and Ireland, high public debt in Italy, slow growth and increasing debt to GDP ratio in Portugal. Therefore, certain secondary markets for government bonds began to dry up. These developments presented the risk of impairing the transmission mechanism through three channels:

1. The price channel, because of the link between government bond prices and the price of assets and costs of borrowing in the economy.
2. The liquidity channel, because government bonds play a crucial role in repurchase transactions.
3. The balance sheet channel, because the price of government bonds would have an impact on banks' balance sheets.

This sovereign debt crisis brought to the fore institutional design problems of the euro area. The Treaties include provisions that prohibit monetary financing by the ECB (Article 123 TFEU) and bailouts (Article 125 TFEU). Therefore, the ECB was more constrained in its actions than, for instance, were the Federal Reserve or the Bank of England.

To reduce market turbulence, the ECB introduced the Securities Markets Programme in May 2010, under which it purchased mainly sovereign bonds on the secondary markets. In addition, it sterilized its interventions by offering banks, on a weekly basis, interest bearing deposits for an amount equal to the amount of government bonds it purchased. At its peak, the programme's volume totaled around €210 billion. According to an ECB study, it led to stabilization in markets as well as to an immediate and substantial decline of government bond yields.

The Securities Markets Programme was not enough. The downgrades of euro area sovereign bonds, the slowing down of the European economy, and uncertainty regarding the effectiveness of the measures to tackle the euro area crisis increased the pressure on the government debt of euro area countries under financial assistance. In autumn 2011, the adverse interaction between government bonds and national banking systems raised concerns about their viability, which once again rendered the interbank market dysfunctional.

This situation worsened on 26 October 2011, when the Council agreed on a capital package proposed by the European Banking Authority (EBA), under which banks were required to build up additional capital buffers to reach a level of 9% Core Tier 1 capital. The objective of the exercise was to create an exceptional and temporary capital buffer to address market concerns over sovereign risk, which would provide a reassurance to markets about banks' ability to withstand a range of shocks and still maintain adequate capital. Nevertheless, the results of the exercise showed that banks needed another €115 billion in total to reach the desired level, which created uncertainty about their capital adequacy and added to market turbulence. In this contest, in December 2011 the ECB response focused on providing banks with short term liquidity support and sufficient time to reach the desired capital level. It undertook the following actions:

1. Two LTROs, one in December 2011 and one in February 2012, with a maturity of three years each: these LTROs of a total amount of around €1 trillion provided banks with liquidity over the medium term. According to the ECB, the bank participation in those operations proves that liquidity reached out even to small and very small banks, whose primary business is to refinance small and medium sized enterprises.
2. Reduction in the minimum reserve ratio requirement from 2% to 1%, with the scope of reducing banks' liquidity needs and thereby the amount of collateral that they may need to mobilize to satisfy reserve requirements, and to favor money market activity by increasing the incentives of banks with excess cash to offer their liquidity to other banks, as they can no longer deposit it with the fully remunerated reserve account.
3. Increase in collateral availability: the ECB allowed NCBs to accept additional credit claims, in particular bank loans, as collateral. Since credit claims correspond to certain types of loans to households and firms, their eligibility as collateral allowed banks to access refinancing using these credit claims, which were directly related to their lending activity.
4. Second Covered Bond Purchase Programme: finally, in November 2011, the Eurosystem launched a second Covered Bond Purchase Programme (CBPP2). The programme ended, as planned, on 31 October 2012 when it reached a nominal amount of €16.4 billion.

The end of 2011 and beginning of 2012 were tumultuous, with a proposed Greek referendum on the EU financing package and government crises in both Greece and Italy, as well as with Standard & Poor's downgrades of nine euro area sovereigns in January and their lowering the credit rating of 16 Spanish banks in April. The uncertainty created, which the Greek election in spring 2012 did not lessen, resulted in government bond yields of a number of euro area countries reaching new heights and starting to incorporate redenomination risk premiums, that is, the risk that those countries would exit the EMU and redenominate their public and private liabilities.

Against this background, the ECB sent a strong signal to the markets, with its President declaring in a speech that the ECB is ready to do whatever it takes to preserve the euro. Then in September, the ECB announced the Outright Monetary Transaction (OMT) Programme, under which it was prepared to intervene along with NCBs in the secondary sovereign bond markets of euro area member countries. In this way, the ECB became a lender of last resort in the government bond markets, restoring financial market confidence, even though no operations have yet been conducted.

The OMT Programme differed from the Securities Markets Programme in several ways. A condition for access to the OMT was "strict and effective conditionality attached to an appropriate European Financial Stability Facility / European Stability Mechanism programme". The OMT programme would be, in principle, unlimited in time and scope. Finally, the ECB would be treated without preferential treatment with respect to other creditors. Furthermore, the transparency of OMT purchases would be greater since the breakdown by country and the average duration of holdings would be published.

Mario Draghi's declaration and the OMT programme have greatly reduced market volatility in the euro area. Sovereign bond yields in Spain and Italy fell by 100 and 50 basis points in August 2012. In addition, the bond spreads fell very significantly.

Nevertheless, as 2012 ended and 2013 started, a new source of tension appeared. Inflation, which during the crisis had reached a peak of 3%, started decreasing, reaching 1.2% in April 2013. This disinflation, combined with the slow growth of the euro area economy, prompted the ECB to adopt another precautionary non-standard measure, namely, forward guidance.

In July 2013, ECB President Draghi declared in a press conference that, "looking ahead, our monetary policy stance will remain accommodative for as long as necessary. The Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time". This has been seen as the introduction by the ECB of forward guidance or "explicit statements by a central bank about the likely path of future policy rates typically conditioned on the evolution of certain key macroeconomic aggregates".

According to Hubert and Labondance, the objective of the forward guidance is to influence private expectations about short term rates, which in turn will influence expectations about long term rates, in order to strengthen the transmission of monetary policy, and thus support the economy. Eggertsson and Woodford observe that this strategy is meant to complement quantitative easing and is especially relevant when policy rates are at, or close to, their effective lower bound, the normal channels of monetary policy transmission are impaired, or when there is exceptional uncertainty on the state of the economy.

According to the ECB Executive Board Member Peter Praet, "the ECB's forward guidance has contributed to more stable money market conditions and has helped to anchor market expectations more firmly. It also ensures that our monetary policy stance is not excessively vulnerable to shocks that are disconnected from the underlying economic and monetary conditions in the euro area".

1.2.2: The first TLTROs[7]

5 June 2014 (Press release): The Governing Council decided to conduct a series of targeted longer-term refinancing operations (TLTROs) with the purpose to improve bank lending to the euro area non-financial private sector, excluding loans to households for house purchase, over a window of two years.

Counterparties are entitled to an initial TLTRO borrowing allowance (initial allowance) equal to 7% of the total amount of their loans to the euro area non-financial private sector, excluding loans to households for house purchase, outstanding on 30 April 2014. In two successive TLTROs to be conducted in September and December 2014, counterparties can borrow an amount that cumulatively does not exceed this initial allowance.

Further TLTROs are conducted quarterly from March 2015 to June 2016. The additional amounts that can be borrowed by counterparties can cumulatively reach up to three times each counterparty's net lending to the euro area non-financial private sector, excluding loans to households for house purchase, provided between 30 April 2014 and the respective allotment reference date (the most recent month for which net lending data are available for each TLTRO allotment) in excess of a specified benchmark.

[7] Source: Press releases on monetary policy from the ECB website: https://www.ecb.europa.eu/press/pr/activities/mopo/html/index.en.html [Last access on 15 January 2019]

All TLTROs mature in September 2018. The interest rate on the TLTROs is fixed over the life of each operation at the rate on the Eurosystem's main refinancing operations (MROs) prevailing at the time of take-up plus a fixed spread of 10 basis points. Interest is paid in arrears when the borrowing is repaid. Starting 24 months after each TLTRO, counterparties have the option to repay any part of the amounts they were allotted in that TLTRO at a six-monthly frequency.

Counterparties that have borrowed under the TLTROs, and whose net lending to the euro area non-financial private sector, excluding loans to households for house purchase, in the period from 1 May 2014 to 30 April 2016 is below the benchmark, are required to pay back borrowings in September 2016.

1.2.3: The Quantitative Easing program[8]

To increase the ability of banks to expand their lending and finance economic growth, the ECB decided to launch two programmes, in October and November 2014, to revive particular segments: covered bonds and asset backed securities. The programmes, the third Covered Bond Purchase Programme (CBPP3) and the Asset Backed Securities Purchase Programme (ABSPP), were planned to last for at least two years. Their goal is to support financing conditions in the euro area, facilitate credit provision to the real economy and generate positive spillovers to other markets. On 13 February 2015, the purchases in the context of the ABSPP amounted to €2870 million and those for the CBPP3 to €45954 million.

Inflation in the euro area in December 2014 was -0.2% and growth rates were low. At the same time, the key interest rates were close to zero, with the rate for the deposit facility at -0.2%. To contribute to reviving the euro area economy and raise inflation, bringing it back to the desired level of lower than but close to 2%, the ECB decided to pursue an Expanded Asset Purchase Programme (EAPP) on 22 January 2015. Similar unconventional measures were implemented by the bank of Japan in 2001 and by the Federal Reserve and the Bank of England since 2008. Although the names of the specific programmes and their details differ, they are commonly referred to as quantitative easing (QE), an unconventional form of monetary policy where a central bank creates new money to buy financial assets, like government bonds.

Under QE, a central bank creates money and uses it to purchase financial assets from

[8] See Delivorias (2015)

private investors such as banks, pension funds and insurance companies. This process is electronic and does not involve printing banknotes: the central bank creates money by increasing the credit in its own account. Under the programme, the ECB adds the purchase of "euro denominated investment grade securities issued by euro area governments and European institutions" to the ABSPP and the CBPP3.

The combined monthly purchases under the three programmes were planned to amount to €60 billion. They started in March 2015 and were originally planned to be carried out for 18 months or until a sustained adjustment in the path of inflation towards the ECB's objective of lower but close to 2% is observed. The purchases will be based on the Eurosystem national central banks' shares in the ECB's capital key. They will be done in the secondary market and amounts purchased will never exceed one third of a country's debt issuance, or 25% of any given issue. Certain additional eligibility criteria will be applied in the case of countries under an EU/IMF adjustment programme. Finally, with regard to the sharing of hypothetical losses, 20% of the additional asset purchases will be subject to a regime of risk sharing.

However, the programme has generated lively debate, because the results of the previous three major QE programmes have been mixed and because of concerns relating to its legality and to its feasibility.

1.2.4: The second TLTROs[9]

10 March 2016 (Press release): The Governing Council of the ECB decided to launch a new series of four TLTROs (TLTRO II). The new operations offer attractive long-term funding conditions to banks to further ease private sector credit conditions and to stimulate credit creation. TLTRO II is intended to reinforce the ECB's accommodative monetary policy stance and to strengthen the transmission of monetary policy by further incentivizing bank lending to the real economy. Together with the other non-standard measures in place, TLTRO II contribute to a return of inflation rate to levels below, but close to, 2% over the medium term.

Counterparties can borrow in the operations a total amount of up to 30% of a specific eligible part of their loans as at 31 January 2016, less any amount which was previously borrowed and still outstanding under the first two TLTRO operations conducted in 2014. The

[9] Source: Press releases on monetary policy from the ECB website: https://www.ecb.europa.eu/press/pr/activities/mopo/html/index.en.html [Last access on 15 January 2019]

four TLTRO II operations are conducted in June, September and December 2016 and in March 2017.

All TLTRO II operations have a maturity of four years from their settlement date. Counterparties can repay the amounts borrowed under TLTRO II at a quarterly frequency starting two years from the settlement of each operation. Counterparties are not subject to mandatory early repayments.

The interest rate applied to TLTRO II is fixed for each operation at the rate applied in the main refinancing operations (MROs) prevailing at the time of allotment. In addition, counterparties whose eligible net lending in the period between 1 February 2016 and 31 January 2018 exceeds their benchmark are charged a lower rate for the entire term of the operation. This lower rate is linked to the interest rate on the deposit facility prevailing at the time of the allotment of each operation.

The Governing Council decided to introduce an additional voluntary repayment possibility for all currently outstanding TLTROs in June 2016, coinciding with the settlement of the first TLTRO II operation. This allows counterparties to roll over amounts borrowed under the current TLTROs into TLTRO II. The remaining two operations of the first TLTRO programme are implemented in March 2016 and June 2016, as originally scheduled.

1.2.5: Monetary policy decisions about the QE program[10]

22 January 2015 (Press release): The monthly purchases under the asset purchase programme will be €60 billion and will last until at least September 2016.

3 December 2015 (Press conference): The monthly purchases are now intended to run until the end of March 2017, or beyond if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its aim of achieving inflation rates below, but close to, 2% over the medium term. The principal payments on the securities purchased under the APP will be reinvested as they mature, for as long as necessary. This will contribute both to favorable liquidity conditions and to an appropriate monetary policy stance. Euro-denominated marketable debt instruments issued by

[10] Source: Governing Council monetary policy decisions from the ECB website: https://www.ecb.europa.eu/press/govcdec/mopo/2018/html/index.en.html [Last access on 15 January 2019], Press releases on monetary policy from the ECB website: https://www.ecb.europa.eu/press/pr/activities/mopo/html/index.en.html [Last access on 15 January 2019], and: Press conferences from the ECB website: https://www.ecb.europa.eu/press/pressconf/2018/html/index.en.html [Last access on 15 January 2019]

regional and local governments located in the euro area are included in the list of eligible assets for the PSPP.

10 March 2016 (Governing Council decision): The monthly purchases under the asset purchase programme will be expanded to €80 billion starting in April 2016.

2 June 2016 (Governing Council decision): On 8 June 2016 the Eurosystem will start making purchases under its corporate sector purchase programme (CSPP).

8 December 2016 (Governing Council decision): From April 2017, the net asset purchases are intended to continue at a monthly pace of €60 billion until the end of December 2017, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim. If in the meantime the outlook becomes less favorable or if financial conditions become inconsistent with further progress towards a sustained adjustment of the path of inflation, the Governing Council intends to increase the programme in terms of size and/or duration. The net purchases will be made alongside reinvestments of the principal payments from maturing securities purchased under the APP.

