UNIVERSITAT DE BARCELONA

Essays on the ECB Monetary Policy's Impact on Non-Financial Firms

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To my Family, from both sides of the Atlantic

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Chapter 1 – Introduction

1.1 Motivation

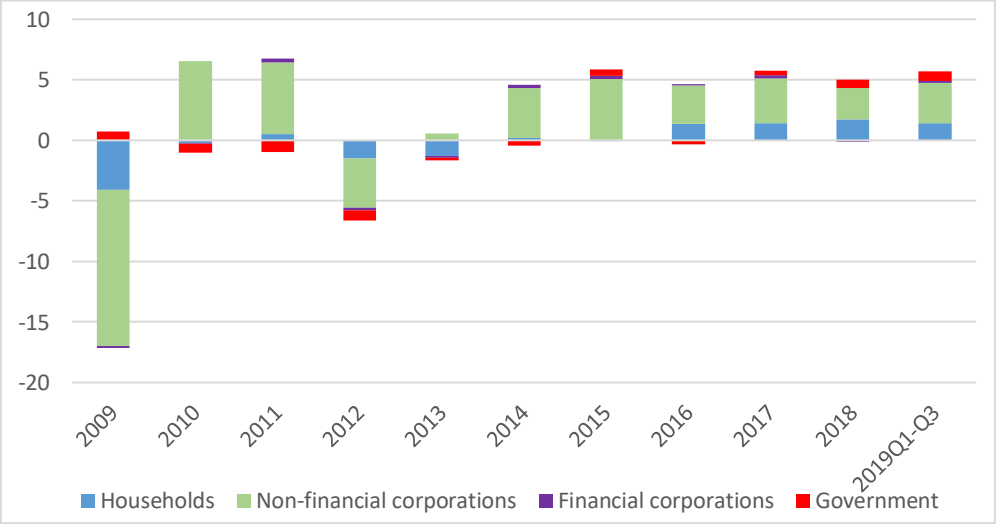
In recent years, one of the main problems the European Economic and Monetary Union (EMU) has been facing is slow economic growth stemming, in part, from subdued investments despite interest rates falling below the zero-lower bound (ZLB). Summers (2013) brought back the term "secular stagnation" – first coined by Hansen (1939) – to describe the United States' economic environment following the 2008-2009 Great Recession, in which a central bank is unable to reduce interest rates enough to stimulate investment and consumption. In recent years, another term, "liquidity trap", has also gained popularity to characterize an economy where short-term interest rates are at the ZLB, and in effect, rendering conventional monetary policy incapable of stimulating growth. Indeed, this topic has fostered extensive research on ways unconventional monetary policies could stimulate an economy (see, for example, Dominguez *et al.* (1998), Bernanke *et al.* (2004), and Eggertsson and Krugman (2012)).

The European Central Bank (ECB) has been trying to ameliorate financial conditions and restore confidence in the EMU, especially after the 2011-2012 Euro Debt crisis. On July 26th, 2012 the then President of the ECB, Mario Draghi, stated the most important three words ever uttered by a central banker that he was going to do "whatever it takes" to save the Euro. Since then, the ECB has introduced an array of conventional and unconventional monetary policies to maintain the EMU project. Some of these policies include slashing interest rates below the ZLB, implementing the longer-term refinancing operations (LTRO), and targeted longer-term refinancing operations (TLTRO), and introducing quantitative easing (QE).

However, were these policies successful in encouraging investment and easing financial conditions? In this thesis, we try to answer this question from the perspective of non-financial firms.
The analysis of the ECB's unconventional policies – mainly of QE – has been widely researched, especially their effect on borrowing costs in general and government bond yields in particular (see Albu *et al.* (2014), De Santis (2020), Jäger and Grigoriadis (2017), and Krishnamurthy *et al.* (2017), among others). However, the research on corporations has been somewhat limited, although non-financial corporations (NFCs) are a vital sector, particularly for investments.

Figure 1 demonstrates the importance of NFCs to investment growth in the Euro Area. The figure breaks down the contribution of each sector to investment growth. As seen, over the past decade, the NFC sector's contribution to the Euro Area's investment growth has accounted, on average, for 67% of its entire investment growth rate.

Figure 1.1: Contributions of sectors to the growth of nominal gross capital formation in the Euro Area 2009-2019Q3

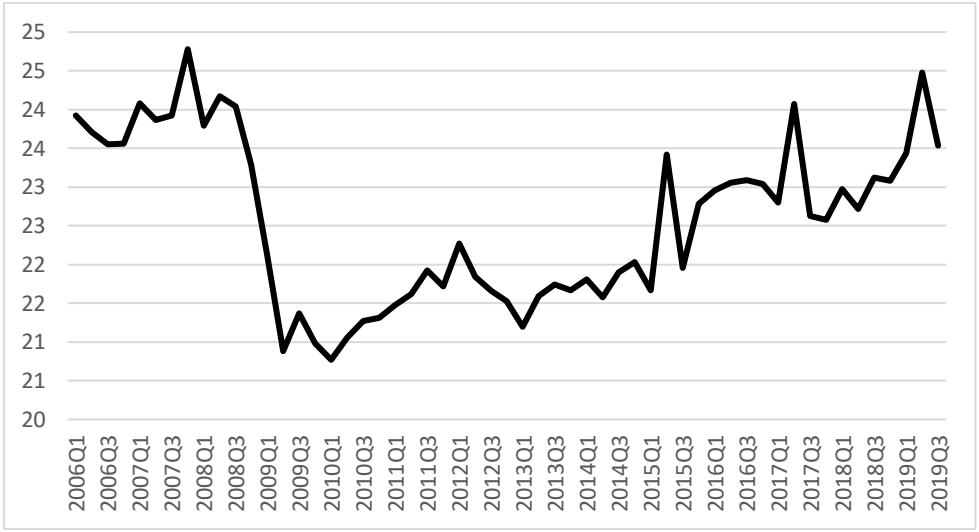


Source of data: Eurostat; data are for the average annual growth rate of each sector in the Euro Area.

Nonetheless, the recovery of NFCs' investment has been slow since 2009 and has yet to settle at the levels it had reached in 2007. Before the global

recession, NFCs' average investment rate was 24% (2006-2007); by 2009, this rate declined to 21%; since then, NFCs' investment rate has been rising, albeit at a slow pace. Only in 2017, the NFC sector reached, briefly, its investment rate from before 2009[1].

Figure 1.2: Investment rate (percent) of European Union non-financial firms 2006-2019Q3



Source of data: Eurostat. The investment rate is the gross fixed capital formation as a percent of gross value added of non-financial firms

In this thesis, we focus on the ECB's interest rate policy and its QE programmes, especially the public sector purchase programme (PSPP), and the corporate sector purchase programme (CSPP).

The PSPP, first introduced on January 22nd, 2015, aimed to lower long-term sovereign bond yields by purchasing sovereign debt at an average pace of 47

[1] One reason for this lackluster recovery in the EMU is that, unlike in the U.S., the EMU countries are not part of a fiscal union, they are only part of a monetary union. During the recovery, not all governments provided a fiscal stimulus along with the accommodating monetary policy. As such, the ECB's efforts may have been less effective than the stimuli implemented by say, the Federal Reserve, where its policies were accompanied, back in 2009, with a fiscal stimulus package to support the economy. Of course, other factors could have played a significant role in the EMU's slow recovery, such as the Greek debt crisis, lackluster corporate innovation, and more.

billion euros a month from March 2015 to December 2018[2]. In total, the ECB purchased over 2.2 trillion euros worth of government bonds of EMU countries. This asset purchase programme accounted for 47% of ECB's balance sheet.

Another vital purchase programme was the CSPP. Under this program, the ECB purchased NFC debt at a monthly pace of 5.8 billion euros from June 2016 to December 2018 for a total of 178-billion-euro worth of European corporate bonds. This programme's goal was to lower NFCs' borrowing costs and to induce corporate borrowing and investment spending.

While the ECB has been implementing several other monetary policies, including the securities markets programme (SMP), LTRO, TLTRO, forward guidance, etc., the ECB's asset purchase programmes have been the primary tools the ECB utilized as interest rates reached the ZLB.

1.2 Summary of the thesis

This thesis consists of three independent chapters, albeit with an overarching theme of investigating the impact of ECB's policies on NFCs.

In Chapter 2, titled *Has ECB's monetary policy prompted NFCs to invest, or pay dividends?,* we take a broad view of the influence of the ECB's conventional and unconventional policies on NFCs' decisions on debt holdings, investments, and dividends. Toward this end, we use a unique dataset comprised of income statements and balance sheets of leading NFCs'

[2] Initially, the ECB targeted purchasing 60 billion euros per month from March 2015 to March 2016 of all three QE programmes, PSPP, asset-backed securities purchase programme (ABSPP) and third covered bond purchase programme (CBPP3); the ECB then augmented the purchasing pace to 80 billion euros in March 2016, before lowering this pace back to 60 billion by April 2017. However, the total purchases under the PSPP were, on average, 50 billion euros until March 2016, and nearly 70 billion euros from April 2016-March 2017. This rate fell back to 50 billion euros for the rest of 2017. By 2018 the average purchase pace was 20 billion euros per month.

operating in the EMU from the four largest economies, Germany, France, Italy, and Spain.

Chapter 2 contributes to the literature by shedding light on the ECB monetary policies' long-term effect on NFCs' leverage and capital allocation – subjects that, to the best of our knowledge, have yet to be methodically investigated over such an extended period and encompasses the ECB's unconventional policies.

The main results in Chapter 2 suggest that the ECB's monetary policies have encouraged firms to raise their debt burden, especially after the global recession of 2008. The ECB's policies, particularly after 2011, also seem to have led NFCs to allocate more resources not only to capital spending but also to shareholder distribution.

Chapter 3, titled *Examining the effect of ECB monetary policy on non-financial corporations' credit risk premia* examines the usefulness of the ECB's policies in ameliorating financial conditions and reducing the risk premia of NFCs. We collected daily credit default swaps (CDSs) prices of publicly-traded European NFCs to analyze the short-term effects of the policy announcements between June 2nd, 2014, and December 30th, 2016. We also test the long-term impact of the ECB's policies on NFCs' CDS prices using monthly data from January 2008 to February 2018.

Chapter 3 contributes to the literature by being the first to methodically investigate the mechanism of the ECB's monetary policy's short-term and long-term impact on NFCs' CDS prices. By doing so, we assess the ECB's various policies' transmission mechanism to NFCs' risk premia – a critical factor in NFCs' borrowing costs.

The main findings in Chapter 3 are that the ECB's asset purchase programme announcements seem to have an immediate impact on CDS daily prices; these announcements had a stronger effect, especially after the PSPP started in March 2015. From 2008 to 2012 and from 2015 to 2018, the ECB's interest

rate policy had statistically and economically significant effects in reducing CDS prices. We also find that some of ECB's asset purchase programmes, such as the PSPP, had a statistically significant long-term impact on CDSs. These findings indicate that some of the ECB's policies were effective in reducing NFCs' risk premia, notably since 2015, as market conditions improved.

In Chapter 4, titled *Bang for the QE buck: Examining the impact of ECB's corporate bond purchases on firms' credit risk, debt and investment*, we focus on the CSPP. This programme, first announced in March 2016 and started by June 2016, aimed to ameliorate corporations' financial conditions and encourage NFCs to borrow and invest.

Chapter 4 analyzes the CSPP's short-term and long-term effect on corporate credit risk by utilizing daily (from March to August 2016) and monthly data (June 2016- December 2018) of corporate zero-volatility, and nominal spreads. We also employ NFCs' debt covenants data to assess the pass-through of the CSPP to firms' risk of credit. We examine the CSPP's long-term effect on liquidity risk by using scaled bid-ask spread data. The data include purchased bonds under the CSPP (targeted bonds) and European bonds that were not purchased. We then analyze the CSPP's short-term and long-term impact on capital structure and capital allocation of NFCs whose bonds the ECB purchased (targeted firms) compare to European firms whose bonds were not purchased.

Chapter 4 contributes to the literature by shedding light on the CSPP's short-term and long-term effect on corporate bonds' risk premia liquidity costs. Third, to the best of our knowledge, we are also the first to investigate the CSPP's long-term impact on firms' borrowing costs and corporate decisions.

In Chapter 4 we find that following the CSPP announcement, targeted corporate bonds' zero-volatility spread, and nominal spread fell by 3.5 basis points (2.6%) and 4.1 basis points (4.2%), respectively. Initially, the programme encouraged firms to borrow more and pay dividends; however,

it did not improve investments. Throughout its implementation (June 2016-December 2018), the CSPP only marginally reduced targeted bonds' risk premia and did not lower corporate bonds' liquidity risk. Nonetheless, it reduced targeted firms' cost of debt, improved their debt covenants, and encouraged investments.

The findings in Chapter 4 suggest the CSPP did not have a persistent impact in reducing credit risk or liquidity risk in the corporate bond market; however, it had an economically significant lasting effect in lowering corporate debt cost and stimulating investment.

1.3 Structure of the thesis

The rest of the thesis is organized as follows: In Chapter 2, we discuss the impact of the ECB's policies on investment, dividends, and debt. In Chapter 3, we examine the impact of monetary policies on NFCs' credit default swaps. In Chapter 4, we focus on the CSPP and analyze its effect on corporate bonds spreads, investments, and debt. Finally, in Chapter 5, we make several concluding remarks.

Chapter 2 – Has ECB's monetary policy prompted NFCs to invest, or pay dividends?

2.1 Introduction

This chapter aims to examine whether European Central Bank (ECB)'s conventional and unconventional monetary policies in times of crisis influenced non-financial firms' decisions. Specifically, it focuses on three critical issues: leverage, investments, and shareholder distribution. The contribution of this chapter to the existing literature is twofold. First, it examines how ECB monetary policies in times of crisis have affected non-financial firms' decisions on leverage. Second, it analyzes how those policies have influenced non-financial firms' decisions on capital allocation – primarily capital spending and shareholder distribution (which comprises dividends and share buybacks). To the best of our knowledge, this is the first attempt to delve so deeply into the study of the effects of the ECB's policies on non-financial firms. To this end, we use an exhaustive and unique dataset comprised of income statements and balance sheets of the leading non-financial firms that operate in European Economic and Monetary Union (EMU) countries.

The main results suggest that the ECB's conventional and unconventional policies encouraged firms to raise their debt burden, especially after the global recession of 2008.

A joint work with Prof. Marta Gómez-Puig and Prof. Simón Sosvilla-Rivero based on this chapter has been published as: Cohen, L., Gómez-Puig, M., and Sosvilla-Rivero, S. (2019). Has the ECB's monetary policy prompted companies to invest, or pay dividends? Applied Economics. 51: 4920-4938.

Moreover, the ECB's monetary policies – mainly after 2011 in the wake of the European economic crisis and with the appointment of Mario Draghi as president – also seem to have led non-financial corporations (NFCs) to allocate more resources not only to capital spending but also to shareholder distribution.

The rest of the chapter is organized as follows. Section 2 reviews the literature on the effects of the ECB's monetary policies on non-financial firms. Section 3 presents the analytical framework. Section 4 describes the data used in the chapter. Section 5 explains the econometric methodology, and Section 6 reports the empirical results. Finally, Section 7 presents the concluding remarks and suggests some possible policy implications.

2.2 The effects of ECB's monetary policies on NFCs

An extensive literature has studied the impact of ECB's policies since 2011 from different perspectives and using different methodologies; however, only a few papers have focused on the effects of these policies on non-financial corporations, despite the crucial role that the latter play in the economy[3]. Lenza *et al.* (2010) and Giannone *et al*. (2012) focus on the impact of the ECB's monetary policy on macroeconomic variables by applying vector autoregression (VAR) methods, while Gambacorta *et al.* (2014) examine the relations between the ECB's balance sheet and macroeconomic conditions. They estimate a panel of eight advanced economies and show that an unexpected rise in a central bank's balance sheet – mostly via quantitative easing (QE) – would raise liquidity (supply side), especially in countries where central banks are already hitting the zero-lower bound and under the prevailing conditions following the global economic crisis of 2008.

[3] According to Eurostat, non-financial firms account for nearly 58% of the total gross added value in the Euro Area and 55% of Euro Area's gross fixed capital formation (2002-2017 average).

Indeed, only a few papers have attempted to show the link between non-financial corporations' investments in the EMU and the ECB's monetary policy. Darracq-Paries and De Santis (2015), who look at the effects of the 3-year long-term refinancing operations (LTROs) by considering them as a credit supply shock, show that LTROs have helped to increase the growth rate of real gross domestic product (GDP) and to raise the prospects of loan provisions for non-financial firms. Meanwhile, according to Ferrando *et al.* (2015), small and medium enterprises (which are more reliant on local bank credit) are hit harder by the Euro Area's credit crisis than large companies that can seek funding abroad. This result is more evident in the stressed countries (Spain, Italy, Greece, Portugal, and Ireland) than in the rest of the EMU countries.

Therefore, the existing literature that has already focused on the effects of ECB's unconventional monetary policy on non-financial corporations is not only scarce but has not focused on how the different types of policy measures affected companies' decisions on capital structure and capital allocation. This chapter will try to fill this gap.

2.3 Analytical framework

In order to analyze the possible effects of the ECB's monetary policies on non-financial firms' decisions, in this section, we will first review the literature on firms' optimal choice of capital and then examine how interest rates could influence their decisions to allocate capital between investments and profit distribution – via dividends and buybacks, or a combination of the two.

2.3.2 Capital structure

One of the first studies on firms' optimal choice of capital structure is the seminal paper by Modigliani and Miller (1958), who proposed what is known as the "leverage theorem." According to this theorem, in a context of asymmetric information between companies and investors, a firm determines

its leverage ratio based on the capital cost and access to finance. However, since then, many other theories have been proposed [Myers (1984), Kraus and Litzenberger (1973), or Merton (1974), to name a few]. Myers (1984) frame a company's choice under the "pecking order" theory, which holds that firms prefer internal funds such as retained earnings to external financing, and debt to equity. Kraus and Litzenberger (1973) offer a competing view (the "trade-off" theory) which assumes that every company achieves an optimal capital structure (a "debt target") at some point in time and trades off tax advantages from debt against refinancing cost risk. Other authors consider market conditions – including interest rates – as a variable that might influence companies' decisions on their capital structure. Merton (1974), for example, examines from a theoretical perspective how changes in macroeconomic conditions influence companies on matters such as debt, while Barry *et al.* (2008) examine this subject, albeit empirically.

The theories mentioned above have different implications, not only regarding the reasons underlying the company's decision to issue more debt but also about the effects that interest rate changes have on that decision. Although there is no consensus on the effect that interest rate changes have on capital structure decisions, in this chapter, we do not aim to explore the accuracy of those models. Our objective is to use them as a background to build up an econometric framework to examine how those changes may influence firms' leverage decisions.

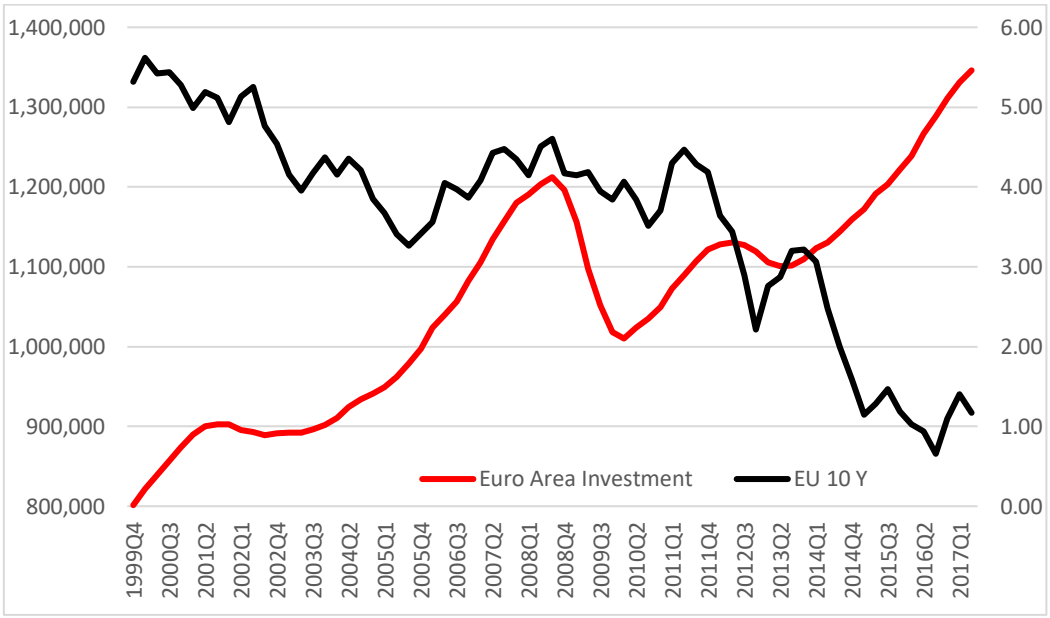
2.3.3 Capital spending, dividends, and buybacks

One of the ECB's goals in implementing its extraordinary monetary policies was to boost investment. The underlying logic (a negative correlation between investments and interest rates) is prominent in a simple Keynesian IS-LM model where the interest rate and its coefficient of interest sensitivity determine investment:

$$I = \bar{I} + dr$$

In the above equation, $d>0$ stands for the coefficient of interest sensitivity; under normal economic conditions, falling interest rates should lead to higher investments and lift the aggregate demand. This relationship has mainly been examined in the literature from an empirical perspective, and its evolution in EMU countries from 1999 until the present is shown in Figure 2.1. This figure shows that it is not clear-cut in the Euro Area since it only suggests a limited relationship between investments and yields (the correlation over the period is not significant, although the fall in interest rates since 2014 coincided with a steady rise in investment in EMU countries).

Figure 2.1: Euro Area investment and 10- year European Union (EU) yield, quarterly data, 1999-2017



Source of data: Eurostat and European Central Bank data warehouse; EMU 10-year yield (right axis)

Nonetheless, the aim of this chapter goes beyond this relationship, since the goal is to analyze the effect of interest rates not only on investments but also on dividends and buybacks. To the best of our knowledge, this is the first attempt to examine how companies change their capital allocation between investments, buybacks, and dividends due to changes in interest rates. Below we present a simple analytical framework for understanding those relationships and the underlying assumptions behind them.

Let us consider that a company, which has already taken on a debt obligation, needs to decide how to allocate its resources. Specifically, consider a company that needs to evaluate how much to invest in a particular project – noted as I – versus how much it should allocate to returning capital to shareholders – in the form of dividends or buybacks and noted as V– over a timeframe of two periods:

$$Z_i = \frac{\pi(I)}{1+r} + \rho V \qquad (1)$$

Z_i is the added value to the company's stock price, which the firm aims to maximize.

The firm has a budget constraint given by:

$$1 = \mathrm{I} + V \qquad (2)$$

This constraint means that the company has to divert all its resources towards an investment I in a particular project or towards paying its shareholders via dividends or buybacks – noted as V – or a combination of both (we are assuming that there are no other alternatives, for example, keeping the capital in cash).

The investment I will yield in the first period a profit of $\pi(I)$ – a convex, continuous function of I (let us assume that the company can allocate any portion it desires towards a particular project). This profit will need to be discounted with $(1 + r)$ where r stands for the company's cost of debt. For simplicity, we assume that r is the prevailing market interest rate (in other words, the company's risk premium over the market is zero). Conversely, the company can allocate V towards shareholders via dividends or buybacks. This shareholder distribution has a positive and constant return ρ . We then consider that profit distribution creates value for its shareholders because of its signaling mechanism about the positive prospects of the company's future returns – especially if the company's management considers its value to be

underestimated[4]. This positive correlation could be explained by agency costs, information asymmetries, and market irrationality (Fairchild, 2006). It is worth noting that while the empirical research has also shown a positive relationship between buybacks and stock prices (Gup and Nam, 2001), with regard to the relation between dividends and firm valuation (Black and Scholes, 1974), the empirical research is not conclusive. Using an international comparison, Denis and Osobov (2008) find scarce empirical evidence for a signaling effect for dividend-paying companies, Bernhardt *et al*. (2005) call into question the validity of signaling theories for dividends and Hussainey *et al*. (2011) support the positive relationship between dividends and share prices. In any case, for our model, we consider share buybacks and their more established positive relationships with a firm's value to justify a company's decision to allocate capital towards them instead of investing. In the econometric estimation, however, we use a broader term: "shareholder yield", which includes dividends, buybacks, and deleveraging. With these methods, firms can return value to investors as a signaling mechanism.

Given these assumptions, we can solve the firm's maximization problem to establish how a company distributes its capital in time zero between *V* and *I*, based on prevailing market interest rates. The Lagrangian equation is:

$$\mathcal{L} = \frac{\pi(I)}{1+r} + \rho V + \lambda(\mathrm{I} + V - 1) \qquad (3)$$

The First order condition (FOC) for the investment is:

$$\pi'(I) = -\lambda(1 + r) \qquad (4)$$

while the FOC for the shareholder distribution is:

[4]Dividends tend to be "stickier" since, even if market conditions are not good, companies are likely to keep them so as not to alarm investors. Conversely, when companies face a transitory gain, they tend to distribute their windfall through buybacks rather than raise dividends and thus lift expectations about future dividends. This could explain the rise in buybacks in recent years, mainly, although not solely, in the United States.

$$-\rho = \lambda \qquad (5)$$

These two FOCs, before accounting for the λ budget constraint, lead to:

$$\frac{\pi'(I)}{(1+r)} = \rho \qquad (6)$$

The solution shows that a company assesses a project based on two parameters: ρ the company's return to shareholders and r. Therefore, a company divides its resources between investments and shareholder distribution until the discounted marginal return on a given project is equal to the added value that a dividend or buyback has on a company's stock price. This framework might help us to understand how monetary policy changes could impact non-financial firms' decisions on capital expenditure and shareholder yield[5].

2.4 Data

Data have been gathered from companies' financials provided by Bloomberg. We focus on non-financial firms listed in the leading stock exchanges from the four largest economies in the EMU: Germany (DAX), France (CAC40) Spain (IBEX35), and Italy (FTSE MIB)[6]. Explicitly, we gather quarterly data from a total of 62 non-financial firms (banks and insurance companies are excluded) registering a market capitalization of 2

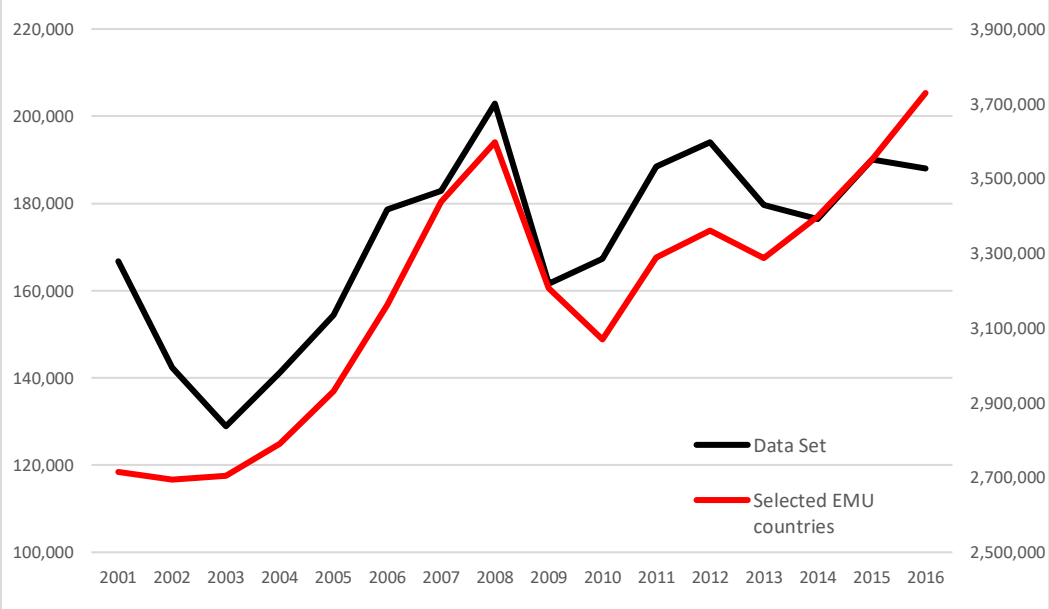
[5] To examine how these relationships work, we run simulations under different assumptions and investment functions. The results of these simulations suggest that under the baseline parameters, as r falls, companies tend to allocate more capital towards investment rather than on shareholders' returns. However, as ρ rises and interest rates fall, the tradeoff between investment and shareholder distribution tends to flatten. In other words, if the added value to shareholder is high enough mainly in a low interest rate environment, a further fall in the interest rate will not encourage firms to allocate more resources to investments rather than to shareholder distribution. Conversely, if ρ is low, investment allocation is more likely to crowd out shareholder distribution as interest rates decline.

[6] A good representation for the entire EMU, since their aggregate GDP accounts for roughly 75% of EMU's GDP in 2017

trillion euros at the beginning of 2017 (which represents nearly a third of the total market capitalization of non-financial firms in the four leading stock exchanges). Therefore, our analysis focuses on large-cap companies since, although their number is not high, they represent a sizable portion of the market value of publicly traded non-financial firms in the EMU.

For our analysis, we use three main dependent variables: "CapEx-to-sales," "Debt-to-equity," and "Shareholder yield"[7], which capture capital spending, leverage, and capital distribution to shareholders respectively. Figures 2.2 and 2.3 show the high correlation between the first two variables' behavior in the 62 companies included in the sample and in the four largest economies in the EMU (Germany, France, Spain and Italy) while a detailed description of them, together with the rest of the variables used in our analysis, is presented in Appendix A.

Figure 2.2: Capital formation in selected EMU countries and capital spending of firms in the sample, 2001-2016



Source of data: Bloomberg, Eurostat, and authors' calculations. Data in millions of euros. Data set (left axis).

[7] Because of data restrictions, we use the total amount that a company returns to its shareholders by distributing dividends, repurchase shares or paying back debt as a proxy of the "shareholder yield".

Figure 2.3: Private debt in selected EMU countries and total debt of firms in the sample, 2001-2016

Source of data: Bloomberg, Eurostat, and authors' calculations. Data in millions of euros. Data set (left axis).

As for the independent variables that gauge monetary policies, we use changes to the ECB's assets and the 3-month Euribor interest rate. The ECB's assets are used because they show the different policy measures the ECB has employed over the years about changes to its balance sheet. This variable does not distinguish the different policy schemes such as LTRO, TLTRO, PSPP, ABSPP, CBPP3, and CSPP. These programmes have different targets, starting points, and budgets, and some have even wound down in recent years. However, all these policies aim to boost liquidity and reduce borrowing costs.

Moreover, since late 2014, the majority of the growth in the ECB's assets is attributed to the PSPP. Therefore, we choose the changes to the ECB assets to show how these conventional and unconventional policies, without distinction, affect companies' decisions. We then use the 3-month Euribor as

a proxy of the ECB's direct impact on interest rates. We use this variable rather than the ECB's deposit rate because it has a more direct connection to the interest rates faced by companies, and these two variables are highly correlated.

To produce a data matrix without missing values, we apply two complementary procedures: the technique of multiple imputation developed by King *et al.* (2001) (which permits the approximation of missing data and allows us to obtain better estimates) and the simultaneous nearest-neighbour predictors proposed by Fernández-Rodríguez *et al.* (1999) (which infers omitted values from patterns detected in other simultaneous time series).

2.5 Econometric estimation

Based on the theoretical framework laid out in Section 4, we estimate the econometric models for examining the role of monetary policy in determining firms' capital spending, leverage, and shareholder payouts. Our panel data analysis relies on Blundell and Roulet (2013) who looked at 4,000 global companies and examined the impact of low interest rates – the direct result of the monetary policies of central banks including the Federal Reserve, the ECB and Bank of Japan in recent years – on their investments. They conclude that, since capital spending depends on the cost of equity and uncertainty, low- interest rates and tax benefits incentivize long-term investment (because debt finance is cheap, companies have an incentive to borrow and carry out buybacks –also known as de-equitation).

2.5.1 Leverage

Two of the models most widely used in the literature to analyze the way a company decides on its capital structure are the tradeoff model of Kraus and Litzenberger (1973) and the pecking order model of Myers (1984). In the first model, a company raises its debt burden until it reaches a specific debt ratio

target, and in the second, a company will first exhaust its internal funds (available cash) before raising funds from debt and equity. However, neither model analyzes the relationship between interest rates and the company's decisions on debt as described in Section 3.1; nor do they examine the role of macroeconomic or monetary policy factors (such as QE programmes) on the capital structure of firms. Therefore, following Kühnhausen and Stiber (2014)[8], in our model, we incorporate external variables that might influence a company's decision on its debt-to-equity ratio ($L_{i,t}$ is the dependent variable in the model, which measures the company's debt burden or leverage):

$$L_{i,t} = \alpha_{i,t} + \beta_1 * X_{i,t-1} + \beta_2 * Y_{t-1} + \beta_3 * Z_{t-1} + \varepsilon_{i,t} \quad (7)$$

As equation (7) shows, our model includes three prime independent variables. The first (*X* vector) corresponds to microeconomic variables that are attributed to each company and is also related to the tradeoff and pecking order models. The second (*Y* vector) comprises macroeconomic variables that may proxy the changes in the economy. Finally, the third (*Z* vector) includes variables that are directly or indirectly related to the ECB's monetary policy and proxy supply-side developments[9].

For our purposes, the monetary policy variables (*Z* vector) are the most important. They include the ECB's asset levels – a proxy for the ECB's asset purchase programmes and loans – and changes in the 3-month Euribor interest rate. Since the ECB added more funds to the economy and brought down interest rates to encourage companies to take on more loans, we should expect a negative correlation between companies' leverage and interest rates and a positive correlation with the changes in the ECB's assets. Regarding the microeconomic variables (*X* vector), three variables are included in the model: profitability (EBITDA-to-sales), growth in profits (growth in earnings per share or EPS), and WACC. We include the variables

[8]Their model is based on Rajan and Zingales (1995) and includes five macroeconomic factors: GDP per capita, the growth rate of GDP (in constant local currency), inflation rate, interest rate, and tax rate.

[9] All independent variables, except WACC, lag the dependent variable by one period.

profitability and growth in profits since they play an essential role in determining the leverage of a company, as both Myers (1984) and Kraus and Litzenberger (1973)[10] report. Additionally, the cost of capital (estimated by the Weighted Average Cost of Capital (WACC)) is a critical variable in this kind of model, and a negative relationship is to be expected between it and the leverage ratio. Finally, as regards the macroeconomic variables (*Y* vector), we have included the average inflation rate in the EMU because, since inflation depreciates the debt value in real terms, we should expect a positive relationship between this variable and leverage.