26 October 2017 (Governing Council decision): From January 2018 the net asset purchases are intended to continue at a monthly pace of €30 billion until the end of September 2018, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim. If the outlook becomes less favorable, or if financial conditions become inconsistent with further progress towards a sustained adjustment in the path of inflation, the Governing Council stands ready to increase the APP in terms of size and/or duration. The Eurosystem will reinvest the principal payments from maturing securities purchased under the APP for an extended period of time after the end of its net asset purchases, and in any case for as long as necessary. This will contribute both to favorable liquidity conditions and to an appropriate monetary policy stance.

14 June 2018 (Governing Council decision): The Governing Council anticipates that, after September 2018, subject to incoming data confirming the Governing Council's medium term inflation outlook, the monthly pace of the net asset purchases will be reduced to €15 billion until the end of December 2018 and that net purchases will then end. The Governing Council intends to maintain its policy of reinvesting the principal payments from maturing securities purchased under the APP for an extended period of time after the end of the net asset purchases, and in any case for as long as necessary to maintain favorable liquidity conditions and an ample degree of monetary accommodation.

1.2.6: Other announcements of unconventional monetary policies[11]

18 June 2015 (Press release): ECB Governing Council takes note of ruling on OMT. The Governing Council of the ECB takes note of the ruling of the Court of Justice of the European Union (ECJ) confirming that the Outright Monetary Transactions (OMT) programme announced in 2012 is compatible with EU law and within the ECB's competences.

23 September 2015 (Press release): Eurosystem adjusts purchase process in ABS programme. The Governing Council of the ECB decided to increase the proportion of purchases by national central banks rather than external managers in the ABSPP, as announced when the programme was first launched.

9 November 2015 (Press release): Increase in PSPP issue share limit enlarges purchasable universe. The PSPP issue share limit will be set at 33% per international securities identification number (ISIN), subject to verification on a case-by-case basis that a holding of 33% per ISIN would not lead the Eurosystem central banks to reach blocking minority holdings.

10 March 2016 (Press release): ECB adds corporate sector purchase programme (CSPP) to the asset purchase programme (APP) and announces changes to APP.

21 April 2016 (Press release): ECB announces details of the corporate sector purchase programme (CSPP)

3 May 2016 (Press release): ECB publishes legal acts relating to the second series of targeted longer-term refinancing operations (TLTRO II).

2 June 2016 (Press release): ECB announces remaining details of the corporate sector purchase programme (CSPP)

8 December 2016 (Press release): Eurosystem introduces cash collateral for PSPP securities lending facilities. ECB adjusts parameters of its asset purchase programme (APP).

15 December 2016 (Press release): Eurosystem adjusts purchase process in ABS purchase programme (ABSPP).

26 October 2017 (Press release): Additional information on asset purchase programme.

[11] Source: Press releases on monetary policy from the ECB website: https://www.ecb.europa.eu/press/pr/activities/mopo/html/index.en.html [Last access on 15 January 2019]

CHAPTER 2: THE MONETARY POLICY AND THE STOCK MARKET: LITERATURE REVIEW

Given that this thesis is focused on the impact of unconventional monetary policies on stock returns of banks in the euro area, this chapter summarizes the main methodologies and findings of the literature. This chapter is divided into four sections, a first section about monetary policy and stock market, a second section about unconventional monetary policy and stock market, a third section about monetary policy and bank stocks, and a fourth section about unconventional monetary policy and bank stocks.

The literature about the impact of unconventional monetary policy is not very wide with respect to the literature about the impact of conventional monetary policy, and also the literature about the impact on bank stocks is small with respect to the literature about the impact on the whole stock market. In each of the four sections, we will see in depth some of the main articles, and more briefly other articles.

2.1: MONETARY POLICY AND STOCK MARKET

There is a considerable amount of literature about the link between monetary policy and stock market. The importance of understanding this relationship is explained by Bernanke and Kuttner (2005). In their paper they highlight that "the ultimate objectives of monetary policy are expressed in terms of macroeconomic variables such as output, employment, and inflation. However, …[the monetary policy directly affects financial markets, and then], by affecting asset prices and returns, policymakers try to modify economic behavior in ways that will help to achieve their ultimate objectives. Understanding the links between monetary policy and asset prices is …[very] important for understanding the policy transmission mechanism."

How stock prices should react to monetary policy? Thorbecke (1997) remembers that, according to the theory, "stock prices equal the expected present value of future net cash flows. Thus evidence that positive monetary shocks increase stock returns indicates that expansionary monetary policy exerts real effects by increasing future cash flows or by decreasing the discount factors at which those cash flows are capitalized". In addition, Bernanke and Kuttner (2005) point out that "stocks are claims to real assets, so, if monetary neutrality holds, stock values should be independent of monetary policy in the very long run.

In the medium term, however, real and nominal volatility induced by the form of the monetary policy rule may well influence stock values."

Among the wide literature about this argument, in this section we will see some of the most cited articles about this topic. Different methods are employed by these papers to estimate the link between monetary policy and stock prices. Thorbecke (1997) uses three methods: a VAR, a linear regression and an event study. Rigobon and Sack (2002) introduced a methodology, the "identification through heteroskedasticity", to solve the problems of omitted variables and simultaneous determination of asset prices and monetary policy. This methodology is used also by Bohl et al. (2008). Bernanke and Kuttner (2005) use an event study, and introduced a method to separate the expected and unexpected component of the policy rate change. A lot of papers use this method, such as Bredin et al. (2009). Bjørnland and Leitemo (2005) use a VAR methodology, which has an important difference with respect to the event study. Indeed, according to Huston and Spencer (2016), even if "event studies reduce the risk of both omitted variable bias and endogeneity problems …[, this method looks only] at the immediate market reactions to policy actions …[and, unlike the VAR, it cannot detect] longer term effects".

The majority of papers analyze the impact on US by the Federal Reserve (Fed). Few papers treat other countries, such as Bohl et al. (2008), which analyzes the impact on Europe, and Bredin et al. (2009), which analyzes and compares the impact on UK and Germany, in a period that comprises the transition to the EU, so the German monetary policy is replaced by the ECB monetary policy starting from 1999.

Besides estimating the impact of monetary policy on stock market, some articles find other interesting results. Bernanke and Kuttner (2005), Bredin et al. (2009), and Ehrmann and Fratzscher (2004), find that the impact is different across sectors. Bernanke and Kuttner (2005) notice that the impact of monetary policy on expected future excess equity returns is the main reason of the impact on stock returns. Thorbecke (1997), and Ehrmann and Fratzscher (2004), find that the impact differs between individual firms depending on their characteristics, for example both papers agree that firms with a small size are more affected by monetary policy. Bomfim (2003) analyze the impact of monetary policy on the volatility of stock markets, finding that the volatility increases after a surprise in the policy rate change.

In the continuation of this section we will see more in-depth some of the main articles, and more shortly some other articles.

2.1.1: Bernanke and Kuttner (2005)

The paper of Bernanke and Kuttner (2005) uses Federal funds futures data to distinguish between expected and unexpected policy actions. Since the expected actions should be already incorporated into prices, only unexpected actions should have an effect on the market.

"For an event taking place on day d of month m, the unexpected … target funds rate change can be calculated from the change in the rate implied by the current-month futures contract. But because the contract's settlement price is based on the monthly average Federal funds rate, the change in the implied futures rate must be scaled up by a factor related to the number of days in the month affected by the change: $\Delta i^u = D/(D-d) * (f^0_{m,d} - f^0_{m,d-1})$, where Δi^u is the unexpected target rate change, $f^0_{m,d}$ is the current month futures rate, and D is the number of days in the month. The expected component of the rate change is defined as the actual change minus the surprise…[that is:] $\Delta i^e = \Delta i - \Delta i^u$."

Two regressions are run with the CRSP value weighted return as the dependent variable. In the first regression, this variable is regressed on the raw change in the Federal funds rate target, instead in the second regression it is regressed on the expected and unexpected components. The regressions are run only for the days with a change in the target rate and days of meetings of the FOMC.

The raw target rate change has a negative but not significant coefficient. In the second regression, "however, the estimated stock market response to the …[surprise component] is negative and highly significant", with a change in the surprise component of 1% point causing a one-day return of 4.68% with the opposite sign of the change. When six outliers are eliminated, the response is smaller even if still significant (2.55%).

They find other additional results. Firstly, the market responds more "to policy changes that are perceived to be relatively more permanent…[, and less to] unexpected inaction … of FOMC". Secondly, the reactions to monetary policy surprises are different across industries, "with the high tech and telecommunications sectors… [being more affected, and] other sectors, such as energy and utilities,… [not] significantly affected by monetary policy".

The effect of monetary policy on expected future excess equity returns is found to be the main reason of the impact on equity returns. Revisions in cash flow forecasts have some effects, and changes in expected real interest rates have a very small effect.

2.1.2: Rigobon and Sack (2002)

The paper of Rigobon and Sack (2002) proposes a methodology to solve "the two main problems in estimating the interactions between monetary policy and asset prices…[, namely] the endogeneity of the variables and the existence of omitted variables. First, while asset prices are influenced by the short-term interest rate, the short-term interest rate is simultaneously affected by asset prices, primarily through their influence on monetary policy expectations. Second, […] other variables influence both asset prices and short-term interest rates".

This article uses "a technique called identification through heteroschedasticity". "To implement this approach, […] two subsamples [are identified], denoted F and ˜F, […] for which […] the following assumptions […] hold: [the variance of the monetary policy shock is greater in the subsample F and the variance of the asset price shock and of the omitted variables are equal between the two subsamples], conditions […] weaker than… [those] required …[for] the event-study approach."

The days of FOMC meeting are the subsample F, and the days before them are the subsample ˜F, in fact the monetary policy shock has a bigger variance on days of meetings, and the other variables should have a relatively constant variance. The identification is possible through the variance covariance matrices of the two subsamples. This approach can be implemented simply using instrumental variables.

The sample size is 3 January 1994 - 26 November 2001, with a total of 78 policy dates. The results show that "a 25 basis point increase in the three-month interest rate results in a 1.9% decline in the S&P 500 index and a 2.5% decline in the Nasdaq index. …[In addition,] the short term rate has a significant positive impact on market interest rates, with the largest effect on rates with shorter maturities."

2.1.3: Thorbecke (1997)

The article of Thorbecke (1997) studies the link between stock returns and monetary policy in the US using three different methods. The period analyzed is January 1967 - December 1990.

The first method is "a monthly VAR with [the following variables:] the growth rate of industrial production, the inflation rate, the log of a commodity price index, the federal funds rate, the log of nonborrowed reserves, the log of total reserves, stock returns, a constant, and six lags[…]. Since the Federal Reserve targeted nonborrowed reserves …[from] October 1979 …[to] August 1982 […] orthogonalized innovations in NBR are used to measure monetary policy over this period."

The second method is a regression of the industry stock return on the following variables: "the Treasury bond / Treasury bill spread (the horizon premium), the corporate bond / Treasury bond spread (the default premium), the monthly growth rate in industrial production, unexpected inflation, and the change in expected inflation", and "an index that classifies monetary policy into five categories: strongly anti inflationary (-2), anti inflationary (-1), neutral (0), pro growth (1) and strongly pro growth (2)".

The third method is an event study. The percentage changes in the Dow Jones Industrial Average (DJIA) and the Dow Jones Composite Average (DJCA) are regressed on the change in percentage points of the federal funds rate, for those days with news of a federal funds rate change.

"Using several measures of monetary policy and a variety of empirical techniques, this article presents evidence that monetary policy exerts large effects on ex ante and ex post stock returns. These findings are consistent with the hypothesis that monetary policy, at least in the short run, has real and quantitatively important effects on real variables. …[Moreover, the impact is bigger] on small firms than [on] large firms. This evidence supports the hypothesis that monetary policy matters partly because it affects firms' access to credit".

2.1.4: Other papers about monetary policy and stock market

Bohl et al. (2008) analyze the impact of monetary policy shock on European stock market returns. The method used is the identification through heteroskedasticity of Rigobon and Sack (2002). The period considered is 1 January 1999 to 28 February 2007. The impact found is a decrease between 1.42% and 2.30% in response to an unanticipated increase of 25 basis points in the interest rate. In addition, the impact is similar between the main stock markets of the EMU.

Bredin et al. (2009) use the approach of Bernanke and Kuttner (2005) to separate expected and unexpected change in the policy rate. They analyze the impact of monetary policy on stock returns for UK and Germany. The sample is May 1989 - May 2004 for Germany (so it includes the transition to the EU) and January 1993 - May 2004 for UK.

“Results show that the UK monetary policy surprises have had a statistically significant impact on both the UK aggregate and industry level stock returns. […] The sectors that respond to domestic monetary policy changes […] are similar [in UK and US. In addition,] unanticipated changes in the UK monetary policy have significant impacts on German aggregate and industrial level stock returns. […] However, the results for German / Euro area monetary policy surprises are […] different. […] Both expected and unexpected changes in …[the policy rate] have an insignificant impact on stock returns in Germany and the UK. … [In summary,] equity markets in the UK and Germany are sensitive to […] the monetary policy […] of the Bank of England, but are ambivalent to the decisions of the ECB”.

Bjørnland and Leitemo (2005) “estimate the interdependence between US monetary policy and the S&P 500 using structural VAR methodology …[with] a combination of short-run and long-run restrictions. …[Results show that] stock prices immediately fall by 1.5% due to a monetary policy shock that raises the federal funds rate by 10 basis points, …[and] a stock price shock increasing stock prices by 1% leads to an increase in the interest rate of 5 basis points”.

Ehrmann and Fratzscher (2004) analyze “the effects of US monetary policy on stock markets [, from 1994 to 2003. They] find that, on average, a tightening of 50 basis points reduces returns by about 3%. Moreover, returns react more strongly when no change had been expected, when there is a directional change in the monetary policy stance and during periods of high market uncertainty. […] Individual stocks [reaction is] highly heterogeneous …[, and the reaction of individual stocks depends on] financial constraints and Tobin’s q. First, […] there are strong industry-specific effects of US monetary policy. Second, […] for the individual stocks comprising the S&P 500 those with low cashflows, small size, poor credit ratings, low debt to capital ratios, high price-earnings ratios or high Tobin’s q are affected significantly more. [Moreover, both] firm- and industry-specific effects […] play an important role”.

Bomfim (2003) studies “pre-announcement and news effects on the stock market in the context of public disclosure of monetary policy decisions. The results suggest that the stock market tends to be relatively quiet - conditional volatility is abnormally low - on days preceding regularly scheduled policy announcements. [This effect is significant only after the] changes in the Federal Reserve’s disclosure practices in early 1994. …[The monetary policy surprise] tends to boost stock market volatility significantly in the short run, and positive surprises […] tend to have a larger effect on volatility than negative surprises”.

2.2: UNCONVENTIONAL MONETARY POLICY AND STOCK PRICES

In this section we consider some of the main articles about the impact of unconventional monetary policy on stock prices. These articles focus on different currency areas where unconventional monetary policies were decided. Huston and Spencer (2016) and Rosa (2012) focus on the US, Nakazono and Ikeda (2016) and Honda (2014) on Japan, Joyce et al. (2010) on UK, Haitsma et al. (2016) and Fratzscher et al. (2014) on euro area, Gambacorta et al. (2014) and Rogers et al. (2014) on more than one currency area.

Huston and Spencer (2016), Honda (2014), and Gambacorta et al. (2014) use a VAR model. The variables of unconventional monetary policy on Huston and Spencer (2016) are the monetary base, excess reserves, and M2, Honda (2014) uses the total balance of bank reserves (TBBR), and Gambacorta et al. (2014) use the central bank's assets.

Nakazono and Ikeda (2016), Haitsma et al. (2016), Rogers et al. (2014) and Rosa (2012) use an event study. To identify the unconventional monetary policy, Nakazono and Ikeda (2016) use Euroyen future rates, Haitsma et al. (2016) and Rogers et al. (2014) use the spread between German and Italian 10-year government bonds, Rosa (2012) uses Financial Times articles.

Haitsma et al. (2016) analyzes also how the results are affected by the firm's characteristics. In addition, this paper and Rosa (2012) study the impact of both conventional and unconventional monetary policy. Fratzscher et al. (2014) and Rogers et al. (2014) find spillover effects, that is unconventional monetary policies in a currency area which affect stock prices in other currency areas.

The articles on this topic are quite recent, since unconventional monetary policies are a tool used recently. In the continuation of this section we will see more in-depth some of the main articles, and more shortly some other articles. In particular, we will see deeply the paper of Haitsma et al. (2016), since the methodology of this thesis is based on this paper.

2.2.1: Huston and Spencer (2016)

The paper of Huston and Spencer (2016) "explores the effectiveness of the Fed's actions to increase asset prices and thus enable the wealth effect.". The method used is a vector autoregression (VAR). The sample is September 2008 - March 2016. "The traditional measure of monetary policy is the federal funds rate …[, but from the end of 2008] the policy rate has been near zero and thus not useful. […] Other potential measures include the monetary base, money supply and excess reserves”.

The VAR variables are the monetary base as the monetary policy variable, the S&P Case-Shiller 10-city home price index, the real value of the S&P 500 index, the 30-year conventional mortgage rate, the civilian unemployment rate, and the index of S&P 500 volatility (VIX). This six-variables VAR model has two lags.

“The trends [of the impulse response functions] are as expected for all five impulse responses to a change in the monetary base: an increase in the monetary base increases stock values and housing prices. It reduces unemployment, volatility and the mortgage rate. The effects on the S&P 500 VIX and unemployment are significant at the 5% level though the effect on the VIX attenuates. The Case-Shiller index becomes significant only starting at the two year mark. Mortgage rates fall but are not statistically significant”.

“To explore the relative importance of Fed policy in affecting asset prices, a variance decomposition is performed with a 24-month forecast horizon. […] In the early months, shocks to the SP500R’s own equation error term dominate, but over the 24-month period the share of S&P 500 forecast error variance attributed to changes in the monetary base rises to over 40%, far above the other factors. For housing prices, the role played by monetary base shocks is more modest. The proportion assigned to the monetary base still rises over time but at 24 months is just over 12%. For the [other] three variables […], monetary-base shocks claim the highest percent of forecast error variance for unemployment at 31.1%. A peak of 16.7% is reached for the monetary base share for the VIX at 21 months. Consistent with the insignificant impulse response, the monetary base share of forecast variance error for the mortgage rate is only 7.7%”.

In summary, “this study finds that the expansionary monetary policy …[on the period investigated] has been quite effective. […] The ability of these programs to raise asset prices is a necessary, though not sufficient, condition for monetary policy to affect spending through increased wealth”.

2.2.2: Nakazono and Ikeda (2016)

The paper of Nakazono and Ikeda (2016) “evaluates the effects of unconventional monetary policies adopted by the Bank of Japan from the year 2001 to 2006”. The dataset consists of stocks “listed in the First Section of the Tokyo Stock Exchange […] from April

2001 to February 2006". Log intraday returns are computed only for days of monetary policy meetings.

"[The] unconventional monetary policy shock …[is computed] as follows: $MPS_t^{Spread} = \Delta f_{6,t} - \Delta f_{1,t}$, where $\Delta f_{k,t}$ is the change between the opening and the closing futures rate (100 minus the futures contract price) of the k^{th} nearest month Euroyen futures in day t when the monetary policy meeting is held".

"Note that whether a policy is expansionary or contractionary is not determined by what the Bank of Japan does …[, but] by whether the Bank of Japan beats markets' expectations. If market participants expect monetary easing and the Bank of Japan maintains the existing policy, the policy is considered as contractionary even when the Bank of Japan does not change the policy".

The intraday returns of TOPIX (Japanese stock index) are regressed on the monetary policy surprise. Results show that "an expansionary monetary policy shock decreases the stock index return …[, contrasting] with the literature".

Dividing the sample into recession (April 2001 - December 2001), and boom (January 2002 - February 2006), "a contractionary monetary policy surprise decreases TOPIX returns during the recession …[even if] not significantly …[, but] during the boom …[it] increases the stock index significantly". Results are confirmed by a regression with a dummy for the recession and one for the boom (the explanatory variables are $MPS_t^{Spread} * D_t^{Recession}$ and $MPS_t^{Spread} * D_t^{Boom}$).

As in the previous equation, the sample is split into two parts, this time into tightening and easing. An unexpected tightening increases stock prices, and an easing decreases stock prices, inconsistent with the theory.

"In October 2003, the Bank of Japan gave more detailed description of the commitment to maintaining accommodative monetary conditions and quantitative easing policy until inflation rates reach above zero …[, enhancing] monetary policy transparency. To examine whether enhancing monetary policy transparency has any effect on the reaction of the stock market, [the regression which divides the sample into tightening and easing is run further dividing the sample into before and after October 2003]".

"Until October 2003, the response is negative when a monetary policy surprise is contractionary or expansionary. That is, stock prices fluctuate and become volatile in response to any policy surprises. After that, however, the reaction is not dependent on the monetary policy shock: an unexpected monetary policy easing (tightening) decreases (increases) stock returns. […] The reaction is not consistent with economic theory".

2.2.3: Haitsma et al. (2016)

The paper of Haitsma et al. (2016) employs an event study to "examine how stock markets respond to the policies of the European Central Bank during 1999-2015". "The following model [is estimated]:

$$R^i_t = \alpha + \beta_1(1\text{-}C_t)\Delta r_t^u + \gamma_1(1\text{-}C_t)\Delta r_t^e + \beta_2 C^t \Delta r_t^u + \gamma_2 C^t \Delta r_t^e + \varphi \Delta r_t^{u,c} + \delta X_t + \varepsilon_t$$

where R_t^i represents the returns on day t of a certain stock index or portfolio i […], α is a constant, C_t is a dummy that takes a value of zero before the crisis and one thereafter, Δr_t^u, Δr_t^e, $\Delta r_t^{u,c}$ are respectively the conventional monetary policy surprise, the expected policy rate change, and the unconventional monetary policy surprise on day t […], X_t is a vector of control variables on day t, and ε_t is the error term on day t. β_1 represents the effects of the [conventional] monetary policy surprise on stock returns pre-crisis, whereas β_2 shows the effects after the start of the crisis. […] The vector of control variables X_t consists of two variables: the MSCI World index (excluding Europe) to control for general economic movements in the rest of the world and the crisis dummy. […] The ECB's announcement of the first unconventional monetary policy on 22 August 2007 …[represents] the start of the crisis period".

The returns are log returns. "The stock market index used is the EURO STOXX 50 index. […] For sector indices […] the 19 'supersectors' [are used], as defined by the International Classification Benchmark". According to the interest rate channel, "the response to monetary policy surprises should differ across sectors depending on the interest-elasticity of the demand for their products".

"The credit channel implies that sectors will be more affected by monetary policy surprises, the stronger their dependence on bank funding". "Several portfolios [are identified] based on firm characteristics to examine the credit channel. First, for size […] the Datastream portfolios for the euro area, i.e. EURO STOXX Large, Mid and Small. Second, …[the following indices are considered]: the interest coverage ratio, the free cash flow to income ratio, the current ratio, the financial leverage ratio, and the debt-to-equity ratio. …[For each of these characteristics, stocks are divided] into three groups: high, mid and low, and […] the average daily returns [are computed for each group of stocks]".

Finally, other two characteristics are considered, "namely value versus growth stocks and momentum. A value stock …[has] a low market-to-book and price-to-earnings ratio…[, and] the opposite holds for a growth stock. […] For the momentum factor …[, stocks are sorted] based on past performance […], i.e. one month, three months and twelve months".

The method of Bernanke and Kuttner (2005) is used to separate expected and unexpected component of the conventional monetary policy rate. The "continuous three-month Euribor futures rates …[are employed] to construct …[a] proxy for conventional monetary policy surprises: $\Delta r_t^u = f_{s,t} - f_{s,t-1}$, where Δr_t^u represents the policy surprise at day t, and $f_{s,t} - f_{s,t-1}$ [is the difference between the future rate at day t and t-1]. […] The expected part of the policy change (Δr_t^e) …[is] the difference between the actual rate change (Δr_t) and the unexpected part […]: $\Delta r_t^e = \Delta r_t - \Delta r_t^u$".

"To measure unexpected unconventional policies, …[this article follows] Rogers et al. (2014) who proxy the surprise by the change in the spread between German and Italian 10-year bond yields. If the spread increases following an unconventional monetary policy announcement it implies that monetary policy is tighter than expected and vice versa. The surprise factor for the unconventional measures …[is:] $\Delta r_t^{u,c} = (y^I_{s,t} - y^G_{s,t}) - (y^I_{s,t-1} - y^I_{s,t-1})$, where $y^I_{s,t}$ and $y^G_{s,t}$ are the Italian and German 10-year government bond yields at day t respectively". The spread is used since "the ECB's unconventional monetary policies were to quite some extent aimed at reducing intra-euro area sovereign spreads".

The Governing Council meeting dates are used as the conventional monetary policy days. "The unconventional measures taken by the ECB in recent years did not always correspond to the regular announcement dates. […] For these announcements, …[the dates used are taken from] Rogers et al. (2014) for the period up to April 2014 and the database of press release of the ECB up to and including February 2015".

"[Results] show that both conventional and unconventional monetary policy surprises affect the EURO STOXX 50 index. The strongest effects are found for unconventional monetary policy surprises. …[Moreover,] results do not provide strong evidence for the interest rate channel. Although stocks of different sectors respond differently to monetary policy surprises, these differences are hardly linked to differences with respect to their sensitivity to interest rates. […] Value stocks are affected more by unconventional monetary policy surprises than growth stocks. The effects on value and growth stocks are fairly similar for conventional policy surprises. For portfolios constructed on the basis of momentum, […] loser stocks react more strongly to unconventional monetary policy surprises".

"The impact […] differs across the crisis and non crisis period. During the crisis, unexpected conventional monetary policy tightening is frequently associated with higher stock prices although the coefficients are insignificant in most cases. In addition, Wald tests frequently suggest a change in the effects of conventional monetary policy before and after the crisis".

2.2.4: Honda (2014)

The paper by Honda (2014) summarizes the VAR findings of a paper from Honda and Tachibana in 2011. The sample period is January 1996-March 2010. Four dummy variables are used: d1 equal to 1 during the QE period, d2 equal to 1 before and after the QE (d2 is 1 when d1 is 0 and vice versa), d3 equal to 1 before the QE and d4 equal to 1 after the QE.

Three kinds of VAR models are considered. The first model's variables are prices, production, the overnight call rate, stock prices, and finally TBBR (total balance of bank reserves) multiplied by d1. The second model adds to the previous model the variable TBBR*d2. The third model, starting from the second model, substitutes TBBR*d2 with TBBR*d3 and TBBR*d4, to allow TBBR to have a different effect before and after the QE.

Impulse response function to a quantitative easing policy shock are computed. "In all three models, the responses in prices […] are negligible, but those in production […] and stock prices are significantly different from zero. Stock prices react within 1 to 6 months, but production reacts with a time lag of 7 to 9 months. […] The main message […] is that nontraditional monetary policy as a package has significant impacts on production through changes in stock prices".

2.2.5: Other papers about unconventional monetary policy and stock market

Joyce et al. (2010) evaluate the impact of the QE on asset prices in UK (then not only stocks). They find that the QE policy reduced gilt (UK government securities) yields by about 100 basis points. "The […] impact on other asset prices is more difficult to disentangle from other influences".

Rosa (2012) "examines the impact of large-scale asset purchases (LSAP) on US asset prices […] using an event study. [The assets considered are bonds, stocks and exchange rates.] The surprise component of LSAP announcements is identified from Financial Times articles. […] Results show that the LSAP news has economically large and highly significant effects on asset prices, even after controlling for the [conventional] surprise component […] and communication about its future path of policy".

Fratzscher et al. (2014) measure "the impact of the most important ECB's non-standard monetary policy measures on asset prices in the euro area and globally. …[For a period from May 2007 to September 2012,] results show that ECB policies …[positively affected] asset prices [both in the euro area and on other advanced and emerging economies]".

Gambacorta et al. (2014) use a panel VAR to evaluate "the macroeconomic effects of unconventional monetary policies …[on] eight advanced economies. …[The VAR variables are output, prices, VIX (volatility index) and the central bank assets.] An exogenous increase in central bank balance sheets at the zero lower bound leads to a temporary rise in economic activity and consumer prices. The estimated output effects …[are] similar to …[what can be] found in the literature on the effects of conventional monetary policy, while the impact on the price level is weaker and less persistent".