2.5.2 Capital spending and shareholder's yield

To analyze the relationship between ECB's monetary policy and the developments of capital spending and shareholder yields, we have adjusted the model described by Blundell and Roulet (2013), who conducted a panel data analysis and estimated two regressions (one for capital spending per sales and another for dividends and buybacks per sales). Therefore, we have also estimated two equations (an investment equation (8) and a shareholder yield equation (9)), but have adjusted their model by including variables that show how monetary policy affects capital expenditure and dividends/buybacks:

$$C_{i,t} = \alpha_{i,t} + \beta_1 * i_{t-1} + \beta_2 * ECB_{t-1} + \beta_3 * S_{t-1} + \beta_4 * P_{t-1} + \beta_5 * E_{i,t-1} + \beta_6 * k_{i,t-1} + \varepsilon_{i,t} \quad (8)$$

$$y_{i,t} = \gamma_{i,t} + \beta_7 * i_{t-1} + \beta_8 * ECB_{t-1} + \beta_9 * E_{i,t-1} + \beta_{10} * k_{i,t-1} + \vartheta_{i,t} \quad (9)$$

In equation (8), the dependent variable is the company's capital spending divided by sales ($C_{i,t}$). The regression also includes the two main ECB policy variables – the cost of debt (i_{t-1} which is proxied by 3-months Euribor rate) and the changes in the ECB's assets (ECB_{t-1}) – plus another four independent variables: the cost of capital ($k_{i,t-1}$, measured by the WACC), changes in

[10] The empirical evidence is also divided: Fama and French (2002) show that companies with higher profits tend to be less leveraged (thus correcting the pecking order model on this issue); whilst Frank and Goyal (2008) show the opposite.

profits ($E_{i,t-1}$ proxied by EBITDA-to-Sales), the inflation rate in the EMU (P_{t-1}), and the spread between long-term and short-term yields (S_{t-1})[11].

By including the last two variables, we aim to test changes to the economy and market expectations that are directly linked to the ECB's policies, while still including variables related to the ones Blundell and Roulet use in their analysis. In particular, inflation serves as a proxy for changes in demand and monetary policy. Nonetheless, the relationship between inflation and capital spending is not clear. On the one hand, higher inflationary pressures may lead the real returns (see Fama and Gibbons, 1982) on projects to be less profitable, but on the other, a rise in the rate of inflation might also indicate higher economic activity. As for the spread between long- and short-term rates, it is used as a proxy of economic conditions. According to Baumeister and Benati (2010), the compression of long-term bond spread may even impact GDP and inflation.

Furthermore, this compression tends to indicate a fall in the term premium. The decline in the term premium could be due to lower expectations of either sudden inflation eruptions or lower interest rates in the future because of slower economic activity. In other words, a contracting spread, or the flattening of the yield curve, may correspond to companies reducing capital spending as economic activity deteriorates. Therefore, we would expect a positive relationship between capital expenditure and bond yield spread.

As stated above, our model includes an investment equation (8) and a shareholder yield equation (9) where the variables that may affect the shareholder yield ($y_{i,t}$) are explored.

Like equation (8), equation (9) also includes the two main ECB policy variables – the cost of debt (i_{t-1}) and the changes in the ECB's assets (ECB_{t-1}) – plus another two independent variables: the cost of capital ($k_{i,t-1}$ measured by WACC) and changes in profits ($E_{i,t-1}$ proxied now by earnings per sale or

[11] The spread between 10-year weighted average of sovereign bond yields of all EMU countries and 3-month Euribor rate.

EPS of each company). A positive relationship is expected for the former variable (if the cost of retaining a euro to invest relative to the cost of bonds rises, a company is better off repurchasing its shares – and reducing its relative rising cost of capital). Finally, regarding the latter variable, although Blundell and Roulet (2013) use an earnings yield in their model, we decided to use changes in EPS because it isolates the changes in a company's fundamentals by not including the variations in its underlying stock price (which could shift based on changes to liquidity in the markets, supply and demand changes, and more). As for the expected relationship, even though there is no consensus in the literature[12], we still expect a rise in earnings to lead to higher returns to investors.

2.6 Empirical results

In this section, we first discuss the results from the panel data analysis applied to the leverage, the investment, and the shareholder yield regressions. Specifically, we consider two basic panel regression methods: the fixed-effects (FE) method and the random effects (RE) model[13]. To determine the empirical relevance of each of the possible methods for our panel data, we test FE versus RE. We do so by using the Hausman test statistic to analyze the non-correlation between the unobserved effect and the regressors. This test indicates that the fixed effect estimators are more appropriate for all the timeframes in the leverage and the investment regressions. However, in the shareholder yield model, the Hausman test shows that the choice of method (FE or RE) depends on the subsample. Subsequently, we also present the results corresponding to a cross-country and a cross-sector analysis for the whole period in order to examine whether companies from different countries or industrial sectors react in different ways to the ECB's policies.

[12] According to Fama and French (2002), more profitable firms tend to have higher dividend payments. But Miller and Modigliani (1961) point out that rising profits do not necessarily lead to a rise in dividend payment – this will depend on other factors such as the payout ratio.

[13] Estimations were also performed by the Arellano-Bond GMM approach, providing similar quantitative results.

In the empirical estimation, we take into account the two substantial economic events which occurred during our sample period: (1) the global economic recession of 2008 and (2) the peak of the European debt crisis in 2011-2012, which may not only have played a substantial role in swaying European companies' decisions, but may also have determined the ECB's monetary policy. Based on the above, we introduce two breakpoints to capture these significant events: 2008Q1 (the tipping point for the global economic recession), and 2011Q3 (in order to examine not only whether the European debt crisis may have had an impact on the results, but also whether Mario Draghi's leadership of the ECB had affected them). Therefore, we examined five different time frames: The first covers the sub-period 2000Q2-2008Q1; the second spans from 2008Q2 to 2017Q4; the third ranges from 2000Q2 to 2011Q3; the fourth spans 2011Q4 and 2017Q4; and the last one covers the entire sample period from 2000Q2 to 2017Q4.

2.6.1 Panel unit root tests

A dependent stationary variable cannot be explained using non-stationary variables since the statistical properties of the former (mean, variance, autocorrelation, et cetera) remain constant over time, while those of the latter change. Therefore, to assess the statistical characteristics of our variables, we perform a variety of unit root tests in panel datasets. In particular, we use the Levin–Lin–Chu (2002), Harris–Tzavalis (1999), Breitung (2000), Im–Pesaran–Shin (2003), and Fisher-type (Choi, 2001) tests. The results of these tests[14] decisively reject the null hypothesis of a unit root for all the variables except for the ECB assets. Therefore, while the rest are found to be stationary in levels, the latter can be treated as the first-difference stationery. So, in the different empirical estimations, the variable ECB assets will be transformed into a stationary variable by differencing it.

[14] They are not shown in this paper to save space.

2.6.2 Leverage: Empirical results

The results regarding the main drivers of the leverage ratio are presented in Table 2.1. As can be seen, we report the results obtained using the FE model since it is the relevant one in all cases.

Table 2.1: Results of panel analysis for debt-to-equity

OLS Estimates of the Effect of the ECB's policies on Leverage Dependent variable: Debt-to-equity					
	2001Q2-2011Q3	**2011Q4-2017Q4**	**2001Q2-2008Q1**	**2008Q2-2017Q4**	**2001Q2-2017Q4**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
D(ECB Assets (t-1))	1.22**	8.56***	1.25**	65.4**	0.1711***
3 Mo Yld (t-1)	-1.174***	-2.495**	-0.655***	-3.968***	-3.459***
EPS (t-1)	-2.129***	-1.213***	-1.872***	-2.804***	-2.437***
WACC	-7.547***	-4.396***	-6.506**	-3.802***	-8.214***
EBITDA to Revenue (t-1)	0.028***	0.058***	0.120**	0.542***	0.159***
EU inflation (t-1)	0.947***	1.768***	7.034**	1.086***	4.300***
Constant	162.11***	130.81***	149.38***	130.88***	154.77***
Statistics					
R-squared (overall)	81.4%	82.7%	83.3%	66.7%	75.5%
F-statistic	49.28***	22.54***	51.50***	54.71***	53.40***
Total Obs.	3160	1240	2044	2480	4462
Cross sections	62	62	62	62	62
Hausman Test (Chi-Sq Stat.)	34.91***	47.35***	32.12***	79.21***	36.01***
RE/FE	FE	FE	FE	FE	FE

This table shows the results of estimating an equation for a balanced panel of 62 publicly traded non-financial firms. *, **, *** indicate statistical significance at the 10, 5% and 1% levels respectively.

Results in Table 2.1 indicate that interest rates and changes to the ECB's balance sheet have a positive and significant impact on companies' leverage. For the entire period (column 5), a one-percentage-point fall in the 3-months Euribor tends to lift the debt-to-equity ratio, on average, by 3.46 percentage points. Moreover, for every 1 trillion euros the ECB adds to its balance sheet via the various LTRO and QE programmes, companies are likely to raise

their debt ratio, on average, by 0.17 percentage points. A closer examination of the results also reveals that the ECB's policies have a stronger marginal effect on companies' debt-to-equity ratio after 2011Q3 (column 2) and 2008Q1 (column 4). Specifically, the 3-months Euribor coefficients in column 4 (-3.968) and column 2 (-2.495) are much lower than the coefficients in column 3 (-0.655) and column 1 (-1.174). As for changes in the ECB's assets, the coefficients are much higher in columns 4 and 2 than in columns 1 and 3. The inflation rate, which is another variable that is indirectly affected by monetary policy, also presents positive and significant coefficients across different time frames. Finally, the fit of the overall regressions is satisfactory as measured by the R^2 values, which range from 66.7% to 83.3% for the various time samples.

2.6.3 Capital spending: Empirical results

The results corresponding to the investment equation (8) are presented in Table 2.2. Once again, the FE model is found to be the relevant one in all sample periods under consideration. It can be observed that the ECB's policies (both changes in interest rates and balance sheet assets) have a significant and stimulating impact on a company's capital spending across the different periods under study. In particular, from 2001 to 2017 (column 5) for every 1 trillion euros buildup in the ECB's assets, the capital-spending-to-sales ratio rises, on average, by 2.98 percentage points. As for interest rates, a decline of one percentage point in the 3-months Euribor tends to raise the CapEx-to-sales ratio, on average, by 1.5 percentage points.

Table 2.2 : Results of panel analysis for capex-to-sales

Estimates of the Effect of the ECB's policies on investments Dependent variable: Capex-to-sales					
	2001Q2-2011Q3 (1)	**2011Q4-2017Q4 (2)**	**2001Q2-2008Q1 (3)**	**2008Q2-2017Q4 (4)**	**2001Q2-2017Q4 (5)**
D(ECB Assets (t-1))	2.98**	1.63**	2.76**	1.38**	2.98**
3 Mo Yld (t-1)	-1.679**	-4.189**	-2.176**	-0.570**	-1.501**
EU inflation (t-1)	-1.159**	-1.305***	-7.045**	-0.294***	-0.997***
EBITDA-to revenue (t-1)	0.027**	0.084***	0.029**	0.036***	0.125**
Spread 10 Year Y and 3 mo Libor (t-1)	0.216**	0.011**	1.290**	0.44794***	0.623***
WACC (t-1)	-0.4131***	-0.0845***	-1.022***	-0.0125**	-0.268***
Constant	12.72**	7.10**	62.26***	-33.43***	15.65**
Statistics					
R-squared (overall)	67.5%	59.9%	80.3%	79.1%	72.0%
F-statistic	2.88**	2.71**	12.24***	11.26***	5.61***
Total Obs.	3160	2040	1150	2480	4462
Cross sections	62	62	64	62	62
Hausman Test (Chi-Sq Stat.)	26.32***	7.09**	15.28***	74.73*	63.30***
RE/FE	FE	FE	FE	FE	FE

This table shows the results of estimating an equation for a balanced panel of 62-64 publicly traded non-financial companies. *, **, *** indicate statistical significance at the 10, 5% and 1% levels respectively.

A comparison of the different sub-periods reveals that the ECB's policies related to its interest rates have a stronger marginal impact after 2011Q3. Specifically, based on the results in column 2, for every one-percentage-point decline in the 3-months Euribor, the CapEx-to-sales ratio tends to rise, on average, by 4.19 percentage points. Conversely, before 2011Q4 this coefficient is only 1.68, indicating that changes to the 3-months Euribor rate had a much smaller impact on the CapEx-to-sales ratio before Mario Draghi entered office. The same, however, cannot be said after 2008Q2 (column 4), where the 3-months Euribor coefficient is only -0.57. This result may indicate that the financial crisis may have played an important role in

diminishing the correlation between interest rates and capital spending. In other words, it seems that, during 2008-2011 (i.e., between the global recession and the European debt crisis and before Mario Draghi's tenure), interest rates may have had a lesser impact on capital spending than either before or after this period. These results also correspond to the relationship we have highlighted in Section 3.2: falling interest rates tend to encourage companies to allocate more capital towards investments. For their part, the ECB's asset purchase programmes seem to have positively affected companies' capital spending; however, the coefficients are not vastly different across the various time frames. This finding suggests that the ECB's policies did not have a marginally stronger impact on companies' capital spending decisions after 2011Q3 or after 2008Q2. Lastly, across the different periods considered the values of R^2 range between 59.9% and 80.3%. These results indicate that our econometric model may identify notable and interpretable relationships among the economic variables under study.

2.6.4 Shareholder yield: Empirical results

Table 2.3 presents the results of the panel data analysis for the shareholder yield model. As can be seen, except the 2011Q4-2017Q4 and the 2088Q2-2017Q4 sub-period (where the tests favor FE), the RE model is found to be more appropriate for the econometric analysis.

Table 2.3 : Results of panel analysis for shareholder yield

Estimates of the Effect of the ECB's policies on dividends and buybacks Dependent variable: Shareholder yield					
	2000Q2-2011Q3	**2011Q4-2017Q4**	**2000Q2-2008Q1**	**2008Q2-2017Q4**	**2001Q2-2017Q4**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
D(ECB Assets (t-1))	1.41***	2.40**	0.965**	2.67***	1.33***
3 Mo Yld (t-1)	-0.839**	-2.759***	-0.315**	-0.860**	-0.912***
EPS (t-1)	0.262**	0.485***	0.347**	0.095**	0.108**
WACC (t-1)	0.521**	0.856***	0.667***	0.493***	0.437**
Constant	-1.533**	-4.051***	-4.645**	-0.921**	-0.706**
Statistics					
R-squared (overall)	65.1%	62.8%	59.1%	65.2%	73.5%
F statistic	67.18**	22.64***	12.70*	34.68***	103.52***
Total Obs.	3160	1240	2044	2480	4463
Cross sections	62	62	62	62	62
Hausman Test (Chi-Sq Stat.)	4.28	12.78***	15.43***	3.92	1.93
RE/FE	RE	FE	FE	RE	RE

This table shows the results of estimating an equation for a balanced panel of 62 publicly traded non-financial companies. *, **, *** indicate statistical significance at the 10, 5% and 1% levels respectively.

The results indicate that changes in the ECB's policies have a positive and significant impact on companies' shareholder yield across different time samples. In particular, from 2011 to 2017, for every 1 trillion euros the ECB adds to its balance sheet, shareholder yield rises, on average, by 1.33 percentage points (column 5). Moreover, for every one percentage point decline in the 3-months Euribor rate, shareholder yield increases, on average, by 0.912 percentage points. We also find that after 2011Q3 (column 2) the ECB's policies, mainly related to changes in interest rates (3-months Euribor), seem to have a stronger marginal impact on shareholder yield than before. The results of the regressions are significant according to the F-tests and the R^2 values throughout different sample periods. The R^2 values range from 59.1% to 73.5%. Finally, these results also suggest, as indicated in sub-section 2.3.2, that lower interest rates do not crowd out dividends or buybacks in favor of investments. This finding implies that the added value for

companies of returning capital to shareholders may have been high enough to encourage them to allocate more funds not only to investments but also to shareholder distribution.

2.6.5 A cross-country analysis

In order to analyze how companies from different countries react to ECB policies, we also conducted a cross-country analysis. To this end, we separated the companies in our sample according to their country of origin (based on where their head offices are located): Germany, France, Italy, and Spain. The results of the panel data analysis for the entire period (2000-2017) [15] show that, for the debt-to-equity ratio, the coefficients for the ECB's assets are positive and significant across the different countries. However, the ECB's balance sheet variable appears to have the strongest stimulating effect on German companies: for every 1 trillion euros the ECB adds to its balance sheet, a German company's debt-to-equity ratio rises, on average, by 4.7 percentage points. Conversely, Italian companies have the lowest coefficient, at 1.51. Moreover, the 3-months Euribor coefficients are all negative and significant. However, Spanish and French companies have the lowest coefficients, at -9.8 and -8.3, respectively. German companies recorded the highest 3-months Euribor coefficients. This result suggests that Spanish and French companies are more sensitive to changes in interest rates than German companies.

Regarding the CapEx-to-sales ratio regressions, German companies are the least sensitive to changes in ECB assets or interest rates while Spanish and French companies are the most sensitive to the ECB's policies. Finally, regarding shareholder yields, Italian companies are the least sensitive to changes in the ECB's assets: their coefficient is only 0.267, while the coefficient of Spanish companies is the highest in the sample at 3.06. Conversely, Spanish companies are the least sensitive to changes in interest

[15] They are not shown in this paper to save space.

rates, with a coefficient of -0.452, while the coefficient of Italian companies is the lowest at -1.437. These findings indicate that both Italian and Spanish companies are more sensitive to single ECB policies than companies from other countries.

2.6.6 A cross-industry analysis

Finally, we also conducted a cross-sector analysis in order to examine whether the effect of ECB policies varies depending on the economic sector. Therefore, we break down the sample into 12 industrial sectors[16]. The results from the panel data regressions for the entire sample (2000-2017) [17] for all three models indicate that the ECB's policies (both changes to interest rates and balance sheet) have a stimulating effect across the different industrial sectors, as was the case in previous analyses. Specifically, in the leverage model, the Communications sector has the highest ECB assets coefficient, at 9.3. Moreover, the lowest 3-months Euribor coefficients are for Information Technology, Industrial, and Communications at -11.927, -11.927 and -11.187, respectively. Regarding the investment model, Basic Materials have the highest coefficient for changes in the ECB assets, at 2.78, while the Technology & Telecommunications sector has the lowest 3-months Euribor coefficient at -2.224. Finally, the results for the shareholder yield model show that for the changes in the ECB's assets, the Consumer Cyclical's coefficient is the highest at 4.95; the lowest 3-months Euribor coefficient is for Utilities.