Rogers et al. (2014) evaluate "the effects of unconventional monetary policy by the Federal Reserve, Bank of England, European Central Bank and Bank of Japan on bond yields, stock prices and exchange rates. […] These policies are effective in easing financial conditions […] at the zero lower bound …[through reductions in the] term premia". "The pass-through from bond yields into other asset prices generally seems to be bigger for the US than for other countries. There are also important cross-country spillovers, but they are asymmetric …[, with] the effects of US monetary policy shocks on non-US yields […] larger than the other way round".

2.3: MONETARY POLICY AND BANK STOCKS

In this section we consider some of the main articles which study the relationship between monetary policy and stock prices of banks. In addition to estimate how bank stocks are affected by monetary policy, Flannery and James (1984) and Kwan (1991) find that the maturity composition of assets and liabilities affects the interest rate sensitivity of bank stocks. Madura and Schnusenberg (2000) and Yin and Yang (2013) analyze also how bank characteristics affect the interest rate sensitivity of bank stocks.

Some articles of the literature, such as Flannery and James (1984), Chance and Lane (1980), Lynge and Zumwalt (1980), Booth and Officer (1985) and Akella and Chen (1990) extend the CAPM to include, beyond the equity market return, a bond market return, to measure the interest rate sensitivity of bank stock returns. Also Madura and Schnusenberg (2000) and Yin and Yang (2013) extend the CAPM in a similar way, but instead of a bond market return they include the change in the actual and unexpected policy rate, respectively.

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. …[Results show that the] interest rate and …[its] volatility […] directly impact the first and the second moments of bank stock returns distribution, respectively".

The difference in the methodology used by articles of many years ago and a recent paper, that is Yin and Yang (2013), is the use of the unexpected component of the change in the policy rate, computed with the methodology introduced by Bernanke and Kuttner (2005).

In the continuation of this section we will see more in-depth some of the main articles.

2.3.1: Flannery and James (1984)

The paper of Flannery and James (1984) "examines the relation between the interest rate sensitivity of common stock returns and the maturity composition of the firm's nominal contracts".

"The nominal return on the [firm's] stock […] is […] a weighted average of the returns on the firm's nominal and real assets". "Nominal assets are simply assets with cash flows that are fixed in nominal terms […], while the cash flows generated by real assets fluctuate with the price level. […] The nominal contracting hypothesis postulates that, […] since unanticipated inflation […] affects the real value of nominal but not real assets, stockholders of firms with fewer nominal assets than nominal liabilities should benefit from unexpected inflation".

"The interest rate sensitivity of a firm's common stock returns will depend upon the firm's holdings of net nominal assets […] and the[ir] maturity composition. […] The higher the proportion of the net nominal assets and the longer the[ir] maturity […], [the higher should be the firm's sensitivity]".

For each bank in the sample, its stock return is regressed on the return of an equally weighted portfolio of stocks and on the return of an index of constant maturity default free bonds. The coefficient of the latter variable is the estimate of the interest rate sensitivity. This estimated sensitivity is then regressed on the ratio between the net short position and the average market value, representing the maturity composition.

The results show "a negative and statistically significant relation […] between …[the] measure of bank rate sensitivity and the bank's net short asset position". The evidence from this article "supports the hypothesis that the effect of nominal interest rate changes on common stock prices is related to the maturity composition of a firm's net nominal asset holding".

2.3.2: Madura and Schnusenberg (2000)

The paper of Madura and Schnusenberg (2000) has two objectives. "The primary objective is to investigate the stock price reaction of commercial banks to announced changes in the relevant policy tool by the Federal Reserve. […] The second objective is to investigate …[how this reaction depends on] financial characteristics of these banks".

"Over time, the Fed has followed various operating procedures. Three operating regimes are investigated in this article: […] interest rate targeting …[(September 1974 to] October 1979), […] reserves targeting (October 1979 to August 1987) and […] a new phase of interest rate targeting (August 1987 …[to December 1996)]". The following analysis is done for each period.

The portfolio return of commercial banks is regressed 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, it is added 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.

"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, …[results] provide […] 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 the authors of the paper, "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". Note, however, that the models do not distinguish rate changes between expected and unexpected components.

"To investigate whether the [sensitivity depends on] bank-specific characteristics, … [banks are divided] in each period into three portfolios based on one of the characteristics being investigated".

The six regressions considered before (baseline model, only positive changes, only negative changes, and these three models with the dummy) are estimated for three bank portfolios (small, medium and large) over each of the three periods using seemingly unrelated regressions. Moreover, it is tested if the differences between coefficients of the three portfolios are significant. Three portfolios are formed based on the market value of equity, and other three portfolios on the capital ratio, that is equity divided by total assets.

Results show that "values of larger commercial banks and low capital ratio commercial banks are more exposed to changes in the relevant Fed policy tool".

2.3.3: Yin and Yang (2013)

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. Now let's see how bank characteristics are expected to influence the sensitivity to interest rate changes.

Bank size: "Stocks of small nonfinancial firms are more affected than stocks of large firms by monetary shocks …[since] large firms are better collateralized and thus …[less sensitive to the interest rate risk]. However, […] large banks rely more on the federal funds market for financing …[Moreover,] large banks also borrow heavily with other money market instruments. These short-term borrowings in money markets are not covered by federal deposit insurance and, therefore, are more interest rate sensitive". So, large banks should be more sensitive than small banks to a rate change.

Business activity mix: The literature shows that nonbanking activities or non interest income sources are more interest rate risk sensitive than banking activities. So, banks which rely more on nonbanking businesses should be more sensitive to target rate changes.

Funding sources: "since nondeposit funding is normally excluded from deposit insurance, [it is more interest rate risk sensitive]". So, banks which rely more on non deposit funding sources should be more sensitive to target rate changes.

Bank soundness indicators: “Solvency and adequate capital help banks better withstand market shocks and make bank stocks less susceptible to changes in the federal funds rate target. Hence, […] banks […] more financially sound …[should be] less affected by unexpected changes in the federal funds rate target”.

Two measures for each bank characteristic are used. “Bank size [is measured] with the natural logarithm of number of employees (Employees) and the natural logarithm of total assets (Total assets). […] Business activity mix [is measured] with the income mix, [that is] net interest income as a percentage of total operating income (Net interest income share), and the assets mix, that is the share of lending assets as a percentage of total earning assets (Loan share). The diversity of funding sources is measured as the share of total deposit to total liability (Deposit share) and the share of non deposit short term funding to total deposits and short term funding (nondeposit funding share). […] Bank soundness [is measured] by the capital to asset ratio (Capital) and the Z-score, […] defined as (ROA+CAR)/SROA, where ROA is a bank’s return on assets, CAR represents its capital to asset ratio and SROA stands for standard deviation of return on assets. …[It is used] Ln(1+Z-score) […] to smooth out higher values of the Z-scores in the dataset”.

The impact of the characteristics is estimated with two methods. The first method consists of adding to the basic regression the product of the unexpected target rate change and the value of the characteristic. The second method is the categorical analysis, that is “for each bank characteristic …[banks are ranked] in ascending order and …[divided] equally into 10 bins”, and for each bin the sensitivity coefficient of the basic regression is estimated.

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”.

“Nondeposit funding makes banks more susceptible to monetary shocks. Traditional bank deposits provide a steady and reliable flow of funds to banks while nondeposit funding is more sensitive to shocks in short term interest rates. The fact that some investment banks (Goldman Sachs and Morgan Stanley, for example) switched to deposit taking institutions during the 2008 financial crisis provides a case in point".

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. This sheds light on the capital adequacy requirement by bank regulators. It is necessary to maintain a certain level of capital to absorb monetary shocks and other risks, but too much capital may prove to be an unnecessary cost to banks".

2.4: UNCONVENTIONAL MONETARY POLICY AND BANK STOCKS

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 QE regime changed the impact of the conventional monetary policy on stocks returns of financial institutions. Fiordelisi and Ricci (2016) compares the results for the global systemically important banks with those for non financial corporations. Kobayashi et al. (2006) analyze the impact of QE in Japan, adding dummy variables for event days to the CAPM model. In the continuation of this section we will see more in detail the article by Ashraf et al. (2017), and more shortly the other two papers.

2.4.1: Ashraf et al. (2017)

The paper of Ashraf et al. (2017) examines "the impact of monetary shocks and policy tools on aggregate stock returns as well as the stock returns of financial institutions, during the […] period of quantitative easing (QE) in the US". The sample consists of daily and weekly returns from 18 December 2002 to 30 November 2011 of 855 financial firms. This sample is 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 (EXP) and unexpected (UNEXP) components. It is also considered the change in the

Fed’s total asset holdings in special purchase programs (ΔTOT). 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: Security and commodity brokers; depository institutions; holding companies; other investment offices, insurance carriers, insurance agents, brokers and financial services, non-depository credit institutions and real estate firms.

Finally, 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 (DJIA) and S&P 500 (SNP500) 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 (DFF), money supply (M1 and Non-M1) and Fed special asset holdings (TOT) on the market indexes. For each VAR estimation, first and second lags of the independent variables, as well as lags of the dependent variable, are also included in each estimation. …[The models are estimated] for the overall sample, the pre-QE sample and the QE sample”.

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, measured by […] ΔTOT […], 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”.

2.4.2: Other papers about unconventional monetary policy and bank stocks

Fiordelisi and Ricci (2016) evaluate the impact on G-SIBs (Global Systemically Important Banks) of the various types of policy interventions during the financial crisis, focusing on stock returns and credit default swap (CDS), analyzing also non financial companies (NFCs) as a robustness check. The 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) conduct an event study to analyze the impact of QE in Japan on bank equity values. 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”.

CHAPTER 3: METHODOLOGY AND DATA

3.1: BASELINE MODEL AND TYPES OF ANALYSIS

3.1.1: Baseline model

We employ a method based on Haitsma et al. (2016). The basic model is the following:

$$R_t = \alpha + \beta_u*Unexp_t + \beta_e*Exp_t + \beta_s*Spread_t + \beta_x*X_t + \varepsilon_t$$

This is an event study, that is a regression done only for specific days. 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), but since those dates arrive until April 2014, they add days when there are news about unconventional monetary policy from the ECB press release, up to February 2015. We use the same procedure, taking in the period 01/01/2000 - 30/09/2018 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. The days of governing council meetings and press releases are taken from the ECB website.

The three explanatory variables of interest are Unexp, Exp, and Spread. X is a vector of control variables, and ε is the error term. Unexp and Exp are the unexpected and the expected components of the one-day change in the policy rate, respectively. The variable Spread 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. Note that Spread with the initial capital letter refers to the variable, spread refers to the effective sovereign spread. The policy rate is the main refinancing rate.

The main focus is on β_s, the coefficient of Spread, which is 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.

Spread is set equal to 0 before 22/08/2007, the first day of unconventional monetary policy, given that unconventional monetary policy is not present before. Using a dummy variable equal to 1 after that day and interacting it with Spread, we find that Spread is strongly significant in the period following that day, instead it is not significant before.

Remember that, according to this model, a variation 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.

The variables are computed as in Haitsma et al. (2016). The computation of Spread has just been explained. Unexp is the one-day change in the implied future rate of the Eurex continuous 3 month EURIBOR future, where the future rate is 100 minus the future price. Exp is the difference between the actual change in the policy rate and Unexp. The dependent variable R is the return of an index or of a portfolio of bank stocks. The vector X of control variables 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. For more details about the methodology of Haitsma et al. (2016), see subsection 2.2.3 of this thesis.

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

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

3.1.2: 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. All indexes used in this analysis are FTSE indexes, and they are taken from Thomson Reuters Datastream for Excel.

3.1.3: Bank characteristics

For the analysis of the role of characteristics, we take banks' historical prices from Thomson Reuters Datastream for Excel. Through the filters available, we select banks for which stock prices are available in the period 01/01/2000 to 30/09/2018, from the 11 countries which are on the Eurozone since 1999, that is Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain. The Table 3.1 shows the 47 banks of the sample, with the exchange where they are listed and the country where they are located. After downloading historical adjusted closing prices, we compute the log returns, 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 ($price_t$ / $price_{t-1}$).

	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 3.1: Banks on the baseline dataset (Data source: Thomson Reuters Datastream for Excel)

We obtain some characteristics of the banks. Based on Yin and Yang (2013) we take number of employees and total assets to measure the bank size, the net interest income divided by total operating income and total loans divided by total assets to measure the business activity mix (the portion of banking activity compared to the total activity of the bank), total deposits divided by total liabilities to measure the funding sources, the capital to asset ratio, that is total capital divided by total assets, to measure the bank soundness.

Based on Haitsma et al. (2016), we take the debt to equity ratio, that is total debt divided by equity, as a measure of funding sources, the market to book ratio and the price to earnings ratio as market data, and market capitalization as a measure of bank size. In reality, Haitsma et al. (2016) do not take the market capitalization of the firms in the sample, but they take the EURO STOXX Large, Mid and Small.

In addition, we take interest on government securities to measure the investment on government bonds, which are the object of the PSPP of the QE program. From Thomson Reuters Datastream, we get the average over the period 01/01/2000 - 30/09/2018 of each of those characteristics. Since some data could be not available on the same dates, we take for example the average of total capital and the average of total assets, and then divide the two averages, instead of computing the capital to asset ratio for each day and then doing the average. The Table 3.2 summarizes the characteristics considered.

characteristic	category	based on
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 (Dte)	funding sources	Haitsma et al. (2016)
market to book ratio (Mtb)	market data	Haitsma et al. (2016)
price to earnings ratio (Pe)	market data	Haitsma et al. (2016)
interest on government securities (Gov)	government bonds on bank's portfolio	-

Table 3.2: Bank characteristics and the articles to which are based

We estimate the model for two overall portfolios, that is portfolios with all the banks of the sample, one equally weighted and another 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 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 of dividing the sample into portfolios to examine the role of characteristics is done also by Haitsma et al. (2016), Madura and Schnusenberg (2000), and Yin and Yang (2013), with the first and the second paper dividing the sample into three portfolios, and the third paper into ten portfolios.

The procedure to construct the portfolio returns in Excel is the following. First of all, from Thomson Reuters Datastream, we take the adjusted closing stock price from 01/01/2000 to 30/09/2018 of the banks identified above, and we compute the log returns. In addition, we take the average value of the characteristics over the same period.

To compute the portfolio returns, we use the functions MEDIA.PIU.SE (AVERAGEIFS in English) and PERCENTILE (PERCENTILE also in English). With the function PERCENTILE we can obtain the percentiles 1/3 and 2/3 of the characteristic, and with the function MEDIA.PIU.SE we can compute for each day the average return of those banks which respect some criteria, that is a value of the characteristic on the desired range (lower or equal than the percentile 1/3, higher than the percentile 1/3 and lower than the percentile 2/3, higher or equal than the percentile 2/3). To select the days for the event study, we use the function SOMMA.SE (SUMIF in English) which allows to take the values corresponding to specific days, that is the event days.

All the data employed in both types of analysis are obtained from Thomson Reuters Datastream for Excel, 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. As already said, 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.

3.2: DIFFERENT SPECIFICATIONS OF THE MODEL AND OF THE 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.

3.2.1: Alternative model specifications

The various model specifications consist of using dummy variables and interacting them with the three explanatory variables. The Table 3.3 describes these 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 3.3: Dummy variables

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. Note that for sign and change direction the dummy is different for each variable.

The first model is the basic model, with the variables for conventional and unconventional monetary policy considered for the entire sample period. The second model adds the dummy UN, 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. This dummy variable is the same used by Haitsma et al. (2016), with only a different name.

The third model adds the dummy QE to the previously described 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), even if in 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 respectively are positive. In this way we can see if expansionary and restrictive policies have a different impact. This type of dummy variable is used also by Nakazono and Ikeda (2016), even if in 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. The inspiration for 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 of the models 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 can see if the difference between the coefficients is significant or not.

3.2.2: Alternative dataset specifications

Dataset	Description
Baseline	47 banks, 2000-2018, Eurex future, one day return, all 248 event days
Twoday	47 banks, 2000-2018, Eurex future, two day 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 day return, all 248 event days
Ext2007fut	70 banks, 2007-2018, Liffe future, one day return, all 248 event days

Table 3.4: Description of alternative datasets

The Table 3.4 describes the alternative datasets considered. Firstly, 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. Also Bernanke and Kuttner (2005) consider the elimination of outliers, even if computed differently.

Thirdly, the dataset Future considers another continuous Euribor future. On Datastream, there are two continuous Euribor future, one from Eurex, used in the baseline dataset, and one from Liffe. We will see if and how results change with this different future. 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 have 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, which joined in 2001, and Slovenia, which joined in 2007. 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.

To have all the variables with 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.

Remark: when we say that a coefficient is significant without indicating the significance level, we mean significant at 10% level. When the significance is expressed by the stars, we have *=significant at 10% level, **=significant at 5% level, ***=significant at 1% level.

CHAPTER 4: RESULTS AND DISCUSSION

4.1: DESCRIPTIVE STATISTICS

The tables below show some descriptive statistics. The Table 4.1 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 4.2 is the correlation matrix of these variables, and the Table 4.3 is the correlation matrix for the post-crisis sample. The Table 4.4 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. Remember that the variables are defined only on event days.

	mean	std	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

Table 4.1: Mean, standard deviation, minimum, maximum, and non zero values

The Table 4.1 shows that the volatility of the bank portfolio is much 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, and this means that there is always a change in the spread in the post-crisis period event days (remember that, in the pre-crisis period, Spread is set to 0).

Corr FS	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 4.2: Correlation table of the full sample

Corr PC	AllW	Unexp	Exp	Spr	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
Spr	-0,63	0,11	-0,11	1	-0,20
MSCIret	0,55	-0,07	0,31	-0,20	1

Table 4.3: Correlation table post-crisis

The Table 4.2 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 4.3), almost all correlations increase in absolute value, suggesting a greater dependence of bank stock returns to monetary policy in the crisis period.

	event days	first day	last day
Total	248	05/01/2000	13/09/2018
pre-crisis	116	05/01/2000	02/08/2007
post-crisis	132	22/08/2007	13/09/2018
post-crisis pre-QE	97	22/08/2007	04/12/2014
post-QE	35	22/01/2015	13/09/2018
conventional	235	05/01/2000	13/09/2018
unconventional	34	22/08/2007	14/06/2018

Table 4.4: Event days

The Table 4.4 shows 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 possible because of 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. This is explained by Nakazono and Ikeda (2016), as already seen in the second chapter of this thesis.

Remember that, 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 means that the days are not all the days that go from the first and last day indicated in the Table 4.4.

4.2: RESULTS FROM BANK AND MARKET INDEXES

This section reports the results for the analysis of the aggregate banking index. The focus is on the banking sector indexes and whole market indexes for Eurozone, Europe excluding Eurozone and World.

In the tables of this section, if coefficients are in bold it means that they are significant at the 10% level. When we say that Spread is significant, we mean that the coefficient of Spread is significant. Normally, almost always, coefficients of Spread are negative, so when we say that the impact increases in reality the coefficient decreases, since we refer to the absolute value.

4.2.1: Baseline specification

	bank index	market index	difference
Eurozone	**-13,93**	**-6,61**	7,32
Europe ex Eurozone	**-6,57**	**-3,75**	2,82
World	**-4,78**	**-3,24**	1,54

Table 4.5: Results from the baseline specification

The Table 4.5 shows that Spread is significant for all three areas, for both bank and market indexes. However, there is a clearly stronger impact on Eurozone rather than on the rest of Europe and the entire World. The Table 4.5 reports also 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. This additional impact is much higher for Eurozone compared to Europe ex Eurozone and World. The differences between bank and market indexes are not tested, so they are not in bold, but it does not mean that the differences are not significant.

Among bank and market indexes of single countries, almost all have a significantly negative coefficient. The impact on Eurozone countries is heterogeneous, with the coefficient of the bank index ranging between a maximum of -18.07 for Italy and a minimum of -7.88 for Greece. The coefficients in other countries have a lower magnitude, with European countries having a higher coefficient than countries of other continents. In fact, European non-Eurozone countries coefficients range between -7.22 for Switzerland and -4.16 for Poland. Non-European countries have coefficients ranging between -5.16 of USA and -1.72 of Canada.

We compute the difference between coefficients for the banking sector and the whole market for single country indexes (only if both coefficients are significant). This difference for Eurozone countries ranges between 2.91 for Greece and 8.93 for Belgium. For European non-Eurozone countries, it ranges between 0.84 for Poland and 4.31 for Switzerland. Therefore, 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. This means that in Eurozone the banking sector is more affected than the whole market, and this additional impact is found also in European non-Eurozone countries, even if of a lower magnitude. For non-European countries the difference is relatively small.

4.2.2: Pre- and post-QE

	bank index			market index		
	pre-QE	**post-QE**	**difference**	**pre-QE**	**post-QE**	**difference**
Eurozone	**-14,05**	-5,58	8,47	**-6,65**	**-4,24**	2,41
Europe ex 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

Table 4.6: Results in the pre- and post-QE periods

The Table 4.6 shows that, for all three bank indexes, the coefficient is significant only in the pre-QE period, instead for the market indexes it is significant also in the post-QE period only for Eurozone. In addition, the impact is higher in the pre-QE period than in the post-QE, for both bank and market indexes. The World and Europe ex Eurozone indexes have a lower difference between coefficients than the Eurozone indexes.

However, the difference between coefficients is not significant for all bank and market indexes, so the impact is not significantly different in the two periods. This may be due to the small sample size in the post-QE period (2015-2018), where we have only 35 event days, compared to the 97 event days in the pre-QE period (2007-2015).

Results are confirmed by indexes of single countries, given that only few countries have a significant coefficient in the post-QE period and almost all have a significant coefficient in the pre-QE period. Moreover, the difference between coefficients is significant only for few countries, and this holds for both bank and market indexes. For the few indexes with a significant difference between coefficients, this difference suggests that the impact is stronger in the pre-QE period.

In summary, we find that in the post-QE period the impact of unconventional monetary policy surprises seems no more significant, but the change in the impact is not significant, suggesting that the small sample size does not allow to establish a clear result.

4.2.3: Positive and negative changes

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.

	bank index			market index		
	Positive	Negative	difference	Positive	Negative	difference
Eurozone	**-9,27**	**-17,99**	**8,72**	**-3,74**	**-8,15**	**4,41**
Europe ex 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**

Table 4.7: Results for increases and decreases of the spread

The Table 4.7 shows that for all three areas the impact is significantly negative for both increases and decreases of the spread. However, the impact of decreases is higher than that of increases. Therefore, there is an inverse relation between spread changes and index returns for both decreases and increases, but decreases have a stronger impact. The difference between coefficients is significant, except only for the Europe ex Eurozone bank index.

Moreover, the impact on Eurozone is always higher than on the other areas, for both increases and decreases of the spread and for both bank and market indexes, and the impact on bank index is always stronger than on market index. These results are in line with the previous findings in the baseline model.

About single countries, in Eurozone we find significant coefficients for both increases and decreases for almost all countries, instead in other countries we find more significant coefficients for decreases than for increases. The difference between coefficients is significant for almost all Eurozone countries, instead it is significant for few other countries. When this difference is significant, it is always in favor of decreases.

In summary, we find evidence 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.

4.2.4: Change direction

Now we consider the model with the dummy for a change in the sign of the variable. This means that 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.

	bank index			market index		
	no change direction	change direction	difference	no change direction	change direction	difference
Eurozone	**-12,48**	**-14,74**	2,26	**-6,32**	**-6,91**	0,59
Europe ex 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**

Table 4.8: Results for no change and change of direction

The Table 4.8 shows that there is a significantly negative impact in both cases, for all three areas and for both bank and market indexes. The difference between coefficients is positive for Eurozone bank and market indexes, instead it is negative for the other two areas. However, this difference is significant only for the World market index. This suggests that there is not a different impact in the two cases. A change in the direction of policy seems to give an additional impact on Eurozone bank and market indexes, but this additional impact is not significant.

As already said, the World market index shows a significantly negative difference between coefficients, which means that there is a lower impact on this index when there is a direction change. Results are supported by single country indexes, where we find a significant difference between coefficients only for Canada bank index and for USA market index.

In summary, there is 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.

4.2.5: Types of monetary policy

We 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.

	bank index			market index		
subtable A	**U and C**	**other days**	**difference**	**U and C**	**other days**	**difference**
Eurozone	**-9,89**	**-16,79**	**6,90**	**-4,68**	**-7,92**	**3,24**
Europe ex Eurozone	**-4,76**	**-7,80**	3,04	**-2,72**	**-4,50**	1,78
World	**-3,34**	**-5,84**	**2,50**	**-2,45**	**-3,85**	**1,40**
subtable B	**C / not U**	**other days**	**difference**	**C / not U**	**other days**	**difference**
Eurozone	**-12,32**	**-14,95**	2,63	**-5,89**	**-7,07**	1,18
Europe ex Eurozone	**-6,73**	**-6,46**	-0,27	**-3,68**	**-3,79**	0,11
World	**-5,28**	**-4,46**	-0,82	**-3,29**	**-3,21**	-0,08
subtable C	**U / not C**	**other days**	**difference**	**U / not C**	**other days**	**difference**
Eurozone	**-25,56**	**-10,95**	**-14,61**	**-11,77**	**-5,23**	**-6,54**
Europe ex Eurozone	**-10,53**	**-5,61**	-4,92	**-6,05**	**-3,08**	-2,97
World	**-7,17**	**-4,14**	-3,03	**-4,87**	**-2,75**	-2,12

Table 4.9: Results for the three types of monetary policy

The subtable A of the Table 4.9 shows that in both cases the impact is significantly negative. Moreover, for Eurozone the difference is significant and positive, suggesting that a contemporaneous conventional monetary policy day makes the unconventional monetary policy less effective. The difference is positive also for Europe ex Eurozone and World indexes, but for Europe ex Eurozone it is not significant for both bank and market indexes.

Among single country indexes, the difference is significant and positive for some, but not all, Eurozone countries, and for few other countries, for both bank and market indexes. These results support our findings.

In summary, when the two types of policy happen in the same day, the unconventional monetary policy surprises have a lower impact on Eurozone bank and market indexes. The same holds for World indexes, but not for the rest of Europe.

Given this result, we consider three types of event days for the unconventional monetary policy surprise. Firstly, conventional / not unconventional event days, that is governing council meeting days when there are no announcements of unconventional monetary policy. Secondly, unconventional / not conventional event days, that is days of unconventional monetary policy announcements which are not governing council meeting days. Thirdly, unconventional and conventional days, that is governing council meeting with an announcement of unconventional monetary policy. The latter type of event day has just been examined, we want to examine the other two types of events in the same way.

The subtable B of the Table 4.9 shows the results for the first type of event days (conventional / not unconventional). The impact is not significantly different from all other days, for both bank and market indexes and for all three areas. The same result is found for all the regressions for single country indexes, strongly supporting the findings.

The subtable C of the Table 4.9 shows the results for the second type of event days (unconventional / not conventional). Only for Eurozone, the impact is significantly different from all other days. Moreover, the impact is more than double than on the other days, for both bank and market indexes. Results are confirmed by single country regressions, where we find significant differences between coefficients mainly for Eurozone countries.

Finally, we run the regression with Spread divided into the three types of event days. The coefficient is strongly significant for all three types of event days. This means that, even if the impact differs between the three types of event days, it is always significant.

In summary, 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.

4.2.6: Multiple dummy specifications

We consider the models with two types of dummy used together. The first of these two models considers the dummy which divides the period into pre- and post-QE together with the dummy for positive and negative changes. In this way we can see if the impact of increases and decreases found before is the same in both periods.

For all three areas, both bank and market indexes have a significant coefficient of increases and decreases only in the pre-QE period, in line with the previous finding that in the post-QE period the coefficient is not significant. There is one exception, for the World bank index there is a significant coefficient for spread decreases also in the post-QE period, probably driven by a significant coefficient on the USA bank index. The coefficients for the post-QE period are not significant for all Eurozone countries, supporting results for Eurozone indexes.

The second model uses the dummy variable to divide the sample period into pre- and post-QE with that for change in the direction of policy. We find, in line to what seen before, that in the pre-QE period Spread is significant, both with and without change of direction. In the second period in general it is not significant in both cases, but for Eurozone market index it is significant when there is no change in the direction. However, there is no strong support to this finding, given that only two Eurozone countries have a significant coefficient.

In summary, in the post-QE period, Spread is not significant even if we split it into increases and decreases or into direction change and no direction change.

4.2.7: Conventional monetary policy

The two variables of conventional monetary policy, that is 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. Besides the issue of significance, the Table 4.10 shows the coefficients of Unexp and Exp for the main indexes.

	bank index		**market index**	
	Unexp	**Exp**	**Unexp**	**Exp**
Eurozone	-1,88	0,17	-0,16	-0,21
Europe ex Eurozone	-1,03	-0,25	1,02	-0,30
World	0,68	0,65	**2,47**	0,38

Table 4.10: Results for conventional monetary policy

The Table 4.10 shows that 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.