2.7 Concluding remarks

We have analyzed the impact of the ECB's monetary policies (both conventional and unconventional) on the capital allocation of leading non-financial firms that operate in the European Economic and Monetary Union,

[16] The list of industries is: Basic Materials, Communications, Consumer Discretionary, Consumer Cyclical, Consumer Non-Cyclical, Energy, Industrial, Information Technology, Materials, Technology & Telecommunications, and Utilities.
[17] They are not shown in this paper to save space.

using firm-level data of income statements and balance sheets. In particular, we have examined whether the ECB's monetary policies have encouraged non-financial firms to raise their debt burden, invest more, and boost their shareholder distribution. The main results indicate that the answer to all three questions is affirmative. However, the results also show that these policies seem to have a stronger marginal impact on these companies' decisions not only after the global recession of 2008 but also after late 2011 – when the EMU debt crisis was unfolding, and Mario Draghi's appointment as president ushered in dramatic changes in the ECB's policies. We also find that French and Spanish companies appear more sensitive to changes in the ECB's policies on issues of investments and leverage. This finding may have policy implications: The ECB's main asset purchase programme (PSPP) allocates its funds based on a country's size rather than its needs. The results suggest that the ECB's policies could boost investments of non-financial firms more efficiently if the bank were to allocate more funds to countries, such as France and Spain, where companies react more strongly to its policies. Finally, one of the ECB's primary goals in imposing its stimulative monetary policies was to encourage companies to invest in the economy and thus increase economic growth. As in every empirical analysis, the results must be regarded with caution, since they are based on a set of countries and companies over a certain period and a given econometric methodology. Nonetheless, we show that while the ECB's policies seem to have achieved their aim, they may have also encouraged companies to use the low-interest rate environment to distribute capital to their shareholders. Even though share buybacks and dividends could play a role in boosting economic activity[18], their stimulative impact on the economy is indirect and unclear.

[18] The excess capital shareholders receive could be used to reallocate funds to firms that require capital for investment. Shareholders could use the funds to increase their spending, which, in turn, could also boost economic activity. Nonetheless, not all shareholders live in the EMU, and so this spending may occur abroad. Also, shareholders could decide to invest in companies outside the EMU. These points only show that it is unclear how shareholder distribution affects the economy.

Appendix A: Description of variables and data sources

Variable	Description	Source
Dependent variables		
Debt-to-equity	Non-Financial Corporate debt to equity ratio	Bloomberg
Shareholder yield	Returns to investors per share – including buybacks, dividends and deleverage per company	Bloomberg
CapEx-to-sales	Capital spending per revenue of a company	Bloomberg
Monetary policy variables		
ECB total assets	Total assets on the ECB's balance sheet (in trillions of euros)	FRED
3-months Euribor rate	Weighted average rate of a 3-months libor in euros	FRED
Control variables		
EBITDA-to-revenue	EBITDA-to-revenue of a company	Bloomberg
WACC	Weighted Average Cost of capital of a company	Bloomberg
Spread between 10 year and 3 months Euribor	Gap between weighted average yield of a 10-year of EMU governments note and 3-months libor in euros	Eurostat and Fred
10-year EMU government bond	Weighted average yield of a 10-year of EMU governments note	Eurostat
Total Debt	The total long term and short term of a company as recorded on its balance sheet	Bloomberg
EPS growth	Quarter-on-quarter rate of growth of earnings per share	Eurostat
Inflation	Year-on-year rate of growth of Harmonized Index of Consumer Price in EMU (HICP)	Eurostat

Appendix B

Table B2.1 : Tests for unit roots

Variable	LLC	HT	Breitung	IPS	Fisher(ADF)	Fisher(PP)
WACC	-8.343***	0.8428***	-11.183***	-2.640***	277.7692***	277.7692***
Shareholder yield	-16.44***	0.734 ***	-7.4528***	-3.596***	702.5072***	702.5072***
Debt-to-equity	-15.826***	0.8539***	-6.6381***	-6.4830***	308.5653***	308.5653***
CapEx-to-Sales	-17.97***	0.8315***	-14.0383***	-9.202***	1264.7517***	1264.7517***
EPS	-22.446***	0.5271***	-13.8662***	-8.564***	1271.692***	1271.6925***
EBITDA-to-sales	-18.077***	0.5109***	-18.238***	-11.036***	1484.347***	1484.347***
Spread 10y-3mo yield	-7.162***	0.9175***	-11.7074***	-9.954***	387.7816***	121.0040***
3 mo Euribor	-9.5504***	0.0000***	-46.042***	-4.6214***	171.7552***	134.8042***
Inflation	-11.67***	0.8943***	-14.698***	-1.956***	446.9590***	250.2261***
ECB assets	21.8598	1.0339	24.4366	20.0003	0.2100	0.2100
D(ECB assets)	63.7046	0.0280***	-40.374***	-24.46***	4434.0483***	4434.0483***

LLC denotes the Levin-Lin-Chu unit-root with Ho: Panels contain unit roots and Ha: Panels are stationary.
HT represents the Harris-Tzavalis unit-root test with Ho: Panels contain unit roots and Ha:
Panels are stationary.

Breitung is the Breitung unit-root test with Ho: Panels contain unit roots and Ha: Panels are stationary.
IPS denotes the Im-Pesaran-Shin unit-root test with Ho: All panels contain unit roots and Ha:
Some panels are stationary.
Fisher(ADF) represents the Fisher-type unit-root test based on augmented Dickey-Fuller tests with Ho:
All panels contain unit roots and Ha: At least one panel is stationary.
Fisher(PP) is the Fisher-type unit-root test based on Phillips-Perron tests with Ho:
All panels contain unit roots and Ha: At least one panel is stationary.
*, **, *** indicate statistical significance at the 10, 5% and 1% levels, respectively.

Table B2.2 : Results of panel analysis for the debt-to-equity equation by countries

Estimates of the Effect of the ECB's policies on Leverage Dependent variable: Debt-to-equity	All sample **(1)**	France **(2)**	Germany **(3)**	Italy **(4)**	Spain **(5)**
D(ECB Assets (t-1))	0.171***	2.19**	4.73**	1.51***	2.25**
3 Mo Yld (t-1)	-3.459***	-8.301**	-0.693**	-2.223**	-9.809**
EPS (t-1)	-2.437***	-1.626***	-3.849***	-0.056**	-0.931**
WACC	-8.214***	-11.689***	-4.460**	-9.854**	-1.543**
EBITDA-to-Revenue (t-1)	0.159***	0.454***	0.058***	0.682**	0.8535**
EU inflation (t-1)	4.300***	5.529***	0.763***	4.744**	3.218**
Constant	154.77***	189.12***	121.22**	196.21**	89.41**
Statistics					
R-squared (overall)	75.50%	74.65%	71.32%	73.91%	72.19%
F-statistic	53.40***	47.31***	18.97***	8.00***	18.87***
Total Obs.	3160	1944	1224	934	360
Cross sections	62	27	17	13	5
Hausman Test (Chi-Sq Stat.)	36.01***	10.52**	22.42	5.12	98.75***
RE/FE	FE	FE	FE	RE	FE

This table reports the results of estimating an equation for a balanced panel of 62 publicly traded non-financial firms over the period 2001.Q2- 2017.Q4. *, **, *** indicate statistical significance at the 10, 5% and 1% levels, respectively.

Table B2.3 : Results of panel analysis for the capital expenditures equation for countries

Estimates of the Effect of the ECB's policies on investments Dependent variable: CapEx-to-sales	All sample **(1)**	France **(2)**	Germany **(3)**	Italy **(4)**	Spain **(5)**
D(ECB Assets (t-1))	2.98**	6.96***	0.282***	0.309***	3.25***
3 Mo Yld (t-1)	-1.501**	-2.211***	-0.212**	-0.636**	-2.712***
EU inflation (t-1)	-0.997***	-1.766***	-0.001**	-0.271**	-2.067**
EBITDA-to-Revenue (t-1)	0.125**	0.614**	0.072**	0.132***	0.125**
Spread 10 Year Yld and 3 mo Libor (t-1)	0.623***	1.115**	0.220***	0.421***	2.036**
WACC (t-1)	-0.268***	-1.104***	-0.368***	-0.492**	-2.568**
Constant	15.65**	32.06**	8.92**	4.26**	14.58**
Statistics					
R-squared (overall)	72.00%	71.94%	72.35%	73.84%	71.46%
F-statistic	5.61***	6.94***	7.31***	12.26***	8.53***
Total Obs.	4462	1944	1224	934	360
Cross sections	62	27	17	13	5
Hausman Test (Chi-Sq Stat.)	63.30***	118.76***	0.97	12.44**	108.35***
RE/FE	FE	FE	RE	FE	FE

This table reports the results of estimating an equation for a balanced panel of 62 publicly traded non-financial firms over the period 2001.Q2- 2017.Q4. *, **, *** indicate statistical significance at the 10, 5% and 1% levels, respectively.

Table B2.4: Results of panel analysis for the shareholder yield equation for countries

Estimates of the Effect of the ECB's policies on dividends and buybacks Dependent variable: Shareholder yield	All sample **(1)**	France **(2)**	Germany **(3)**	Italy **(4)**	Spain **(5)**
D(ECB Assets (t-1))	1.33***	1.64***	1.14***	0.267***	3.06**
3 Mo Yld (t-1)	-0.912***	-0.832***	-0.822**	-1.437**	-0.452***
EPS (t-1)	0.108**	0.013**	0.358**	0.088**	0.211**
WACC (t-1)	0.437**	0.176**	0.618**	0.498**	0.630**
Constant	-0.706**	2.020**	-3.467**	-0.152**	-4.139**
Statistics					
R-squared (overall)	73.50%	74.15%	73.29%	71.83%	71.34%
F-statistic	103,52**	14.65***	7.64***	10.80***	5.21***
Total Obs.	4463	1944	1224	934	360
Cross sections	62	27	17	13	5
Hausman Test (Chi-Sq Stat.)	1.93	1.95	2.05	1.12	0.82
RE/FE	RE	RE	RE	RE	RE

This table reports the results of estimating an equation for a balanced panel of 62 publicly traded non-financial firms over the period 2001.Q2- 2017.Q4. *, **, *** indicate statistical significance at the 10, 5% and 1% levels, respectively.

Table B2.5: Sectorial results of panel analysis for the debt-to-equity equation

Estimates of the Effect of the ECB's policies on Leverage Dependent variable: Debt-to-Equity	All industries (1)	Basic Materials (2)	Communications (3)	Consumer Discretionary (4)	Consumer Cyclical (5)	Consumer Non-Cyclical (6)	Energy (7)	Industrial (8)	Information Technology (9)	Materials (10)	Technology & Telecommunications (11)	Utilities (12)
D(ECB Assets (t-1))	0.1711***	6.47**	9.30**	3.90***	8.51***	2.71***	6.61***	0.455**	0.455**	5.50***	0.547**	3.37**
3 Mo Yld (t-1)	-3.459***	-1.442**	-11.187**	-4.144**	-9.948**	-1.794***	-9.448**	-11.927**	-11.927**	-1.126**	-2.919**	-6.441**
EPS (t-1)	-2.437***	-11.807***	-1.807***	-13.276**	-1.061**	-0.968**	-1.732**	-1.192**	-1.192**	-9.382**	-2.134**	-0.706**
WACC	-8.214***	-7.557**	-24.751**	-0.821**	-10.857**	-2.128**	-0.885**	-2.873**	-2.873**	-1.266**	-1.007**	-3.296***
EBITDA to Revenue (t-1)	0.159***	0.680***	0.305**	0.573**	0.868**	0.968**	1.733**	1.062**	1.062**	0.135**	0.115**	0.033**
EU inflation (t-1)	4.300***	4.839***	3.129***	0.965**	2.718**	1.794***	1.532**	2.541***	2.541***	1.912**	2.176**	2.785***
Constant	154.77***	74.11***	157.99**	83.90**	207.87**	87.70**	58.72**	274.05**	274.05**	36.76**	38.96**	94.03**
Statistics												
R-squared (overall)	75.50%	74.32%	71.32%	70.87%	71.73%	72.46%	73.14%	74.73%	74.73%	72.75%	72.75%	71.34%
F-statistic	53.40***	5.98***	23.17***	8.72***	36.73***	7.87***	43.54***	26.66***	26.66***	6.99***	5.67***	21.37***
Total Obs.	3160	144	360	288	864	576	360	720	720	144	214	214
Cross sections	62	2	5	4	12	8	5	10	10	2	3	3
Hausman Test (Chi-Sq Stat.)	36.01***	13.33***	0.75	30.98***	73.11***	20.55***	0.91	23.45***	0.19	0.31	53.85***	34.89***
RE/FE	FE	FE	RE	FE	FE	FE	RE	FE	RE	RE	FE	FE

This table reports the results of estimating an equation for a balanced panel of 62 publicly traded non-financial firms over the period 2001.Q2- 2017.Q4.
*, **, *** indicate statistical significance at the 10, 5% and 1% levels, respectively

Table B2.6: Sectorial results of panel analysis for the capital expenditures equation

Estimates of the Effect of the ECB's policies on investments Dependent variable: Capex-to-sales	All industries (1)	Basic Materials (2)	Communications (3)	Consumer Discretionary (4)	Consumer Cyclical (5)	Consumer Non-Cyclical (6)	Energy (7)	Industrial (8)	Information Technology (9)	Materials (10)	Technology & Telecommunications (11)	Utilities (12)
D(ECB Assets (t-1))	2.98**	2.78***	0.297***	2.68***	0.122***	0.455***	2.64***	0.224***	1.80***	0.234**	1.87***	0.323***
3 Mo Yld (t-1)	-1.501**	-0.439**	-0.327**	-0.636**	-0.354**	-0.128**	-1.867***	-0.232***	-1.489**	-0.605***	-2.224**	-0.571**
EU inflation (t-1)	-0.997***	-0.042***	-0.092**	-0.990**	-0.649**	-0.094**	-1.657**	-0.017***	-1.021**	-0.948**	-0.168**	-0.211**
EBITDA-to revenue (t-1)	0.125**	0.039**	0.036**	0.033***	0.237**	0.048***	0.370**	0.018**	0.303**	0.073**	0.313***	0.233**
Spread 10 Year Y and 3 mo Libor (t-1)	0.623***	0.474***	0.525***	0.515**	1.595***	0.287**	0.555**	0.118***	1.088**	2.206**	0.965**	0.176**
WACC (t-1)	-0.268***	-0.102***	-0.210***	-1.257***	-0.251**	-0.184***	-1.838***	-0.056**	-0.126**	-1.199**	-0.141**	-0.203**
Constant	15.65**	11.83**	9.05**	-6.25**	12.04**	7.17**	-7.28**	4.39**	3.48**	25.14**	-5.76**	9.36**
Statistics												
R-squared (overall)	72.00%	73.12%	72.53%	73.84%	72.56%	72.31%	72.87%	71.93%	70.36%	71.82%	71.30%	71.23%
F-statistic	5.61***	4.53***	3.77***	4.57***	3.99***	8.21***	9.01***	10.18***	13.24***	9.20***	8.60***	5.56***
Total Obs.	4462	144	360	288	864	576	360	720	144	214	214	360
Cross sections	62	2	5	4	12	8	6	10	2	3	3	5
Hausman Test (Chi-Sq Stat.)	63.30***	79.90***	7.99**	12.44**	2.28	0.49	0.08	1.69	1.15	24.58***	12.24***	2.11
RE/FE	FE	FE	FE	FE	RE	RE	RE	RE	RE	FE	FE	RE

This table reports the results of estimating an equation for a balanced panel of 62 publicly traded non-financial firms over the period 2001.Q2- 2017.Q4.
*, **, *** indicate statistical significance at the 10, 5% and 1% levels, respectively.

Table B2.7: Sectorial results of panel analysis for the shareholder yield equation

Estimates of the Effect of the ECB's policies on dividends and buybacks Dependent variable: Shareholder yield	All industries **(1)**	Basic Materials **(2)**	Communications **(3)**	Consumer Discretionary **(4)**	Consumer Cyclical **(5)**	Consumer Non-Cyclical **(6)**	Energy **(7)**	Industrial **(8)**	Information Technology **(9)**	Materials **(10)**	Technology & Telecommunications **(11)**	Utilities **(12)**
D(ECB Assets (t-1))	1.33***	0.515***	0.417***	4.95***	1.09**	0.164***	0.103***	0.161***	3.55***	2.84***	2.12***	0.353***
3 Mo Yld (t-1)	-0.912***	-0.471**	-1.746**	-0.267**	-0.120**	-0.250**	-1.433**	-1.385**	-0.263***	-1.312***	-1.005***	-2.871***
EPS (t-1)	0.108**	1.800**	1.983***	2.180**	0.324**	0.139**	0.225**	0.350**	0.467**	1.312***	0.736***	0.184**
WACC (t-1)	0.437**	0.748**	0.645**	0.165***	0.722***	0.309**	1.563***	0.422***	0.496***	1.777**	0.156**	0.451**
Constant	-0.706**	-0.234**	3.693**	3.946**	-5.850**	-1.218**	-11.963**	-1.939**	-3.529**	-10.412**	3.492**	7.497**
Statistics												
R-squared (overall)	73.50%	72.80%	73.40%	72.43%	72.62%	72.80%	73.10%	74.20%	72.50%	73.20%	74.60%	72,25%
F-statistic	103,52**	11.11***	9.77***	7.55***	4.15***	5.44***	5.59***	7.81***	3.67**	4.64***	3.42***	9.94***
Total Obs.	4463	144	360	288	864	576	360	720	144	214	214	36'
Cross sections	62	2	5	4	12	8	5	10	2	3	3	5
Hausman Test (Chi-Sq Stat.)	1.93	1.58	0.2	0.48	0.56	3.3	18.45***	9.29***	1.66	16.81***	1.88	0.86
RE/FE	RE	RE	RE	RE	RE	RE	FE	FE	RE	FE	RE	RE

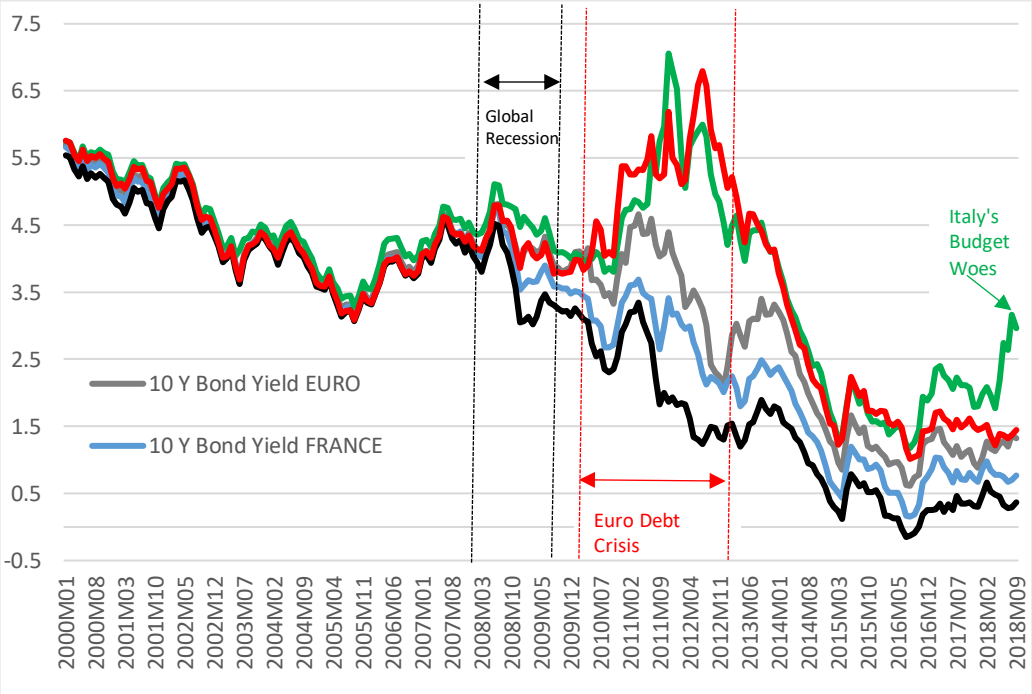
This table reports the results of estimating an equation for a balanced panel of 62 publicly traded non-financial firms over the period 2001.Q2- 2017.Q4.
*, **, *** indicate statistical significance at the 10, 5% and 1% levels, respectively.

Chapter 3 – Examining the effect of ECB monetary policy on non-financial corporations' credit risk premia

3.1 Introduction

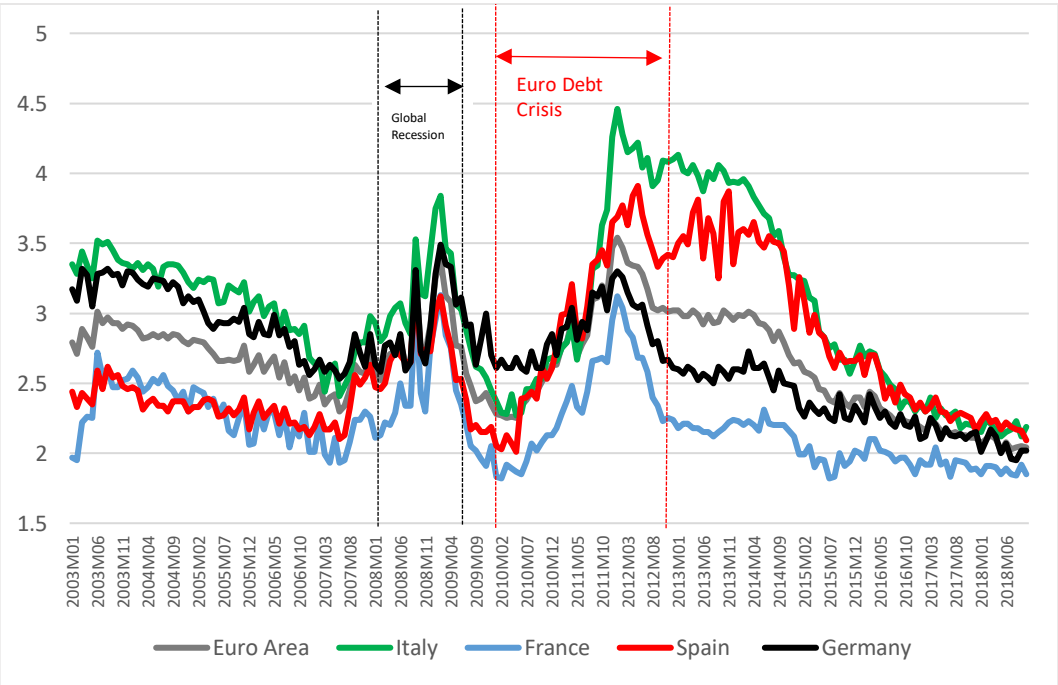
As the European Debt Crisis of 2010-2012 unfolded and the European Economic and Monetary Union's (EMU) financial conditions deteriorated, sovereign bond yields across the continent surged (see Figure 3.1). Similarly, corporations' credit spreads (i.e., spreads between corporations' cost of borrowing and the ECB's deposit rate), especially of Spanish and Italian companies, had reached all-time highs by 2012 (see Figure 3.2).

Figure 3.1: 10-year government bond yields for selected EMU countries, 2000-2018



Source of data: FRED

Figure 3.2: Spread between the cost of borrowing for corporations and the ECB's deposit rate in the Euro Area, Germany, France, Italy and Spain 2003-2018



Source of data: The ECB

At the time, the European Central Bank (ECB) alleviated financial conditions by lowering key interest rates three times (twice in late 2011 and once more in July 2012) before reaching the zero-lower bound (ZLB).

Since then, the ECB has introduced additional conventional and unconventional monetary policies such as reducing the deposit facility rate below the ZLB; initiating the long-term refinancing operation (LTRO) which, later on, was replaced by the targeted longer-term refinancing operation (TLTRO); and implementing several large-scale acquisitions of sovereign and corporate bonds (also known as "quantitative easing", QE). One of the declared goals of these policies was to shore up investment and consumption by ameliorating financial conditions in the debt market. If the ECB's policies were successful, then sovereign and corporations' bond prices would decline, and borrowing costs would be lower.

Although EMU's debt market structure relies heavily on commercial banks rather than on bond issuance, the low-interest-rate environment and the mounting hardships in bank borrowing led corporations to turn to the bond market. The share of EMU non-bank loans has grown from 35% in 2002-2008 to 50% in 2002-2016 (European Central Bank, 2016a). Moreover, the total bond issuance of European non-financial corporations (NFCs) out of all bond issuances (including those of financial firms) rose from 7% in 2007 to 15% in 2017, reaching 1.3 trillion euros (European Commission, 2017). The growing importance of the European bond market since the financial crisis suggests that developments in this market may shed light on the transmission mechanism of the ECB's policies on financial conditions.

In this chapter, we focus on the effect of the ECB's conventional and unconventional monetary policies in lowering firms' borrowing costs by examining NFCs' credit default swap (CDS) prices. To the best of our knowledge, this is the first paper to explore this question.

As is well known, a CDS contract transfers default risk for a company's debt obligation from its seller to the buyer. As such, CDS prices are *de facto* a measurement of the "default risk" of a company's debt obligation. Over the past decade, the CDS market contracted from its all-time highs of nearly $60 trillion in 2008 to $8.3 trillion in 2018. Despite this precipitous fall in outstanding CDS positions, this market continues to play an essential role in evaluating credit risk, especially for European firms, given that European CDSs account for nearly 45% of the total CDS market (Bank of International Settlements, 2019).

We use CDS prices over bond yield spreads because, based on the no-arbitrage reasoning (Duffie, 1999), the premium of a CDS should equal the spread between a bond yield of a company or country and a risk-free bond yield. Several papers have shown occasions in which the price parity fails, or in which the CDS market has its shortfalls (see, e.g., Delatte *et al.* (2012), Das *et al.* (2014), Blanco *et al.* (2005), and Fontana and Scheicher (2016)). Moreover, some papers have shown that over short periods the CDS market tends to lead the bond market (see Coudert and Gex (2010) Palladini and

Portes (2011), and Aktug *et al.* (2012), among others). Nonetheless, this relationship still holds as an equilibrium condition (Blanco *et al.* (2005) and Amato (2005)) and is still widely used to test developments in the debt market[19].

If the ECB's policies affected NFCs' CDS prices, then these firms' credit conditions should ameliorate, and their borrowing costs should fall[20]. To test this relationship, we collected data on some of the largest firms (at market capitalization) in the EMU, which account for 40% of the non -financial business sector's value-added and for a third of total employment in the European Union (EU)'s non-financial business sector (Nouy, 2018).

The contribution of this chapter is to methodically unravel the mechanism of the ECB's monetary policy to NFCs' CDS prices. We aim to assess how effective the ECB's policies were in improving NFCs' financial conditions, and to determine which policies were more useful than others.

Our daily price analysis indicates that the announcements of QE and TLTRO programmes had a statistical and economically significant effect in lowering daily CDS prices, being more sensitive to subsequent asset purchase programme announcements after the PSPP started in March 2015 than before.

For our monthly prices analysis, we find that from 2008 to 2012, between the global recession and the European debt crisis (i.e., the crisis years), the ECB's interest rate policy had a statistically and economically significant impact in lowering monthly CDS prices, after accounting for the Federal Reserve's policy measures. The main refinancing operations (MRO), LTRO, and interest rates policy mainly affected German and French companies' monthly

[19] Besides, by using CDSs, we can compare bonds across various interest payments and payment schedules.

[20] In this chapter we only examine whether the ECB's policies reduce the market's estimates of the chances of companies to default on their debt. We do not investigate whether companies actually improve their credit conditions or reduce their chances of defaulting on their debt.

CDS prices. In the immediate post-crisis years (2013-2014) the ECB's policies were less effective, and the MRO and LTRO programmes had only a limited effect on credit risk premia. Finally, since 2015, the ECB's interest rate policies and some asset purchase programmes – the public sector purchase programme (PSPP) and corporate sector purchase programme (CSPP) – reduced CDS prices. The PSPP appears to affect mostly French and Spanish companies' CDSs.

The rest of the chapter is organized as follows. Section 2 discusses the recent literature on the subject, and in Section 3 we then describe the data used. In Section 4, we present the empirical strategy for analyzing the impact of ECB monetary policy on NFCs' credit risk premia. Section 5 provides the results of the empirical models and their interpretation, as well as a robustness analysis. Finally, Section 6 offers some concluding remarks and explores policy implications.

3.2 A brief review of the ECB's monetary policy effect on the bond market

Since the European debt crisis, many papers have investigated the impact of the ECB's monetary policies on sovereign bonds. Recent contributions by Lupu *et al.* (2014), De Santis (2016), Jäger and Grigoriadis (2017), and Krishnamurthy *et al.* (2017) have demonstrated that the ECB's quantitative easing initiatives have lowered sovereign bond prices in EMU countries. Despite these encouraging findings, several papers have shown that these policies may also have some adverse effects on the bond market and bank lending: Martin and Zhang (2017) found that the asset purchase programmes contributed to the defragmentation of the European bond markets. Jiménez *et al*. (2014) empirically examined the effect of the ECB's accommodating monetary policy on credit risk-taking and found that low-interest rates led under-capitalized banks to grant loans to ex-ante risky firms.

The body of research on the impact of the ECB's policies on NFCs' bond markets is limited, and tends to focus on the fragmentation in the EU corporate bond market after the financial crisis of 2008-2009 (see, e.g., Mayordomo *et al.* (2015), Zaghini (2017), and Gilchrist and Mojon (2017)). The first two centred on the cross-country fragmentation in the European banking and corporate bond markets and showed that the ECB's policies helped to defragment them. Horny *et al.* (2018) concluded that the 2011-2012 crisis led not only to a rise in credit risk premia in the NFC bond market but also to a fragmentation in the bond market, mainly in Italy and Spain. However, the announcements of the ECB's outright monetary transactions (OMT) in secondary markets for sovereign bonds in September 2012 (European Central Bank, 2012) reduced the fragmentation.

Several papers have investigated how the ECB's monetary policies influenced bank lending to NFCs[21]. For example, Creel *et al.* (2016) examined the transmission of conventional and unconventional policies to government bonds, and NFCs and household loans[22]. They showed that the ECB's interest rate policy has been effective in lowering interest rates on bonds and bank loans, while unconventional policies (e.g., asset purchase programmes) had an uneven effect. By using structural vector autoregression analysis, Lewis and Roth (2019) determined that the asset purchase programme expanded bank lending not only in Germany but also in peripheral EMU countries, although borrowing costs did not fall. Kanga and Levieuge (2017) examined the direct and indirect effects of the ECB's unconventional policies on NFCs real cost of credit, finding that the policies had a limited effect on lowering companies' borrowing costs. In contrast to our approach of using CDS prices, their dependent variable was the difference between borrowing costs and inflation. Also, to identify the effect of the ECB's unconventional policies, they used dummy variables for each of the various policy measures, whereas here we gathered monthly data on

[21] Kok *et al.* (2012) modelled the determinants of bank loans to European non-financial firms. According to them, in the years leading up the global financial crisis of 2008, companies appeared to react to changes in credit supply – i.e., as interest rates declined, loans tended to fall and credit costs rose.

[22] For households, the focus in their paper was on housing loans.

each of the ECB's policies. Darracq-Paries and De Santis (2015) framed the 3-year LTRO programme as a credit supply shock and examined its macroeconomic effect. These authors contend that the programme raised loan provision to NFC in the intermediate-term.

A few papers have focused solely on the CSPP. For instance, Zaghini (2019) assessed the CSPP's impact on the primary corporate bond market, concluding that it significantly lowered corporates' bond yield spreads. The CSPP not only affects targeted bonds directly but also affects other corporate bonds indirectly via the portfolio rebalancing channel[23]. Todorov (2020) found that the CSPP reduced corporate bond yield after its announcement and raised corporate bond issuance. Grosse-Rueschkamp *et al.* (2019) reached a similar conclusion regarding the effect of the CSPP on corporate bond yields. However, they also found that bank lending was diverted into lending to private firms. Focusing on Spanish companies, Arce *et al.* (2018) found that the CSPP helped divert bank lending resources to small and medium-sized enterprises, which, in turn, used the loans to increase investments.

Our study makes three contributions to the literature with potentially important policy implications for understanding the ECB's transmission mechanism to debt markets. First, while some articles focus on a single policy, our analysis covers all the central conventional and unconventional policies implemented by the ECB from 2008 to 2018. Second, we study the heterogeneity of the transmission of the ECB's policies by controlling for country of origin, market capitalization, and credit rating. Third, we investigate not only the long-run effects of monetary policy but also the direct short-term effects by identifying the possible impact of the policy announcements on daily CDS prices.

[23] The effect on non-eligible bonds became apparent in the yield spread after 2017.

3.3 Data and descriptive statistics

We collected data on 1-year and 10-year CDS prices from Bloomberg. For the 10-year CDS, we gathered 62 companies with a total market capitalization of nearly 1.9 trillion euros as of December 2018[24]. For the 1-year CDS, we have data on 55 companies. With a few exceptions, the firms are listed on the Stoxx600 [25] and have headquarters in the EMU. All the companies are non-financial and are mostly large and medium market capitalization corporations[26]. Daily and monthly data are provided, and the sample period is from January 2008 to February 2018. We also divided the data according to country of origin and company credit rating (only for the 10-year CDSs).

The data indicate that, during the sample period, most CDS rates reached their maximum level between August 2008 and September 2009, and that some credit spreads experienced another spike between July 2011 and August 2013 (though still well below record levels in many cases). We find that the average 1-year spreads are higher than 10-year spreads, even after controlling for country of origin.

We also note that Spanish and Italian companies have higher average CDSs than their German and French counterparts. Finally, as we would expect, companies with investment-grade rating have lower average CDSs than speculative-grade companies.

[24] As previously mentioned, these companies account for more than a quarter of the total market capitalization out of all the NFCs listed in various stock exchanges in the EMU. Therefore, while the sample size is not large, these companies are a fair representation of publicly-traded NFCs in the EMU.

[25] The companies that are not listed on the Stoxx600 include Abengoa SA (bankrupt since 2016); Alcatel-Lucent International SAS and Compagnie Financière Michelin SCmA, which are private companies.

[26] We include hardly any small market capitalization corporations because most of them do not have CDSs.

Since the data-set has a high degree of missing data, we apply the technique of multiple imputations first developed by King *et al.* (2001), which provides an approximation of missing data in order to achieve more robust estimates).

3.4 Econometric strategy

We start by presenting the econometric models used to examine the effect of ECB monetary policy on NFCs' credit risk premia. We divide this section into two main parts: daily and monthly data analysis. In the former, we focus on the announcements of the ECB's unconventional monetary policies; in the latter, we examine the longer-term effects of these policies.

3.4.1 Daily data analysis

We start by examining the effects of the announcements of the ECB's unconventional monetary policies. We divide each of the ECB's primary policies into three groups: rate cuts, TLTRO, and QE. We focus on the period between June 2014 and December 2016. We pick this specific period because, during this time, the ECB introduced most of its unconventional monetary policies, including the lowering of the cash rate below the zero-lower bound and the initiation of the TLTRO and asset purchase programmes (see Appendix C).

We divide the period into two sub-periods with March 1, 2015 as the cutoff point. This date marked the week when the ECB started the PSPP[27]. However, there is another reason for making this division: De Santis (2016) shows that most of the effect of the ECB's QE announcements on euro area sovereign yields occurred before March 2015, mainly between September 2014 and February 2015. As such, he concluded that by the time the PSPP started in March 2015, market participants have already discounted most of the impact of the ECB's new monetary policy. Dividing the sample into two

[27] Even though, the ECB first announced the PSPP on Jan. 22nd, 2015.

sub-periods allows us to test this conclusion and also to see if it is also applicable to CDSs.