It is surprising to find a significant coefficient only for the World and not for Eurozone or Europe, this means that there is an impact on the world market, but this is driven not by Eurozone's impact but by an impact on USA, a strange result. 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.

4.2.8: Robustness check: alternative datasets

We check the robustness of the results watching at alternative dataset specifications. The alternative datasets are four: 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, but this doesn't mean that results were wrong, since the baseline dataset specification should be the best specification, given 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.

One thing to underline is that 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 datasets specifications. This means that there is for sure 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.

Now let's see how coefficients of bank and market indexes in the baseline model change in the various datasets. We have coefficients for the five datasets, bank and market indexes, for Eurozone, Europe ex Eurozone, World, and the two portfolios equally weighted (All) and capitalization weighted (AllW) of the banks used in the next section about the impact of bank characteristics (listed in the Table 3.1 of the third chapter). All coefficients are strongly significant, in fact all coefficients have a p-value equal to zero, at least when the p-value is rounded to the fourth decimal digit.

	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
Europe ex Eurozone	-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
All	-8,47		-8,43		-8,04		-10,80		-10,81	
AllW	-13,28		-13,24		-12,20		-16,88		-16,83	

Table 4.11: Results from different datasets

The Table 4.11 shows that the coefficients of the Eurozone bank index and of the capitalization weighted portfolio are similar, in fact they are both based on Eurozone banks. The equally weighted portfolio has a lower coefficient in absolute value than the capitalization weighted, meaning that highly capitalized banks have a higher sensitivity to Spread, as we will see in the next section about the impact of bank characteristics.

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. This means that, even if there is an impact of ECB unconventional monetary policy also outside the Eurozone, as expected the impact on Eurozone is stronger. The impact on Eurozone banks is about three times higher than the impact on the entire World bank indexes, and about twice higher for market indexes. In addition, the impact on bank indexes is always higher than on market indexes, especially on Eurozone.

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, for Eurozone banks the impact is about two unities higher, and a lower increase of the impact can be found on other indexes. However, we are not able to say if the reason of this higher impact is a delayed reaction of the market or the influence of omitted variables.

4.3: THE IMPACT OF BANK CHARACTERISTICS

For each category of characteristics we have 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.

Secondly, for each characteristic we test if the coefficients of Spread estimated for the three portfolios are significantly different from each other. To do this, 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. 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, with the stars indicating the significance of the difference between coefficients. This type of test is done also by Madura and Schnusenberg (2000).

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).

Thirdly, we 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. This gives a graphical idea of how the characteristic influences the sensitivity of a bank. 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. Remember that a decreasing (increasing) trend of the scatter plot means an increasing (decreasing) sensitivity, given that coefficients are normally negative (all significant coefficients are negative).

Fourthly, for each characteristic we regress the bank sensitivity on the value of the characteristic, that is we estimate the linear regressions shown in the plots, for both baseline and extended datasets, and show the coefficients for both datasets with their significance indicated by stars. This method of estimating the sensitivity of single banks and regressing it on a characteristic is employed also by Flannery and James (1984), who examine whether the interest rate sensitivity of bank stocks depends on maturity composition of their assets. That paper is discussed in the second chapter of this thesis.

If not specified differently, we will 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. When it is written, for example, employees portfolios, we mean portfolios constructed according to number of employees, and the same for other characteristics. When we refer to the impact or the sensitivity, we mean the impact of Spread or the sensitivity to Spread, two ways to say its coefficient in absolute value.

4.3.1: Bank size

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	**Med**	**Low**	**trend**	**High**	**Med**	**Low**	**trend**
Employees	-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
Capitalization	-12,27	-10,94	-2,34	increasing	-12,26	-8,30	-1,46	increasing

Table 4.12: Bank size: portfolio coefficients

The bank size is measured by the number of employees, total assets, and market capitalization. The Table 4.12 shows that the impact 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 impact is increasing for both pre- and post-QE periods, for both decreases and increases of the spread, for both change and no change direction, and for both contemporaneous conventional monetary policy and not, for all three measures. The only exception is for spread decreases for portfolios based on market capitalization, where the coefficients of High, Medium and Low are -8,08, -9,06 and -1,11 respectively, that is a maximum on the Medium portfolio. This is the only exception, so the models with dummy variables in general provide results in line with the baseline results. 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.

Results are confirmed by the coefficients of the overall portfolios, given that the impact on the capitalization weighted portfolio (-13,28) is bigger than on the equally weighted portfolio (-8,47), as already seen in the previous section (see Table 4.11). In fact, banks with high capitalization, which have a higher sensitivity, have a bigger weight on the capitalization weighted portfolio, increasing the sensitivity with respect to the equally weighted.

Baseline	High=Medium		High=Low		Medium=Low		High=Med=Low		Trend
Emp	0,0003	***	0,0000	***	0,0000	***	0,0000	***	increasing
Asset	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=Med=Low**		**Trend**
Emp	0,0000	***	0,0000	***	0,0000	***	0,0000	***	increasing
Asset	0,0006	***	0,0000	***	0,0000	***	0,0000	***	increasing
Cap	0,0005	***	0,0000	***	0,0000	***	0,0000	***	increasing

Table 4.13: Bank size: SURE test

The Table 4.13 shows that the impact is significantly different between portfolios, since p-values are almost all zero or very close to zero, for all three characteristics, with only one exception. In the baseline dataset, for capitalization portfolios the impacts on High and Medium portfolios are not significantly different, which suggests 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.

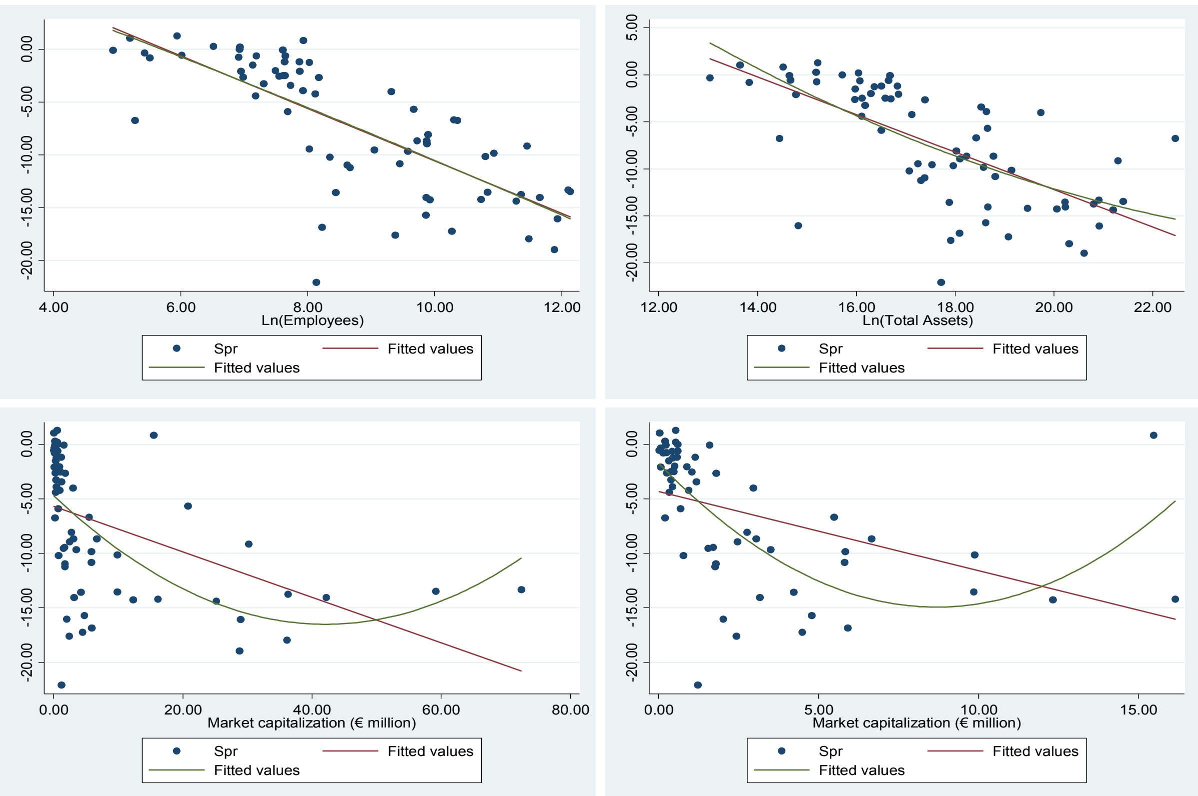

Figure 4.1: Plots for Emp, Asset, and Cap (all and less than €20 million), obtained with Stata

The scatter plots on the Figure 4.1 confirm the findings. The first and second plots show a clearly 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). This means that the banks' sensitivity increases with respect to the characteristic. For market capitalization, this decreasing trend is less clear, the relation could be non-linear. 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 clear for banks with a lower market capitalization, suggesting that this characteristic has an impact which vanishes after a certain level, in fact there is a non significant difference between Medium and High portfolios in the baseline dataset.

The correlations between the bank sensitivity and these three characteristics support the findings: 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 (for the full correlation matrices, see Table 4.30 and Table 4.31). Therefore, there are high correlations at least for employees and total assets.

	Baseline		**Extended**	
Emp	-2,477	***	-2,486	***
Asset	-2,312	***	-1,996	***
Cap	-0,2	***	-0,0264	

Table 4.14: Bank size: Results of the regression of the sensitivity on a characteristic

The Table 4.14 confirms the previous results, since the coefficient is negative and strongly significant for employees and total assets with both datasets. For capitalization instead the strongly significant and negative coefficient is found only with the baseline dataset.

In summary, the number of employees and total assets are strongly related to bank sensitivity to unconventional monetary policy surprise. For market capitalization, the findings suggest that there is an impact only below a certain level of market capitalization.

4.3.2: Activity mix

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	Med	Low	trend	High	Med	Low	trend
Net interest income	-7,85	-10,81	-7,59	max	-9,26	-5,63	-6,95	min
Loan to asset ratio	-5,14	-8,35	-12,21	decreasing	-3,99	-7,35	-10,58	decreasing

Table 4.15: Activity mix: portfolio coefficients

The activity mix is measured by the net interest income divided by total operating income, and the total loans divided by total assets.

The Table 4.15 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 trend is decreasing. This means that 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.

Baseline	High=Medium		High=Low		Medium=Low		High=Med=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=Med=Low**		**Trend**
Nii	0,0000	***	0,0073	***	0,1453		0,0000	***	min
Loan	0,0000	***	0,0000	***	0,0001	***	0,0000	***	decreasing

Table 4.16: Activity mix: SURE test

The Table 4.16 shows that, for portfolios based on loans, the differences between coefficients are all strongly significant (p-values are never higher than 0,0001), for both baseline and extended dataset.

About the net interest income, for the baseline dataset the sensitivity of the Medium portfolio is significantly higher than that of the other two portfolios, and the sensitivity of the High and Low portfolios are not significantly different. 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.

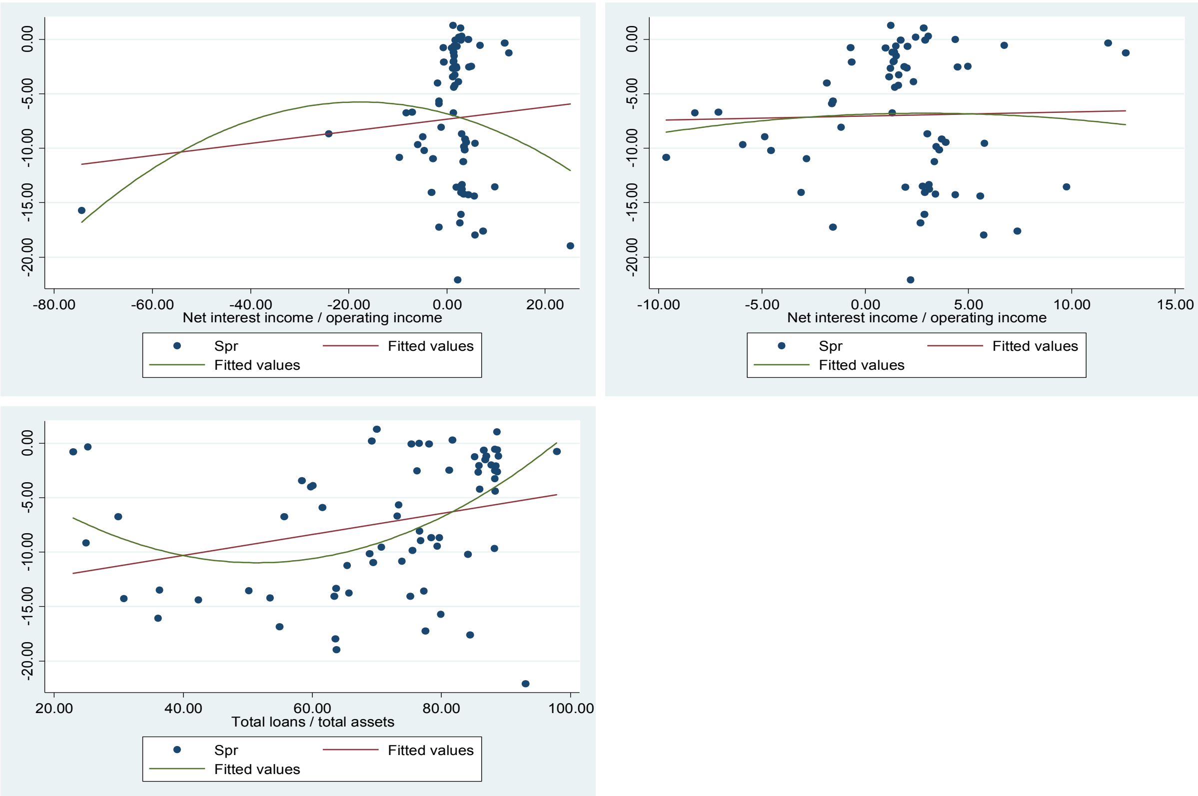

Figure 4.2: Plots for Nii (all and restricted), and Loans, obtained with Stata

The first plot in Figure 4.2 is for the net interest income, 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.