We begin with a baseline model similar to the one used by Gilchrist and Zakrajsek (2013), who conducted an event-style analysis of the impact of the Federal Open Market Committee´s QE announcements on CDSs.

$$\Delta CDS_{i,t} = \beta_0 + \beta_1 QE_t + \beta_2 TLTRO_t + \beta_3 RATE_t + \varepsilon_{i,t} \quad (1)$$

where $\Delta CDS_{i,t}$ denotes percent change in firm *i*'s CDS price; as for the explanatory variables, we create three binary variables for each type of policy announcement with the value of 1 for the day of the announcement and the value zero for all other days: QE_t which stands for any quantitative easing policy announcement; $TLTRO_t$ the announcements related to the LTRO or TLTRO programmes; and $RATE_t$ the policies relates to changes in interest rates. We then use an event-style analysis, as presented in equation (1)[28].

In addition to equation (1), we perform other types of estimations to verify the robustness of our results. In equation (2), we examine the reaction of the CDS prices in anticipation of the policy announcements; to do so, we include the market reaction for the days leading up to and following the policy announcements. In particular, we analyse the effects of the three primary ECB policy announcements on the day of the announcements (*Policyday*),

[28] According to Rigobon and Sack (2004), when conducting event studies with OLS estimations, the natural assumption is that monetary policy changes, especially to interest rates, are the sole source of volatility at the time. However, this assumption might not hold up at times of heightened market volatility or when other economic developments or news unfold. Because of this, Gilchrist and Zakrajsek (2013) were concerned that making this assumption may lead to an identification problem -- it tends to arise when asset prices endogenously react to monetary policy announcements. This problem may result in downward-biased estimates of the coefficients measuring the effect of monetary policy on companies' bond prices. To overcome this identification issue, Gilchrist and Zakrajsek (2013) conducted an identification-through-heteroskedasticity approach first developed by Rigobon (2003) and Rigobon and Sack (2003, 2004). However, this approach cannot be used here since, from an econometric theory perspective, we are entering uncharted territory. We conduct a panel data analysis with multiple imputations. However, the identification-through-heteroskedasticity approach has not been sufficiently researched under these methods. We acknowledge that while the OLS coefficients might have a downward bias, the coefficients for all the policy announcements are significant and robust, as we show in Section 5.2.

five days before (*Policybefore*), and five days after (*Policyafter*), using the following regression.

$$\Delta CDS_{i,t} = \beta_0 + \beta_1 Policybefore_t + \beta_2 Policyafter_t + \beta_3 \ PolicyDay_t + \varepsilon_{i,t} \quad (2)$$

Finally, we also use a Bayesian regression for each of the sub-periods. We start by using uninformative priors for the coefficients[29] for the policy announcements for the first sub-period (from June 2014 to March 2015); we then use the estimated coefficients from the first sub-period (the mean and std. errors for each coefficient[30]) as the informative priors for the second sub-period (March 2015-December 2016). This method allows us to accomplish two goals; it tests the robustness of our event-style ordinary least squares (OLS) regression results, and it also shows whether the policy announcements, mainly related to QE, affected CDS premia differently after the QE programmes started (i.e., after March 2015) than before. This last estimation process could show the effectiveness of the ECB in revising market expectations even after the QE commenced.

3.4.2 Monthly data analysis

For this analysis, we require policy variables, related to the ECB's policies, and control variables (mostly macroeconomic variables) and must keep in mind that using CDS prices entails several estimation challenges. First, the ECB's policy response may simultaneously affect different asset classes, resulting in an endogeneity problem. Specifically, corporate bond prices, and by extension CDS prices, could be simultaneously affected by fluctuations in other risky asset prices. For that reason, we plan to control for other asset classes that should ease some of these endogeneity issues. Second, a spillover effect from abroad, as other central banks (mainly the Federal Reserve) revise their monetary policy, could impact the credit risk of companies in the EMU. To address this concern, in sub-section 3.5.2.2 we will control for changes in the Federal Reserve's policies. Third, identifying the effect of the ECB's

[29] In this case, we assume that each parameter has a normal distribution of (0,100).
[30] We still assume a normal distribution.

policies may be challenging when new economic conditions emerge and could simultaneously impact CDS prices. We therefore plan to examine the ECB's policies over several sub-periods that should control for some significant economic developments that transpired over the last decade.

$$\Delta CDS_{i,t} = \alpha_{i,t} + \beta_1 * \Delta i_t + \beta_2 * \Delta ECB_t + \beta_3 * Vol_t + \beta_4 * \Delta Stoxx600_t + \beta_5 * Inf_{i,t} + \beta_6 * \Delta Euro_{i,t} + \beta_7 * \Delta Spread10y3mo_{i,t} + \beta_8 * \Delta EVZ_{i,t} + \varepsilon_{i,t} \quad (3)$$

where i_t denotes the short-term interest rate, ΔECB_t is the percent change in the ECB's balance sheet; VOL_t is an indicator of equity volatility; $\Delta Stoxx600_t$ is a measure of equity returns (the percent change in the Stoxx600 index); *Inf* is EMU inflation; $\Delta Euro_t$ is the percent change in the EUR/USD exchange rate; $\Delta Spread10y3ma_t$ *is* a proxy for the slope of the term structure; and ΔEVZ_t is a proxy of exchange rate uncertainty (the percent change in the euro currency volatility index). As can be seen, all variables except for VOL_t and *Inf* are in first difference (Appendix D explains all the explanatory variables used in the analysis and their sources).

Our model here mostly relies on Fontana and Scheicher (2016), who provide a detailed set of explanatory variables that account for the variance of CDS premia. They are not the only scholars to have researched the factors affecting CDS prices (see, e.g., Galil *et al*. (2014), and Annaert *et al.* (2013)[31]). We include short-term interest rate, the slope of the term structure, equity returns, and equity volatility, Euro/USD, and Euro/USD uncertainty, and inflation. We also include monetary policy variables not listed by Fontana and Scheicher (2016).

3.5 Empirical results

We divide this section into two parts. First, we examine the effect of the ECB's policy announcements on daily CDS prices. Second, we look into the

[31] These other papers also present several similar explanatory variables.

medium-term ramifications of these policies by using monthly data. In both analyses, we have considered two basic panel regression methods: the fixed-effects (FE) method and the random effects (RE) model. However, based on the Hausman tests (to determine the non-correlation between the unobserved effect and the regressors), we found the RE model to be more appropriate than the FE model throughout all the regressions in this chapter.

As a previous step, we assess the statistical characteristics of all variables in our dataset. To this end, we perform several unit root tests in the panel datasets and across different periods. In particular, we conduct the Levin–Lin–Chu (2002), Harris–Tzavalis (1999), Breitung (2000), Im–Pesaran–Shin (2003), and Fisher-type (Choi (2001)) tests. The results (not shown here to save space) do not reject the null hypothesis of a unit root for most variables. Based on these results, we treat the majority of the variables as first-difference stationary, and in a few cases as either stationary (level) or as second-difference stationary.

3.5.1 Daily data analysis results

We divide the daily analysis into three parts. In sub-section 3.5.1.1, we present the results of the OLS regressions for the event-style study for the day of the announcements. In sub-section 3.5.1.2, we use a Bayesian regression (Gibbs sampling) for the same event-style framework as in sub-section 3.5.1.1. Finally, in sub-section 3.5.1.3 we use a different event-style test, where for each type of policy announcement (QE, rate cuts, and TLTRO) we examine the days before, day of, and days after.

We find that the coefficients for QE and TLTRO programme announcements are economically and statistically significant and indicate that these announcements lowered CDS prices. Moreover, these announcements had a significantly stronger effect after the PSPP started in March 2015 than before. We also find that the rate cut announcements did not appear to have a lasting effect, as the days leading to the announcements are counterbalanced by the effects on the day of the announcements and the following days.

3.5.1.1 An OLS regression analysis

We start with an event-style framework (using OLS regression) of the day of the announcements of the three primary policies: QE, TLTRO, and rate decisions. The results are presented in Table 3.1.

Table 3.1: The ECB's policy announcements, event-style analysis, day of the announcements, June 2, 2014-Dec. 30, 2016

	June 2, 2014 to Dec 30, 2016		June 2, 2014 to Mar 2, 2015		Mar 2, 2015 to Dec 30, 2016	
Explanatory Variables	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y
QE announcements	-2.00***	-2.91***	-0.66	-0.77	-3.49***	-4.96***
TLTRO announcements	-1.74***	-2.48**	-1.50***	-2.51**	-2.71***	-3.54*
Rate Cut announcements	2.93***	4.86***	2.52***	4.84***	4.13***	5.96***
Constant	0.13**	0.29***	0.06	0.20**	0.13***	0.33***
Number of Obs.	39,533	35,202	11,458	10,219	28,075	24,983
Number of Firms	62	55	62	55	62	55
R^2	0.008	0.010	0.007	0.010	0.012	0.013
F-stat	76.03	31.81	17.09	26.98	84.90	16.10

Note: Balanced, random effects (firms) OLS regressions (daily data). The dependent variables are percent change. *p<0.1, **p < 0.05, and ***p < 0.01. The dependent variables are daily changes to percent changes in each of the above-mentioned economic indicators

A few points about these results are worth noting. First, the coefficients related to the QE and TLTRO announcements are statistically significant and suggest that these policy announcements lowered NFCs' credit risk premia. In particular, the ECB's statements on QE and TLTRO led to average declines of 2% and 1.74% respectively for 10-year CDS prices between June 2014 and December 2016. Second, the 1-year CDS prices appear more sensitive to QE and rate cut policy announcements than 10-year CDS prices. For example, throughout the sample, the rate cut announcements lowered 10-year CDS prices on average by 2.93%, and 1-year CDSs by 4.86%. Third, the QE programme announcements seem to have had a stronger impact on

NFCs' credit risk after March 2015 (when the PSPP started) than before; e.g., the 10-year CDS prices fell, on average, by 3.5% in the second sub-period. Conversely, the coefficients for first sub-period are not significant.

Our interpretation of these results is that before QE started, the ECB's announcements did not have a robust signalling effect in revising market expectations about its unconventional monetary policy; that is, the market did not fully incorporate the policy change in CDS prices, as would be expected according to the efficient-market hypothesis. Because the market did not know how to adjust to the new monetary policy or how it would affect asset prices, it was only able to adjust after the ECB started its main asset purchase programme, the PSPP. Moreover, the policy announcements that followed in 2015-2016 (including the raising of the monthly purchases of the PSPP, and the introduction of additional asset purchase programmes, most notably the CSPP) were more instrumental and effective in improving credit conditions than the mere announcements of new asset purchase programmes before they started. Indeed, during this period, their extent and breadth were unclear. This interpretation also supports our daily analysis, because we show there that even after the ECB started these policies, they still affected some CDS prices[32].

Finally, we also conducted a cross-country breakdown. Our results (not shown here to save space) indicate that a company's country of origin did not appear to explain the changes of CDS premia.

3.5.1.2 A Bayesian regression analysis

We now turn to the results of the Bayesian regressions. The critical difference here compared with the previous section is that we use the results of the Bayesian regression from the first sub-period (June 2014 and March 2015) to estimate the coefficients in the second sub-period (March 2015 to

[32] The coefficients of the rate cut announcements are significant and positive, although we expected negative coefficients. This result may be due to market expectations surrounding the ECB interest rate decisions (see sub-section 5.1.3).

December 2016). The results (see Table 3.2) are not substantially different from those reported in Table 3.1.

Table 3.2: **Bayesian regression analysis, day of the announcements, June 2, 2014-Dec. 30, 2016**

Posterior summary statistics	June 2, 2014 to Mar 2, 2015		Mar 2, 2015 to Dec 30, 2016	
Explanatory Variables	CDS10Y	CDS1Y	CDS10Y	CDS1Y
QE announcements (mean coef.)	-0.85	-1.04	-2.64	-3.63
Std. Dev.	0.51	0.73	0.29	0.62
TLTRO announcements (mean coef.)	-1.31	-2.20	-2.14	-3.24
Std. Dev.	0.51	0.72	0.29	0.47
Rate Cut announcements (mean coef.)	2.37	4.86	2.94	5.17
Std. Dev.	0.70	0.99	0.33	0.62
Constant^ (mean coef.)	0.09	0.35	0.16	0.26
Std. Dev.	0.03	0.07	0.05	0.04
Variance_0	25.37	48.56	19.30	36.16
Variance_id	0.135	0.197	0.125	0.086
Number of Obs.	6,165	5,974	15,017	13,915
Number of Firms	62	55	62	55
Acceptance rate	0.861	0.881	0.873	0.861
Log marginal likelihood	-18,866.7	-20,219.2	-43,690.1	-44,797.0

Note: Sample period: daily data from June 2, 2014, to Dec 30, 2016, divided into two sub-periods on March 2, 2015. Unbalanced, random effects (firms) Bayesian normal regressions with Gibbs sampling.
MCMC sample size is 10,000; Entries in the table denote the OLS estimates of the average effect of the ECB's various QE programmes, TLTRO, and rate cuts announcements dummy variable for the day of the announcements for QE, TLTRO and rate cuts. ^ The constant here stands for the mean of random effects in their priors. The priors used in the period June 2, 2014-Mar 2, 2015 are non-informative. For the period Mar 2, 2015-Dec. 30, 2016 the priors are based on the mean and variance taken from the June 2, 2014-Mar 1, 2015 period. Variance_0 is the error variance; Variance_id is the variance of random effects.

However, since this is a Bayesian framework, the credit intervals (see Table 3.3) show the probability of the parameters of the ECB's policy announcements being in a given range.

Table 3.3: Credible intervals of the Bayesian regression analysis, day of the announcements, June 2, 2014-Dec. 30, 2016

Credible intervals 95%	June 2, 2014 to Mar 2, 2015				Mar 2, 2015 to Dec 30, 2016			
Explanatory Variables	CDS10Y		CDS1Y		CDS10Y		CDS1Y	
QE announcements	-1.86	0.148	-2.49	0.4	-3.22	-2.07	-2.8	-4.43
TLTRO announcements	-2.29	-0.307	-3.66	-0.819	-2.8	-1.48	-4.17	-2.32
Rate Cut announcements	0.98	3.748	2.93	6.81	2.24	3.64	3.95	6.4
Constant^	0.016	0.165	0.2	0.49	0.05	0.27	0.175	0.34

Note: Sample period: daily data from June 2, 2014, to Dec 30, 2016, divided into two sub-periods on March 2, 2015. Unbalanced, random effects (firms) Bayesian normal regressions with Gibbs sampling. MCMC sample size is 10,000.

In particular, the QE parameter has a 95% chance of being between 0.40% and -2.49% for 1-year CDSs in the first sub-period, whereas in the second sub-period, the QE parameters have a 95% chance of being between -2.80% and -4.43% (for the 10-year CDS, the results are similar). These results reinforce our previous conclusions in sub-section 3.5.1.1 that the QE announcements had a stronger effect on CDSs after the PSPP started in March 2015.

3.5.1.3 An alternative event study for the announcements

To test the robustness of our results, we additionally examine each type of policy announcement for the five days before, five days after, and the day of the announcement. By doing so, we aim to control for changes in market expectations leading to the decisions and also account for the immediate, lasting effects these policy announcements may have had on CDS prices in the following days.

Table 3.4: The ECB's policy announcements, event style analysis, five days before and after the day of the announcements, June 2, 2014-Dec. 30, 2016

	June 2, 2014- Dec 30, 2016		June 2, 2014- Mar 2, 2015		Mar 2, 2015- Dec 30, 2016	
Explanatory Variables	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y
Rate Cut, five days after announcement	0.84***	1.06***	0.72***	0.84**	1.02***	1.36***
Rate Cut, five days before announcement	-2.10***	-2.62***	-1.50***	-1.65***	-2.69***	-3.58***
Rate Cut, day of announcement	2.44***	4.16***	2.53***	4.88***	2.40***	3.51***
Constant	0.12***	0.26***	0.04	0.15***	0.15***	0.30***
R^2	0.0089	0.0084	0.0086	0.0091	0.0098	0.0092
F-stat	76.81	74.3	20.16	22.49	69.81	56.63
QE, five days after announcement	-0.29***	-0.16	0.27	0.31	-0.60***	-0.60***
QE, five days before announcement	-0.63***	-0.77***	-0.41**	-0.17	-0.79***	-1.28***
QE, day of announcement	-2.45***	-3.46***	-1.63***	-2.35***	-3.27***	-4.56***
Constant	0.20***	0.36***	0.12*	0.20**	0.23***	0.42***
R^2	0.0055	0.005	0.0033	0.0032	0.0078	0.0079
F-stat	50.01	45.56	8.75	8.27	56.72	51.85
TLTRO, five days after announcement	0.29**	0.75***	0.75***	1.40***	-0.17	0.12
TLTRO, five days before announcement	-0.75***	-1.06***	-0.56***	-0.75***	-0.80***	-1.17***
TLTRO, day of announcement	-2.71***	-3.85***	-1.89***	-2.92***	-3.72***	-4.95***
Constant	0.16***	0.31***	0.04	0.15*	0.20***	0.36***
R^2	0.0062	0.0073	0.0081	0.0111	0.0068	0.0071
F-stat	51.7	69.64	19.54	30.29	47.88	6.63
Number of Obs.	39,533	35,202	11,458	10,219	28,075	24,983
Number of Firms	62	55	62	55	62	55

Note: Balanced, random effects (firms) OLS regressions. Sample period: daily data from June 2, 2014 to Dec 30, 2016. *p<0.1, **p < 0.05, and ***p < 0.01. The dependent variables are daily percent changes in each of the above-mentioned economic indicators.
Entries in the table denote the OLS estimates of the average effect of the ECB's various QE programme announcements; dummy variables for five days before and five days after the QE was announced and for the day of the announcement.

Table 3.4 indicates that for the decision to cut rates, we find that in the days leading up to it the market seems to have reacted in anticipation of the news; the coefficients are negative and significant. However, the coefficients for the day of the policy news and the five days afterwards are positive and

significant. We interpret these results as a "buy the rumour and sell the fact" market reaction (i.e., the market expected the ECB to lower interest rates, and once it made the announcement, the market sold off CDSs on the news). As a result, the net effect of the rate cut news was marginal.

Regarding the results for the days leading up to and following the QE and TLTRO announcements, Table 3.4 shows that the coefficients of these events are negative and significant primarily on the day of the announcements and the days leading to the announcements. Specifically, throughout the entire sample, on the day of the QE policy announcements, the CDS prices tended to fall, on average, by 3.46%, for 1-year and by 2.45% for 10-year, whereas in the five days before the QE announcements, the 1-year, and 10-year CDS premia decreased, on average, by 0.77% and 0.63% respectively.

The coefficients are significantly lower in the second sub-period (March 2015-December 2016) compared with the first sub-period. This outcome further confirms our interpretation of the results in sub-section 3.5.1.1 and 3.5.1.2. Finally, as in previous sections, we find again that short-term CDSs are more sensitive than long-term CDSs to the ECB's policies. All these regressions are robust and significant, even though their respective R^2 is low.

We also use a Bayesian regression, in which we use a similar approach in sub-section 3.5.1.2. The results (not shown here to save space, but available from the authors upon request) are consistent with the OLS findings and reaffirm our previous conclusions.

3.5.2 Monthly data analysis results

In the monthly analysis, we test the impact of the ECB's monetary policies on CDSs from January 2008 to February 2018. Throughout this examination, except in parts of sub-section 3.5.2.4, we divide it into three sub-periods, from January 2008 to December 2012 (the crisis-years); January 2013 to December 2014 (immediate post-crisis years); and from January 2015 to February 2018 (the QE years). These three sub-periods allow us to identify

the effect of the ECB's policies in different economic circumstances: During the crisis years, the global recession and Euro debt crisis unfolded. The second sub-period follows the peak of the Euro debt crisis. Finally, the third period is when the ECB introduced its TLTRO and asset purchase programmes.

Another reason why the QE years stand out from previous periods is the divergence in the monetary policy between the ECB and the Federal Reserve. While the ECB introduced additional unconventional policies, the Federal Reserve started normalizing its monetary policy.

While we presented the results for our baseline model (equation 1) in sub-section 3.5.2.1; in sub-section 3.5.2.2, we examine how the dynamics of the ECB and the Federal Reserve's policies affected CDS prices (equation 2). In sub-section 3.5.2.3, we investigate the impact of different asset purchase programmes. Sub-section 3.5.2.4 shows the impact of the MRO, LTRO, and TLTRO programmes. We also conduct a cross-country study in sub-section 3.5.2.5. Finally, in sub-sections 3.5.2.6 and 3.5.2.7, we examine whether companies' market capitalization size and credit rating respectively have explanatory power over CDS prices.

Our results indicate that in the crisis years, the ECB's interest rates policies reduced credit risk premia. However, in 2013-2014, it seems that the ECB's policies were not effective. Only as concerns over Europe's debt crisis started to dissipate, and the ECB commenced its QE programme and lowered interest rates below the ZLB, did CDS prices react to the ECB's policies. Our economic interpretations of these results are that during the crisis years, as risk premia across asset classes rose precipitously, the "flight-to-quality" phenomenon was more prominent and prompted investors to "dump" assets regardless of their quality. During those years, the ECB's monetary policy was only partially useful in lowering risk premia in the credit market (mainly via interest rates). Only in the QE years, as credit risk premia across assets started to fall, has the ECB's interest rate policy become more productive in lowering CDS prices.

Conversely, the relationship between the ECB's balance sheet policies is more complicated. During most of the sample period (2008-2012 and 2015-2018), the rise in the ECB's balance sheet appears to have led to an increase in CDS premia. However, we also find that the PSPP and CSPP (second derivative) reduced CDS prices. Our interpretation of these apparently contradictory relationships is that the market reacted to negative economic news (including the ECB's unconventional monetary policy) as a signal of future deterioration in credit conditions (hence the positive correlation between the ECB's balance sheet and CDSs). However, as the ECB increased its monthly allocations to programmes such as PSPP and CSPP, they helped ameliorate credit conditions (thus the negative correlation). Nonetheless, we also find that when the ECB's balance sheet was contracting (as the LTRO and MRO were being phased out in 2013-2014), this raised CDS prices (i.e., the lack of stimulus also appears to have adversely affected credit risk premia).

3.5.2.1 Baseline model

The results for our baseline model for 10-year and 1-year CDSs are reported in Table 3.5.

Table 3.5 : Baseline model – a regression analysis on the effects of the ECB's policies, Jan. 2008- Feb. 2018

	Jan. 2008- Dec. 2012		Jan. 2013- Dec. 2014		Jan. 2015- Feb. 2018	
Explanatory Variables	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y
1-week Euribor (change)/ (level)^	4.10	4.75	10.85	-9.55	32.20***	49.06***
ECB Assets (percent change)	0.79***	-1.17***	0.26**	-1.85***	1.16***	1.66***
Constant	-11.4***	-3.66*	1.81**	3.17	11.41***	17.27***
Number of Obs.	3,720	3,300	3,844	1,320	2,356	2,090
Number of Firms	62	55	62	55	62	55
R^2	0.463	0.565	0.328	0.450	0.310	0.325
F-stat	353.39	492.34	132.52	117.94	92.37	90.89

Control variables includes: Stoxx600 volatility(level), and first difference of each of Euro index volatility (EVZ), Stoxx600, inflation of EU19, Euro and spread of the 10y-3m bond yield.
Note: Balanced, random effects (firms) OLS regressions. The dependent variables are percent change. *p<0.1, **p < 0.05, and ***p < 0.01. ^For the periods of 2008-2012 and 2013-2014 1 week is Delta; for the period after 2015 -- it is set at a level.

As can be seen, during the crisis years (2008-2012), the ECB's policies did not appear to reduce CDS prices. Conversely, as the ECB was phasing out its LTRO programme in the second sub-period (2013-2014), this process appears to have raised credit risk premia. Finally, during the third period, the ECB's low-interest rates seem to have lowered CDS prices, while its policies related to its balance sheet raised CDS premia; that is, in all three sub-periods, the ECB's balance sheet policies did not appear to lower CDS prices.

Conversely, the ECB's interest rates policies do not seem to have had a significant effect on CDS prices during the years of the crisis and the immediate post-crisis. The coefficients are positive and significant only in the QE years, even though the ECB's cash rate did not change greatly. Nonetheless, the results show that for every 10-basis point decline in the 1-

week Euribor, 1-year and 10-year CDSs decreased, on average, by 4.9% and 3.2% respectively. This result also provides further support for our earlier conclusion in section 3.5.1.1 that short-term CDS prices are more sensitive than long-term CDS prices to ECB policies.

3.5.2.2 The ECB and the Federal Reserve

During the global recession of 2008 the Federal Reserve slashed its interest rate close to the ZLB and in the following years introduced more stimulative programmes most notably the asset purchase programme (also known as QE1, QE2, and QE3).

These policies may have had an indirect slipover effect on the credit conditions of European firms. If there were any effects of this kind, they should be present in the CDS premia. Since 2015 the Federal Reserve has been normalizing its monetary policy by raising interest rates and scaling down its balance sheet. This normalization process occurred while the ECB continued to ease monetary policy. To examine the interaction of these two central banks' policies, we include each of the central bank's policy tools, i.e., their balance sheets, and the 1-week Euribor and 1-week Libor in dollars to proxy their respective interest rate policies. The results are presented in Table 3.6.

Table 3.6: Regression analysis on the effects of the ECB's policies, controlling for the Federal Reserve's policies, Jan. 2008- Feb. 2018

Explanatory Variables	Jan. 2008- Dec. 2012		Jan. 2013- Dec. 2014		Jan. 2015- Feb. 2018	
Explanatory Variables	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y
1-week Euribor (change)/ (level)^	7.29***	8.91**	9.71	38.66	31.17***	48.16***
ECB Assets (percent change)	0.96***	1.16***	-1.28***	-2.92***	0.81***	1.20***
Fed Assets (percent change)	0.028	0.22**	-1.15	-3.97***	14.09***	17.30***
1-week Libor USD (change)	-8.00***	-7.81	-338.67*	-267.41	-12.75*	-9.67
Constant	-9.43***	-16.93***	-4.26	0.86	14.07***	20.21***
Number of Obs.	3,720	3,300	1,488	1,320	2,356	2,090
Number of Firms	62	55	62	55	62	55
R^2	0.468	0.569	0.330	0.455	0.325	0.337
F-stat	278.92	385.29	60.80	96.51	80.30	78.29

Note: Balanced, random effects (firms) OLS regressions. *p<0.1, **p < 0.05, and ***p < 0.01.
Control variables includes: Stoxx600 volatility(level), and first difference of each of Euro index volatility (EVZ), Stoxx600, inflation of EU19, Euro and Spread of the 10y-3m . ^For the period of 2008-2012 and 2013-2014 1-week Euribor is set as first difference; for the periods after 2015 it is set as level.

The key difference of the results in Table 3.6 with respect to those reported in Table 3.5 is that during the crisis years, after controlling for the Federal

Reserve's policies, the coefficients for the changes in 1-week Euribor are positive and economically and statistically significant. So, for every one percentage point decrease in the 1-week Euribor, CDS prices declined on average by 7.3% and 8.9% for 10-year CDS and 1-year CDS respectively.
Another interesting result is that the coefficients of the Federal Reserve's balance sheet (for 1-year CDS) and the 1-week Libor (for 10-year CDS) suggest that the Federal Reserve's expansionary policies raised credit risk premia. Our intuitive interpretation of this result is that the crisis years were characterized by a "flight-to-safety" mood in the financial markets, especially at the peak of the financial crisis of 2008-2009, and investors were rebalancing their portfolios to less risky assets. At the same time, the Federal Reserve's monetary policy reacted to the dire financial conditions. Therefore, these results indicate the market sentiment at the time, rather than a causal relationship. However, since 2015, as financial conditions improved, the Federal Reserve's asset reduction[33] and interest rate hikes also coincided with declining credit risk premia. During this time, the ECB's policies, mostly related to interest rates, have contributed to the fall in CDS prices.

3.5.2.3 Asset purchase programmes

We deconstruct the ECB's asset purchase programmes to their main components -- PSPP, ABSPP, CBPP3, and CSPP (see Appendix E). The cross-country study for the PSPP is in sub-section 3.5.2.5.

[33] Even though the normalization process only started in mid-2017; see the Federal Reserve's monetary policy press release for June 14 2017 (see Federal Reserve System, 2017); the Federal Reserve started normalizing its balance sheet in 2015.

Table 3.7: Regression analysis on the effects of the ECB's policies, breaking down the various QE programmes, and controlling for country of origin, Jan. 2015- Feb. 2018

	All series		Germany		France		Italy		Spain	
Jan. 2015- Feb. 2018										
Explanatory Variables	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y
1-week Euribor	16.52*	19.27*	35.5***	60.3***	33.5***	46.2***	30.8***	42.2***	36.7***	49.1***
PSPP (2nd change) ^	-0.15***	-0.08	-0.29	-0.01	-0.52**	-0.21	-0.82	-0.64	-1.64**	-1.74*
ABSPP (change)	0.32	4.90***								
CBPP3 (change)	0.94**	0.77								
CSPP (2nd change)	-0.36*	-0.7***								
Constant	4.77	5.17	13.84***	23.33	14.90***	20.39***	13.07**	17.60**	14.93***	17.14**
Number of Obs.	2,356	2,090	570	570	1,140	988	228	228	266	190
Number of Firms	62	55	15	15	30	26	6	6	7	5
R^2	0.308	0.325	0.298	0.310	0.287	0.297	0.401	0.377	0.367	0.396
F-stat	66.00	65.91	20.29	23.42	36.43	36.27	12.11	10.51	12.20	11.69

Control variables includes: Stoxx600 volatility(level), and first difference of each of Euro index volatility (EVZ), Stoxx600, inflation of EU19, Euro and spread of the 10y-3m bond yield.
Note: Balanced, random effects (firms) OLS regressions. All QE programmes are in billions. *p<0.1, **p < 0.05, and ***p < 0.01. ^ -- for the PSPP figures for the cross-country analysis, we use the PSPP for each country based on the purchases allocated to each country each month; For the cross-country analysis, we did not include ABSPP, CBPP and CSPP because there was no direct allocation based on a country level. PSPP and CSPP are in second difference; while ABSPP and CBPP3 are in first difference.

Table 3.7 shows that only the CSPP (second derivative) had a consistent effect on 10-year and 1-year CDS prices; that is, for every additional 1 billion euros allotted monthly to purchase corporate bonds, CDS prices tended to fall, on average, by 0.36% for 10-year CDS and 0.74% for 1-year CDSs. Moreover, the PSPP coefficient (second derivative) is statistically significant only for the 10-year CDS: that is, for every additional 1 billion euros allocated to the PSPP, the 10-year CDS price declined, on average, by 0.15%. The R^2 for the 10-year and 1-year regressions are similar, at 30.8% and 32.5% respectively. The F-statistics are also similar at 66 for the 10-year regression and 65.91 for the 1-year regression. These figures confirm the robustness of the results.

3.5.2.4 MRO, LTRO, and TLTRO

We now turn to analysing the MRO, LTRO, and TLRTO. Since the MRO has been less used since the start of the LTRO and later the TLTRO and QE programmes, we divide the sample into three different sub-periods: January 2009-December 2011 (first period); January 2012 to December 2014 (second period); January 2015 to February 2018 (third period). The primary findings are that the LTRO/TLTRO programmes did not reduce CDS prices, while the MRO programme had a limited (though statistically significant) effect.

Table 3.8: Regression analysis on the effects of the ECB's policies, breaking down the LTRO/TLTRO, and MRO programmes, Jan. 2009- Dec. 2014

LTRO/MRO	Jan. 2009- Dec. 2011		Jan. 2012- Dec. 2014	
Explanatory Variables	CDS10Y	CDS1Y	CDS10Y	CDS1Y
1-week Euribor (change)	24.21***	23.69***	16.83**	12.54
LTRO/TLTRO (change)	0.006	0.002	-0.015***	-0.026***
MRO (change)	0.039**	0.077***	-0.083***	-0.12***
Constant	-6.91***	-11.40***	2.07	6.03***
Number of Obs.	2,232	1,980	2,232	1,980
Number of Firms	62	55	62	55
R^2	0.376	0.470	0.389	0.513
F-stat	139.96	193.80	138.76	214.93

Control variables includes: Stoxx600 volatility(level), and first difference of each of Euro index volatility (EVZ), Stoxx600, inflation of EU19, Euro and spread of the 10y-3m bond yield.
Note: Balanced, random effects (firms) OLS regressions. *p<0.1, **p < 0.05, and ***p < 0.01.

Table 3.9: Regression analysis on the effects of the ECB's policies, focusing on the TLTRO programme, Jan. 2015- Feb. 2018

TLTRO	Jan. 2015- Feb. 2018	
Explanatory Variables	CDS10Y	CDS1Y
1-week Euribor	35.10***	50.72***
ECB Assets Sans LTRO (change)	0.042***	0.032
TLTRO (change)	0.025**	0.013
Constant	11.90***	18.85***
Number of Obs.	2,356	2,090
Number of Firms	62	55
R^2	0.304	0.313
F-stat	78.27	77.36

Control variables includes: Stoxx600 volatility(level), and first difference of each of Euro index volatility (EVZ), Stoxx600, inflation of EU19, Euro and spread of the 10y-3m bond yield.
Note: Balanced, random effects (firms) OLS regressions; *p<0.1, **p < 0.05, and ***p < 0.01.

During the first period (Table 3.8), only the MRO's coefficients are significant, albeit positive, suggesting they did not lower CDS prices. Conversely, in the second period, the coefficients for MRO and LTRO turn negative and significant, as the ECB allowed the programmes to phase out. The negative coefficients suggest that as MRO and TLTRO contracted, credit risk premia rose; for the 10-year CDSs, for every 1 billion euros eliminated from the LTRO or MRO, CDS prices declined, on average, by 0.015% and 0.083% respectively. Another interesting result is the fact that the MRO and LTRO programmes appear to have had a significantly stronger impact on 1-year than on 10-year CDSs.

Moreover, the R^2 for sub-periods are much higher for 1-year CDSs than for 10-year CDSs. Finally, during the third period (Table 3.9), when the ECB used QE and TLTRO, the TLTRO did not reduce corporate credit risk. Although the regressions have R2 that indicate robustness (0.304 for 10-year CDS and 0.313 for 1-year CDS), they show that the TLTRO was not effective in lowering credit risk premia.

3.5.2.5 A cross-country analysis

In this sub-section, we divide companies according to their country of origin[34]: Germany, France, Italy, and Spain. At first glance, the country categorization does not have any added value beyond our baseline model. However, once we introduce a more detailed deconstruction of the ECB's policies related to its balance sheet, i.e., QE, LTRO, and MRO, several insights emerge. During the crisis years, the ECB's LTRO and MRO programmes appear primarily to affect German and French companies. During this sub-period (Table 3.10), we find that the LTRO programme appears to have a weak impact mainly on Spanish and Italian companies. Specifically, for every 1 billion euro the ECB allocated to the LTRO programme, Italian companies' 10-year CDS premia rose on average by 0.03% and 1-year CDSs by 0.05%.

[34] This is based on the location of these companies' head office. For the 10-year CDS price analysis, 58 companies were included (out of 62 companies in total in the data set) and for the 1-year CDS price analysis, a total of 52 companies were included out of 55. The companies not included were located in countries other than the four countries listed above.