	Baseline		Extended	
Nii	0,154		0,0556	
Loan	0,0949	*	0,0964	**

Table 4.17: Activity mix: Results of the regression of the sensitivity on a characteristic

The regression results in Table 4.17 support the findings from portfolios, since the net interest income is not significant, and the loan to asset ratio is significant, even if not strongly significant, in fact plots give no support to the decreasing impact.

In summary, 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.

4.3.3: Bank soundness

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	**Med**	**Low**	**trend**	**High**	**Med**	**Low**	**trend**
Capital to asset ratio	-7,95	-8,99	-8,49	max	-7,80	-7,062	-7,059	increasing

Table 4.18: Bank soundness: portfolio coefficients

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.

The Table 4.18 shows a maximum value for the Medium portfolio. However, the coefficients are very close to each other. Watching at the alternative model specifications, the trend differ for the post-QE period, when it is decreasing, even if there is again a low difference between coefficients.

The coefficients of High, Medium and Low are increasing (-7,05, -6,31, -4,73) for positive values of Spread, and decreasing (-8,35, -11,32, -11,72) for negative values. This suggests that a high capital to asset ratio increases the sensitivity to a contractionary unconventional monetary policy shock, but decreases the sensitivity to an expansionary shock. Remembering that in general an expansionary shock has a higher impact than a contractionary one (see subsection 4.2.3 of this thesis), this implies that a high capital to asset ratio decreases the difference between the impact of positive and negative shocks. With the extended dataset the trend is increasing, but the coefficients are again very close to each other.

Baseline	High=Medium	High=Low	Medium=Low	High=Med=Low	Trend
Cta	0,1871	0,6179	0,5408	0,3686	max
Extended	**High=Medium**	**High=Low**	**Medium=Low**	**High=Med=Low**	**Trend**
Cta	0,2548	0,4422	0,9972	0,5106	increasing

Table 4.19: Bank soundness: SURE test

The Table 4.19 shows that, with both datasets, none of the coefficients of the three portfolios is significantly different from the others. This is confirmed by the joint test, which does not reject the null hypothesis that the three coefficients are all equal. This is the only characteristic for which the joint test is not significant, that is the only characteristic for which the coefficients of the three portfolios are not significantly different. Therefore, the sensitivity seems to not depend on the capital to asset ratio.

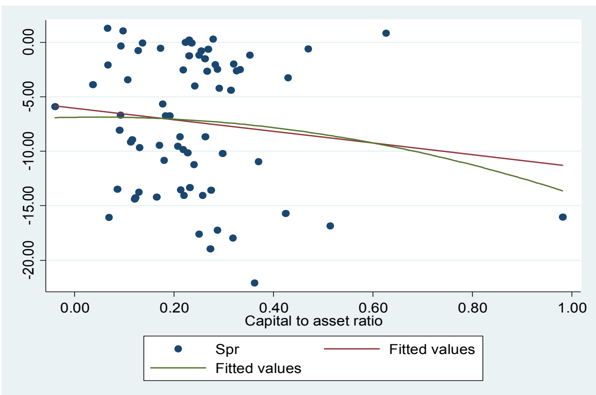

Figure 4.3: Plot for Cta, obtained with Stata

The plot on the Figure 4.3 confirms that there is no clear impact of the capital to asset ratio. Moreover, the correlation of the sensitivity with the capital to asset ratio is -0,07 (-0,12 with the extended dataset), so it is very low.

	Baseline		Extended	
Cta	-4,875		-5,325	

Table 4.20: Bank soundness: Results of the regression of the sensitivity on a characteristic

The regression results in Table 4.20 show that the coefficient is not significant with both datasets, supporting the previous results. In summary, all findings agree that the bank soundness does not affect the sensitivity to unconventional monetary policy surprises.

4.3.4: Funding sources

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	**Med**	**Low**	**trend**	**High**	**Med**	**Low**	**trend**
Deposits	-4,09	-13,02	-9,42	max	-3,74	-11,68	-6,69	max
Debt to equity	-6,33	-12,08	-7,23	max	-4,58	-10,80	-6,85	max

Table 4.21: Funding sources: portfolio coefficients

The funding sources are measured by two quantities, that is the deposits to liabilities ratio and the debt to equity ratio.

The Table 4.21 shows that, for both characteristics and for both datasets, the Medium portfolio has the maximum sensitivity, which means that if these ratios are not too high and not too low the sensitivity is high. The Medium portfolio has a maximum sensitivity also in all the models with dummy variables for both characteristics.

Baseline	High=Medium		High=Low		Medium=Low		High=Med=Low		Trend
Dep	0,0000	***	0,0000	***	0,0395	**	0,0000	***	max
Dte	0,0000	***	0,3585		0,0000	***	0,0000	***	max
Extended	**High=Medium**		**High=Low**		**Medium=Low**		**High=Med=Low**		**Trend**
Dep	0,0000	***	0,0000	***	0,0001	***	0,0000	***	max
Dte	0,0000	***	0,0226	**	0,0000	***	0,0000	***	max

Table 4.22: Funding sources: SURE test

The SURE tests in the Table 4.22 show that, for debt to equity portfolios, the High and Low portfolios don't have a significantly different impact, suggesting, similarly to the net interest income (see subsection 4.3.2: Activity mix), that the impact is similar for those with a high or low debt to equity ratio, but in the middle the impact is stronger.

For deposits portfolios, the impact on High and Low portfolios is significantly different. The trend is strange, given that the impact increases significantly from Low to Medium, but from Medium to High this impact decreases and it becomes not only significantly lower than the Medium portfolio, but also than the Low portfolios. With the extended dataset, this strange trend is found for both debt to equity and deposits.

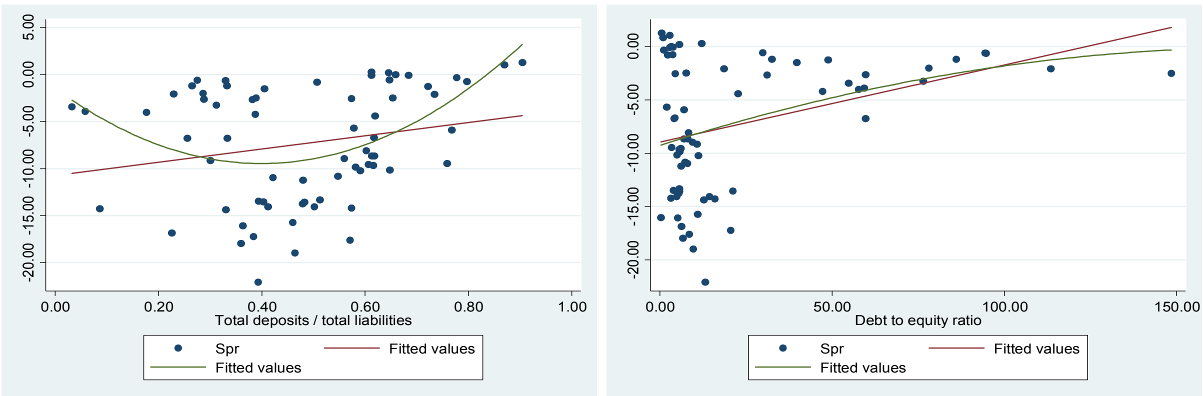

Figure 4.4: Plots for Dep and Dte, obtained with Stata

The plots in Figure 4.4 do not show a strong relationship for all two measures. The plot for deposits (first plot) do 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.

	Baseline		**Extended**	
Dep	13,74	**	7,019	*
Dte	0,00016	**	0,0723	***

Table 4.23: Funding sources: Results of the regression of the sensitivity on a characteristic

About the regression results in Table 4.23, deposits and debt to equity are significant with both datasets, even if we did not find a clear trend from portfolios coefficients. Results are contrasting, and plots do not clarify if these two characteristics matter.

In conclusion, 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.

4.3.5: Market data

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	**Med**	**Low**	**trend**	**High**	**Med**	**Low**	**trend**
Market to book	-9,27	-10,96	-5,33	max	-7,45	-9,98	-4,73	max
Price to earnings	-8,28	-9,47	-7,72	max	-9,04	-7,84	-5,01	increasing

Table 4.24: Market data: portfolio coefficients

The two market data chosen for this analysis are the market to book ratio and the price to earnings ratio.

The Table 4.24 shows for both measures a maximum impact on the Medium portfolios. From the alternative model specifications, the sensitivity to spread decreases is increasing with the market to book ratio. This result is confirmed when considering the actual change for the conventional monetary policy. With the actual change, in addition, we find an increasing impact with the price to earnings ratio for spread increases.

For the price to earnings ratio, we find a decreasing impact when the direction of policy doesn’t change, and again a decreasing impact when there is a contemporaneous conventional monetary policy day. Both results are confirmed when using the actual change in the policy rate.

With the extended dataset, we find the same trend for the market to book ratio, and for the price to earnings ratio instead there is an increasing trend.

Baseline	High=Medium		High=Low		Medium=Low		High=Med=Low		Trend
Mtb	0,0977	*	0,0069	***	0,0000	***	0,0000	***	max
Pe	0,0914	*	0,5927		0,0248	**	0,0220	**	max
Extended	**High=Medium**		**High=Low**		**Medium=Low**		**High=Med=Low**		**Trend**
Mtb	0,0018	***	0,0146	**	0,0000	***	0,0000	***	max
Pe	0,0214	**	0,0000	***	0,0002	***	0,0000	***	increasing

Table 4.25: Market data: SURE test

The Table 4.25 shows that, for the price to earnings ratio, the impact on High and Low portfolios are not significantly different. For the market to book ratio, all three coefficients are significantly different from each other. Contrary to what seen for portfolios based on deposits (see the previous subsection), the High portfolio has a sensitivity bigger than that of the Low portfolio, so the sensitivity increases with the market to book ratio, but after a certain level it decreases, remaining bigger than that for Low portfolios. With the extended dataset, results for the market to book ratio are similar, instead for the price to earnings ratio we find an increasing trend, with all coefficients significantly different from each other.

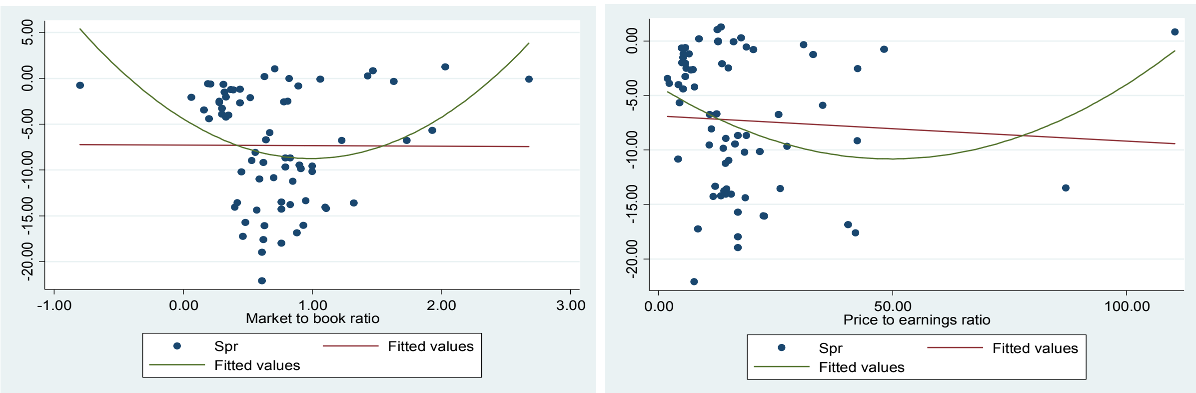

Figure 4.5: Plots for Mtb and Pe, obtained with Stata

The plots in Figure 4.5 do not show a clear correlation between the bank sensitivity and these two measures. The correlations of the sensitivity with the market to book and price to earnings ratio are -0,21 and -0,14 respectively (-0,01 and -0,06 for the extended dataset), so they are very low, especially from the extended dataset. Therefore, even if the only finding about a clear trend is for the price to earnings ratio in the extended dataset, the plot (referred to the extended dataset, as already said) does not show a clear trend.

	Baseline		Extended	
Mtb	-2,704		-0,0683	
Pe	-0,0959		-0,0229	

Table 4.26: Market data: Results of the regression of the sensitivity on a characteristic

The regression results in Table 4.26 show that the market to book and price to earnings ratio are not significant with both datasets, even if we found an increasing trend for the price to earnings ratio with the extended dataset. In conclusion, we do not find evidence of an impact of the two market data on the sensitivity.

4.3.6: Government securities

	Baseline (47 banks, 2000-2018)				Extended (70 banks, 2007-2018)			
	High	Med	Low	trend	High	Med	Low	trend
Interest on government securities	-12,86	-11,63	-1,86	increasing	-11,39	-9,02	-1,89	increasing

Table 4.27: Government securities: portfolio coefficients

Given that asset purchase programmes 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 Table 4.27 shows a clearly higher impact on banks earning more on government securities. We find strong support to this increasing impact from the alternative model specifications, given that all the other models have an impact increasing with this characteristic. The findings from the extended dataset are in line with baseline results.

Baseline	**High=Medium**		**High=Low**		**Medium=Low**		**High=Med=Low**		**Trend**
Gov	0,2604		0,0000	***	0,0000	***	0,0000	***	increasing
Extended	**High=Medium**		**High=Low**		**Medium=Low**		**High=Med=Low**		**Trend**
Gov	0,0461	**	0,0000	***	0,0000	***	0,0000	***	increasing

Table 4.28: Government securities: SURE test

From the SURE tests in Table 4.28, we find that the High and Medium portfolios have a significantly higher sensitivity than that of Low portfolios, and even if the High portfolio has a bigger sensitivity than the Medium, this difference is not significant. However, with the extended dataset these two portfolios have significantly different impacts.

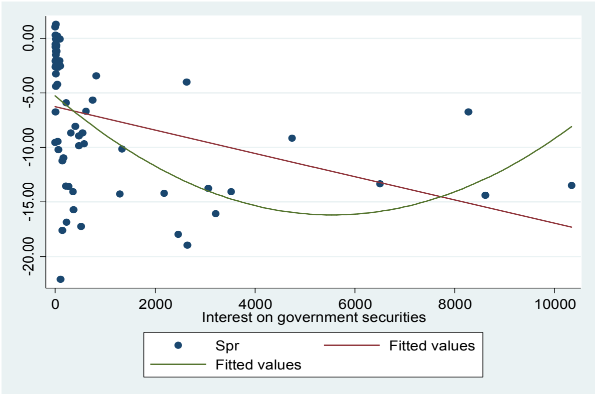

Figure 4.6: Plot for Gov, obtained with Stata

The plot on the Figure 4.6 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.

	Baseline		Extended	
Gov	-0,00138	***	-0,00107	***

Table 4.29: Government securities: Results of the regression of the sensitivity on a characteristic

The regression results in Table 4.29 show that the interest on government securities is strongly significant with both datasets, supporting previous results. This measure seems to explain the sensitivity of banks to unconventional monetary policy surprises. However, this measure is highly correlated with bank size (see the Table 4.30 and Table 4.31 in the next subsection), and even if this measure has a clear impact, the evidence shows 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.

4.3.7: Correlation matrix of sensitivity and characteristics

The Table 4.30 is the correlation matrix between the bank sensitivity and each characteristic, for the baseline dataset, and the Table 4.31 is the correlation matrix for the extended dataset. These tables show a very high correlation between employees and assets (0,97, 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).

base	Spr	Emp	Asset	Cap	Nii	Loan	Cta	Dep	Dte	Mtb	Pe	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
Dte	0,33	-0,20	-0,15	-0,27	0,09	0,25	0,23	-0,41	1	-0,71	-0,37	-0,19
Mtb	-0,21	0,12	0,06	0,20	0,06	-0,21	-0,22	0,28	-0,71	1	0,15	0,08
Pe	-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 4.30: Correlation matrix between sensitivity (Spr) and characteristics, baseline dataset

ext	Spr	Emp	Asset	Cap	Nii	Loan	Cta	Dep	Dte	Mtb	Pe	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
Dte	0,36	-0,20	-0,07	0,04	0,06	0,32	0,16	-0,52	1	-0,46	-0,35	-0,11
Mtb	-0,01	-0,09	-0,09	0,16	0,05	-0,34	-0,06	0,31	-0,46	1	0,15	0,10
Pe	-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 4.31: Correlation matrix between sensitivity (Spr) and characteristics, extended dataset

4.3.8: 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. In total, we have 3x2x1x2x2x1=24 regressions. The Table 4.32 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 characteristic 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.

	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%
Dte	9	12	75%	12	12	100%
Mtb	5	12	41,67%	1	12	8,33%
Pe	4	12	33,33%	3	12	25%
Gov	8	24	33,33%	19	24	79,17%

Table 4.32: Significant coefficients for the overall regressions

About bank size, it is always significant when expressed in terms of employees and total assets, instead about capitalization we have all coefficients significant with the baseline dataset, and none significant with the extended dataset, a strange result. These results strongly support the finding of a strong relationship of employees and assets with the sensitivity, while remaining uncertain the role of market capitalization.

The net interest income is never significant for both datasets, in line with previous results of a weak relationship with the sensitivity. For loans, instead, we find some significant coefficient only in the extended dataset. This is in line with previous results of an absent impact of the net interest income and an unclear result for loans.

We find a contrasting result for the capital to asset ratio, with respect to what seen before. In fact, there is a considerable amount of significant coefficients, even if we previously found no relationship of this characteristic with the sensitivity.

Among measures of funding sources, the deposits to liabilities ratio is sometimes significant, leaving the results inconclusive. The debt to equity ratio is usually significant, which contrasts with previous results. This increases the uncertainty about the link between the sensitivity and funding sources.

The two market data, that is the market to book and price to earnings ratios, are sometimes significant, giving no clear evidence about the impact of this category of characteristics. This confirms the unclear evidence seen before.

Interest on government securities is sometimes significant, but in the extended dataset it is significant many times, supporting previous findings of a relationship not very strong and not very weak.

Given that the interest on government securities is highly correlated with measures of bank size, we redo this analysis without the interest on government securities, leaving only five characteristics for each regression. The findings do not differ so much from that shown in the table, and the conclusions are the same.

In summary, 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, even if we previously do not find it. For funding sources the evidence is not clear, as for the previous findings.

4.3.9: Comparison with conventional monetary policy

	Spread	Unexp	Unexp 0	Unexp 1	Exp	Exp 0	Exp 1
Emp	increasing	increasing	increasing	max	max	increasing	max
Asset	increasing	increasing	min	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
Dte	max	decreasing	decreasing	max	max	decreasing	decreasing
Mtb	max	increasing	increasing	min	min	max	min
Pe	max	increasing	min	min	min	max	decreasing
Gov	increasing	increasing	increasing	min	max	min	increasing

Table 4.33: Unconventional and conventional monetary policy, trends of characteristics

The Table 4.33 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.

About the bank size, in general we find an increasing trend of the conventional monetary policy, as for unconventional monetary policy. The coefficient of Unexp is increasing for all three characteristics, but only for the portfolios based on market capitalization this holds for both periods. The coefficient of Exp is increasing for portfolios based on assets and market capitalization, and this is valid in both periods. Instead, for portfolios based on number of employees, the trend of Exp is increasing only in the pre-crisis period. In summary, both conventional and unconventional monetary policy have an increasing impact with respect to bank size, even if for conventional monetary policy the evidence is not as strong as for the unconventional one.

About the activity mix, for portfolios based on loans the decreasing trend for unconventional monetary policy is found also on Unexp in the pre-crisis period and on Exp in the post-crisis. For portfolios based on net interest income, we did not find an increasing or decreasing trend for unconventional monetary policy, but the trend is increasing for Unexp in the pre-crisis period and for Exp in the post-crisis period. In summary, the conventional policy is in line with the unconventional for loan portfolios, instead for net interest income portfolios both types of policy have a not very clear impact.

About the capital to asset ratio, for unconventional monetary policy we did not find a clear trend, and for conventional policy we find that in the pre-crisis period the trend is decreasing for Unexp, and in the post-crisis period it is decreasing for Exp. Therefore, as for the net interest income, the two types of policy have a different trend.

About funding sources, we found for unconventional monetary policy a maximum for the Medium portfolio, and for the conventional monetary policy we find sometimes a decreasing trend and sometimes a maximum for the Medium portfolio. The findings are not very clear, as for unconventional monetary policy.

For the market to book and price to earnings ratios, we did not find a clear trend for unconventional monetary policy, but we find an increasing trend for Unexp, even if dividing into the two periods this trend disappears for the price to earnings ratio, and it remains only in the pre-crisis period for the market to book ratio.

For the interest on government securities, the increasing trend found for unconventional monetary policy is found in the pre-crisis period for Unexp and in the post-crisis period for Exp. Therefore, the two types of policy have a similar impact.

In summary, 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. 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.

4.3.10: Robustness check: 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
Dte	max	max	max	max	max	max	max
Mtb	max	max	max	max	max	max	max
Pe	max	max	max	max	increasing	increasing	max
Gov	increasing	increasing	increasing	increasing	increasing	increasing	increasing

Table 4.34: Trends from the alternative datasets

The Table 4.34 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, previously described in Table 3.4.

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. There are only four exceptions, and all but one concern the extended dataset. For this reason, in the previous subsections we considered the results both from the baseline and the extended dataset. The use of the other Euribor future and the exclusion of outliers never change the trends. Using a two-day window, the only different result is for the capital to asset ratio, where we find a decreasing impact instead of a maximum value for the Medium portfolio.

Considering the extended dataset, there are three trends that differ with respect to the baseline dataset. Firstly, for the net interest income portfolios, we find a minimum value for the Medium portfolio. Secondly, for the capital to asset ratio portfolios, we find an increasing impact. Finally, for price to earnings ratio portfolios the impact is increasing. In the baseline dataset, all these three types of portfolios show a maximum value for the Medium portfolio.

About the capital to asset ratio, even if we find a different trend with the extended dataset, the coefficients are very close to each other for both datasets. In fact, the SURE test do not reject the hypothesis of equal coefficients for both datasets. About the net interest income portfolios, the trend changes from a maximum to a minimum value for the Medium portfolio, but in any case the findings are not clear with both datasets. About the price to earnings ratio, even if we find an increasing trend with the extended dataset, this is not supported by the plot and regression of the bank sensitivity on the value of this characteristic. In summary, even if for three characteristics the trend differs, the main conclusions do not change much.

4.3.11: Overall portfolios

	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

Table 4.35: Coefficients of the overall portfolios for the various datasets

The Table 4.35 shows the coefficients of Spread on the equation for the two overall portfolios, equally weighted (All) and capitalization weighted (AllW), for each dataset.

The sensitivity of the capitalization weighted portfolio is always higher than that of the equally weighted, since the highest capitalized banks are more sensitive to Spread, something already discussed. The use of another Euribor future does not change much the coefficients.

The exclusion of outliers reduces the impact of Spread, for both portfolios, even if of a low magnitude for the equally weighted. Instead, for the capitalization weighted, it decreases of about 1 point.

Using a two-day window causes an increase of the sensitivity of about 2 points for the equally weighted and of about 3 points for the capitalization weighted. However, we cannot say if it is a delayed reaction or the increased influence of omitted variables.

The extended dataset provides a coefficient lower of about 1 point for the equally weighted and of about 3 points for the capitalization weighted, maybe due to a lower sensitivity of banks which are added to the sample.

In conclusion, 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.

4.4: DISCUSSION OF THE RESULTS

4.4.1: Comparison with other articles

Among the articles seen in the literature review, let's see again those treating the topic of how firm characteristics affect the impact of monetary policy. Thorbecke (1997) finds that "monetary shocks have larger effects on small firms than large firms". Ehrmann and Fratzscher (2004) find that "firms with low cashflows, small size, poor credit ratings, low debt to capital ratios, high price-earnings ratio or a high Tobin's q are affected significantly more by US monetary policy". Flannery and James (1984) find that the interest rate sensitivity of bank stocks "is positively related to the size of the maturity difference between the firm's nominal assets and liabilities", and the findings of Kwan (1991) confirm this result. Madura and Schnusenberg (2000) find that "larger commercial banks and low-capital-ratio commercial banks are more [interest rate sensitive]". Kobayashi et al. (2006) find that the "quantitative easing disproportionately benefited the weakest Japanese banks and industries".

The two articles from which the characteristics for the analysis of this thesis are taken are Yin and Yang (2013) and Haitsma et al. (2016). Yin and Yang (2013) focus on banks, and they find a stronger reaction from large banks (measured by number of employees and total assets) and from banks which rely more on non deposit funding (measured by deposits divided by liabilities and non deposit short term funding divided by total deposits and short term funding). They do not find a significant impact of the activity mix (measured by net interest income divided by total operating income and loans divided by assets) and bank soundness (measured by capital to asset ratio and Z-score).

Haitsma et al. (2016) do not focus specifically on banks, but on the whole stock market. About unconventional monetary policy, they do not find an effect of size, and the impact is stronger for firms with a high debt to equity ratio, low market to book ratio, and low price to earnings ratio.

The Table 4.36 summarizes the results from these articles for the characteristics examined in this thesis. 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 4.37 summarizes the results of this thesis.

characteristic	firm / bank	source	type	impact
activity mix (Nii, loans)	**bank**	Yin and Yang (2013)	C	no impact
capital to asset	**bank**	Madura and Schnusenberg (2000)	C	decreasing
capital to asset	**bank**	Yin and Yang (2013)	C	no impact
debt to equity	**firm**	Haitsma et al. (2016)	U	increasing
debt to equity	**firm**	Ehrmann and Fratzscher (2004)	C	decreasing
deposits to liabilities	**bank**	Yin and Yang (2013)	C	decreasing
market to book	**firm**	Haitsma et al. (2016)	U	decreasing
price to earnings	**firm**	Haitsma et al. (2016)	U	decreasing
price to earnings	**firm**	Ehrmann and Fratzscher (2004)	C	increasing
size (market capitalization)	**firm**	Haitsma et al. (2016)	U	no impact
size (employees, market value)	**firm**	Ehrmann and Fratzscher (2004)	C	decreasing
size (market value)	**bank**	Madura and Schnusenberg (2000)	C	increasing
size (employees, assets)	**bank**	Yin and Yang (2013)	C	increasing

Table 4.36: Characteristics results from other articles

characteristic	impact	robustness
Employees	increasing	strong
Total assets	increasing	strong
Market capitalization	increasing	high
Net interest income / operating income	no impact	strong
Loans / assets	decreasing	medium
Capital / assets	no impact	strong
Deposits / liabilities	no impact	medium
Debt to equity	no impact	medium
Market to book	no impact	medium
Price to earnings	no impact	medium
Interest on government securities	increasing	high

Table 4.37: Summary of characteristics results from this thesis

This thesis 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) examine also the impact of the activity mix. They 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.

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 by Yin and Yang (2013).

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. However, our results suggest that this impact is not present on banks.

4.4.2: Results interpretation

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 finding 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 programmes, 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 programmes, 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. However, this thesis 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. However, the fact that for banks 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 fundings of banks is transmitted to firms through a change in the rate they charge on lending.

Haitsma et al. (2016) find that stocks of firms with a low market to book ratio and a low price to earnings ratio are more sensitive to unconventional monetary policy. However, we do not find the same result for banks.

The finding that banks earning more interest from government securities are more sensitive to unconventional monetary policy is obviously due to the fact that the asset purchases affect the interest that these securities pay, and so those banks which rely more on this source of income are more sensitive. However, as already said, larger banks tend to earn more interest on government securities, so the higher sensitivity could be driven by the size.

The results from the aggregate indexes show that there is a strongly significant impact on Eurozone, but also on other countries. As expected, the impact is greater for Eurozone than the rest of World, and greater for the Europe not part of the Eurozone than the rest of World.

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 from this thesis 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.

About the change of the policy direction, we could expect that the market reaction is bigger if the direction changes with respect to the previous action, since the market should be more surprised. However, we do not find evidence for an additional impact of a direction change.

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 programme made the unconventional monetary policy actions more clear, 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.

The finding of a non significant conventional monetary policy can be explained by the fact that this type of policy is no more effective, and for this reason the unconventional measures were introduced. However, we do not find an impact also in the period before the introduction of unconventional measures.

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 find 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.

Trying 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, measured by the number of employees or total assets. In particular, 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 summary, 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. The event study 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. The event study is one of the most used technique in this topic, as can be seen on the literature review. Other methods were proposed, as the identification through heteroschedasticity introduced by Rigobon and Sack (2002), to solve the problems of omitted variables and of simultaneous determination between interest rate and asset prices. To detect long term effects, the VAR method is used by many articles.

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