Table 3.10: Regression analysis on the effects of the ECB's policies, breaking down the LTRO/TLTRO, and MRO programmes, and controlling for country of origin, Jan. 2008- Dec. 2012

CDS10Y & CDS1Y, percent change	All series		Germany		France		Italy		Spain	
Jan. 2008- Dec. 2012										
Explanatory Variables	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y	CDS10Y	CDS1Y
1-week Euribor (change)	12.91***	12.72***	11.67	10.28	15.34***	16.36**	6.55	12.22	10.75	0.48
LTRO (change)	0.013***	0.014**	0.10	0.008	0.008	-0.0009	0.03*	0.047**	0.022	0.065***
MRO	-0.02***	-0.01	-0.038**	0.005	-0.038***	-0.33	0.04	0.086	-0.011	0.178***
Constant	-11.91***	-22.11***	-14.38***	-26.07***	-10.67***	-23.58***	-11.44**	-15.15***	-10.41**	-10.30*
Number of Obs.	3,658	3,245	885	885	1,770	1,534	354	354	413	295
Number of Firms	62	55	15	15	30	26	6	6	7	5
R^2	0.456	0.556	0.470	0.588	0.457	0.572	0.403	0.514	0.475	0.563
F-stat	308.57	424.05	81.77	130.65	152.91	203.48	23.35	39.71	28.07	40.26

Control variables includes: Stoxx600 volatility(level), and first difference of each of Euro index volatility (EVZ), Stoxx600, inflation of EU19, Euro and spread of the 10y-3m bond yield. Note: Balanced, random effects (firms) OLS egressions; *p<0.1, **p < 0.05, and ***p < 0.01.

Conversely, mostly French and Germany companies' CDSs reacted to the MRO programme. In particular, for every 1 billion euro the ECB allocated to the MRO, the CDS premia of French or German companies fell on average by 0.04% for 10-year CDSs. Therefore, while the ECB assets coefficients in Table 3.2 are positive in the crisis years, the results in Table 3.10 suggest that this positive effect was mostly concentrated in Spanish and Italian companies, and that the MRO programme lowered prices only slightly. However, these results also demonstrate that these programmes had a limited impact on CDSs.

The results also indicate that the 1-week Euribor mostly affected French companies' CDSs: For every one percentage point decline in the 1-week Euribor, the 10-year CDSs of French companies fell on average by 15.34%. Similar results are also found for 1-year CDSs.

Finally, we analyse the various asset purchase programmes in the same way as in sub-section 3.5.2.3 for the QE years (see Table 3.7). However, here we focus on the PSPP, which is the essential programme and accounts for nearly half of the ECB's total balance sheet[35]. We find that the R^2 for Spanish and Italian CDS regressions are seven to ten percentage points higher than the German and French CDS regressions. Moreover, only in the Spanish CDS regressions are the coefficients negative and significant: for every billion euros of Spanish sovereign bonds purchased via the PSPP, CDSs of Spanish companies declined, on average, by 1.64% for 10-year CDSs and 1.74% for 1-year CDSs. This finding suggests that during the QE years, the PSPP primarily affected Spanish companies' CDS prices.

3.5.2.6 Market capitalization

To investigate whether the ECB's policies affect firms with small and large market capitalization in different ways, we divide our sample into two groups

[35] Because under the PSPP, the ECB purchases EMU countries' sovereign debt, this allows us to examine how this country-based allocation affects CDS prices of companies from different countries.

based on market capitalization[36] at the 20-billion-euro mark[37]. The results (not shown here to save space) suggest no significant differences between the two groups[38].

3.5.2.7 Credit rating

Finally, we also test the explanatory power of the firms' credit ratings[39]. Krylova (2016) shows that in the pre-crisis era, those rating effects were the primary catalyst in moving corporate bond spreads. Based on their credit rating, we divide firms into investment-grade and speculative-grade as reported by leading credit agencies[40]. We find that most of the differences between the two groups occur during the crisis-years (2008-2012)[41]. In particular, for every one percentage point decline in the 1-week Euribor, the CDS prices of speculative-grade NFCs tended to rise, on average, by 27.34%; conversely, CDS prices of investment-grade NFCs tended to decline, on average, by 6.88%.

Moreover, the expansion of the ECB's balance sheet appears to have had a stronger effect on speculative-grade companies than on investment grade. However, after 2012, the results do not differ significantly between the two groups. Therefore, during the crisis years, investment-grade companies

[36] Based on the market capitalization as of the end of 2018.
[37] We mark companies with market capitalization or higher as "large caps"; companies with a market capitalization below 20 billion euros as "medium caps".
[38] This outcome could also be, in part, due to the cutoff point we have chosen. However, after investigating other cutoff points and also creating a variable for the market capitalization, we could not find any added value for this division. In other words, the results show that a large-scale market-capitalization firm did not appear to react differently to the ECB's policies compared with medium and small size market-capitalization firms.
[39] Based on the most recent credit rating of each firm as of the end of 2018. This time we focus only on the 10-year CDSs.
[40]To be considered an investment grade issue, the company must be rated at 'BBB' or higher. Any rating below this 'BBB' rating is considered non-investment grade. If the company or bond is rated 'BB' or lower it is known as junk grade, in which case the probability that the company will repay its issued debt is deemed to be speculative. We rely mainly on the credit rating of Moody's recent ratings. Some companies did have changes in their credit rating over the period; however, most of the companies that were rated "investment grade" remained in this status throughout the period.
[41] The results regarding the impact of credit rating are not shown here to save space.

appear to have benefited more from the ECB's simulative policies than speculative-grade companies.

3.6 Concluding remarks

This chapter seeks to assess the effect of the ECB's monetary policies on NFCs' CDS prices. To that end, we exploit a rich dataset that allows us to study questions as yet unanswered in the literature. We find that the immediate effects of the ECB's QE and TLTRO policy announcements were statistically and economically significant, and that these effects were more lasting than those of the interest rate policy announcements in the days following the policy decision. Moreover, the QE announcements continued to revise market expectations even after the main asset purchase programmes (PSPP) started in March 2015. This result suggests that even since the ECB started its major asset purchase programmes, market expectations were still being revised and might be updated as they continued to be affected by these policies in the immediate-term.

The results of our monthly data analysis revealed that during the crisis years (2008-2012), the ECB's interest rate policies lowered CDS premia only after controlling for the Federal Reserve's monetary policy. However, in 2013-2014, the ECB's interest rates policies do not appear to have affected CDS prices, while its balance sheet contraction appears to have had an adverse effect. After the start of the QE programmes, the low-interest-rate environment and several of the ECB's programmes (mainly the PSPP and CSPP) seem to have reduced the credit premia somewhat. Nonetheless, the MRO, LTRO/TLTRO, and the QE programmes appear to have had a limited effect overall on bringing down CDSs.

We find that Spanish companies reacted more favourably to the PSPP stimulus than companies in other countries. Since the ECB allocates its funds to the PSPP based on a country's size rather than on its needs, this result suggests that if this allocation rule were to change, the transmission

mechanism might be able to reduce credit spreads more efficiently. Finally, one notable finding is that the lack of monetary stimulus (mainly in periods of 2011 and 2013) adversely affected credit conditions, while the abundance of the monetary stimulus in other years did not necessarily ease credit risk concerns. This asymmetrical market response may foreshadow the challenges the ECB may face in a future downturn.

Appendix C: List of the ECB's policy announcements

Rate Decisions	
5 June 2014	Cut the deposit rate to -0.1
10 Sep. 2014	Cut the deposit rate to -0.2; and the MRP to 0.05
3 Dec. 2015	Cut the deposit rate to -0.3
10 Mar. 2016	Cut the deposit rate to -0.4; and the MRP to 0
Asset purchase programmes	
5 June 2014	The first mention in the ECB statement of ABSPP
4 Sep. 2014	The first mention in the ECB statement of CBPP3
2 Oct. 2014	Provide further details on ABSPP and CBPP3
4 Dec. 2014	Start the ABSPP; a hint of more QE to follow in the coming months
22 Jan. 2015	Announce the start of the PSPP
5 Mar. 2015	Provide further detail on PSPP
3 Sep. 2015	Raise the issuer share limit from 25% to 33% for PSPP
3 Dec. 2015	Extend PSPP to end of March 2017
10 Mar. 2016	Expand QE from 60b € to 80b € a month
8 Dec. 2016	Lower QE from 80b € to 60b € starting in Apr. 2017 through Dec. 2017
TLTRO 1 and 2	
5 June 2014	The first mention of series of TLTRO in the ECB statement
3 July 2014	Announce further details of the TLTRO
29 July 2014	Define the conditions for participation in the TLTRO
4 Dec. 2014	Announce that "Next week, we will conduct the second targeted longer-term refinancing operation."
22 Jan. 2015	Modify the interest rate applicable to TLTRO
10 Mar. 2016	Announce a new series of TLTRO II
21 Apr. 2016	Announce the start of TLTRO II in June 2016
3 May 2016	Publish legal acts on the TLTROII
31 Oct. 2016	Publish small amendments to the TLTROII

Appendix D: Description of variables and data sources

Variable	Description	Source
CDS10Y	Credit default swap spread for 10-year notes for non-financial firms	Bloomberg
CDS1Y	Credit default swap spread for 1-year notes for non-financial firms	Bloomberg
Spread between 10-year EA government bond and 3-months Euribor	The gap between the weighted average yield of a 10-year of EMU governments note and 3-months libor in euros	Eurostat and Fred
The ECB's total assets	Total assets on the ECB's balance sheet (in trillions of euros)	FRED
1-week Euribor rate	The weighted average rate of a 1-week libor in euros	FRED
10-year EA government bond	The weighted average yield of a 10-year of EMU governments note	Eurostat
1-year EA government bond	The weighted average yield of a 1-year of EMU governments note	Bloomberg
CSPP	Corporate sector purchase programme, billions of euros	The ECB
PSPP	Public sector purchase programme, billions of euros	The ECB
ABSPP	Asset-backed securities purchase programme, billions of euros	The ECB
CBPP3	Covered bond purchase programme 3, billions of euros	The ECB
Inflation EU19	Monthly changes in the rate of growth of the Harmonized Index of Consumer Price in EMU (HICP)	Eurostat
Stoxx600	Price of the Stoxx600 index	Bloomberg
Volatility of Stoxx600	Indicates near term and long-term volatility of the Stoxx600	Bloomberg
EVZ	Euro Currency Volatility Index or Euro VIX, which measures the market's expectation of 30-day volatility of the Euro/dollar exchange rate	CBO
Euro/USD	Euro/dollar exchange rate	FRED
Small Cap.	Dummy variable, 1= companies with market cap. below $20 billion, 0= companies with market cap. above $20 billion (as of December 2018)	Bloomberg/Authors' calculations
Large Cap.	Dummy variable, 1= companies with market cap. above $20 billion, 0= companies with market cap. below $20 billion (as of December 2018)	Bloomberg/Authors' calculations
Credit rating	Dummy variable, 1= for investment-grade rating, 0=non-investment grade (ratings as of December 2018)	Bloomberg/Moody's

Appendix E: List of the ECB's QE programmes

The ECB's QE programmes, as of Dec. 2018 (billions of euros)		Percent of total the ECB's assets*
CBPP3	262.2	5.6%
ABSPP	27.5	0.6%
CSPP	178.1	3.8%
PSPP	2,171.2	46.5%

*The value of the ECB's total assets was 4,669 billion euros as of December 2018.

Chapter 4 – Bang for the QE buck: Examining the impact of ECB's corporate bond purchases on firms' credit risk, debt and investment

4.1 Introduction

Since the 2008 global financial crisis, interest rates have remained persistently low and investments subdued in the developed world. In Europe, this environment has become more pernicious since the 2012 debt crisis. In response, the European Central Bank (ECB) slashed short-term rates below the zero-lower bound (ZLB) and utilized unconventional monetary policies[42]. One of these unconventional policies is the corporate sector purchase programme (CSPP)[43], announced on March, 10th 2016, started on June 8th, 2016, and ended by December 19th, 2018. Under this programme, the ECB purchased 178 billion euros worth of corporate bonds[44].

This chapter assesses the CSPP's short-term and long-term impact on corporate bonds, borrowing costs, and non-financial corporations (NFCs) decisions on capital structure and allocation. Towards this end, we use a unique dataset of European NFCs' bond data, and corporate financial variables to advance the understanding of the CSPP's transmission mechanism.

[42] Eggertsson and Woodford (2003) conclude that to avoid a recession when interest rates reach the ZLB, unconventional monetary policy is required.
[43] Throughout this chapter we use the terms CSPP and quantitative easing or QE, and asset purchase programme interchangeably always referring to the corporate sector purchase programme.
[44] For further details on the CSPP, please see Appendix F.

The transmission mechanism of an asset purchase programme to the real economy may operate via several channels, such as signaling safety, inflation, and duration risk channels[45]. Herein, we focus on liquidity risk and default risk channels. To test them, we use corporate bonds' scaled bid-ask spread for the liquidity risk channel, and zero-volatility spread (Z-spread), nominal spread (G-spread), and corporations' debt covenants for the credit risk channel. We compare bonds that were purchased under the CSPP (targeted bonds) relative to other European bonds that the ECB did not buy (non-targeted bonds).

This chapter stands out from the existing literature in at least three aspects: First, it sheds light on the CSPP's short-term and long-term effect on corporate bonds' risk premia. Second, it assesses the impact on corporate bonds' liquidity costs. Third, to the best of our knowledge, this is the first attempt to investigate the CSPP's long-term impact on firms' borrowing costs and corporate decisions on debt, capital spending, and dividends. Since companies make decisions on capital structure and allocation – and especially on investments – on a yearly or multiyear basis, a long-term perceptive is required to ascertain the CSPP's impact.

We find that following the CSPP announcement targeted corporate bonds' Z-spread, and G-spread declined by 3.5 basis points (2.6%) and 4.1 basis points (4.2%), respectively. Despite this initial reaction, it did not last. Throughout the CSPP's implementation from June 2016 to December 2018, it only slightly lowered bonds' risk premia and did not affect corporate bonds' liquidity risk. These findings suggest that while the credit risk channel in the bond market may have worked initially, it did not have an economically significant lasting effect. A corporate short-term data analysis reveals the CSPP encouraged firms to borrow as their overall debt initially rose (based on data for 2015Q4-2017Q1). Moreover, firms used the added liquidity to pay dividends, but not to increase capital spending. However, a long-term analysis (2016Q1-2019Q3) shows the CSPP did not stimulate borrowing –

[45] For further details see Vissing Jorgensen and Krishnamurthy (2011).

although it reduced the firms' cost of debt; it improved some debt covenants (e.g., Debt-to-EBITDA), and encouraged firms to raise capital spending. Surprisingly, while the CSPP did not have a lasting effect on corporate bond spreads, it had an economically significant impact on easing corporate credit risk – based on corporate debt covenants – reducing the cost of debt, and raising investment spending.

The remainder of the chapter is organized as follows: Section 2 briefly reviews previous literature on this subject. Section 3 introduces the data used. Section 4 describes the econometric methodology employed in the empirical analysis. In Section 5, we present the empirical results, and in Section 6, we make some concluding remarks.

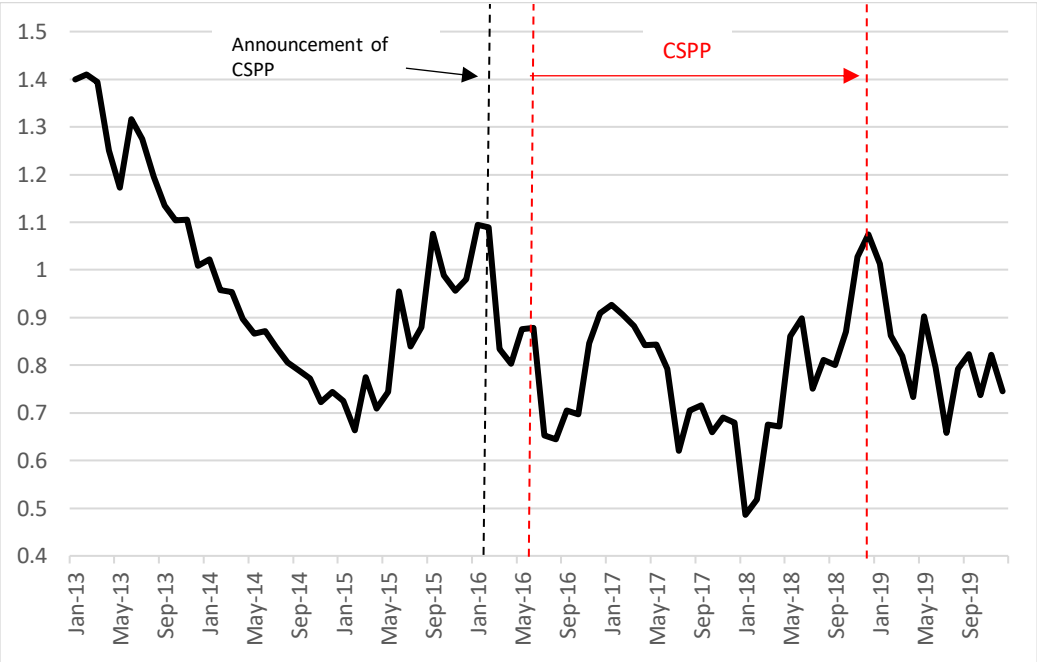
4.2 The effect of corporate purchase programmes – related literature

A couple of papers were recently published about the CSPP by Todorov (2020) and Zaghini (2019). Todorov examines the immediate impact of the CSPP on bond yields, liquidity costs, and companies' decisions around the time of the CSPP announcement and its starting date. Todorov shows that the CSPP was effective in reducing bond yields and liquidity costs in the short-term. However, analyzing corporate bond yields may lead to endogeneity issues because corporate bond yields are also affected by local and global interest rates and other unconventional monetary policies (e.g., public sector purchase program or PSPP). Some of these issues could be mitigated by examining corporate bonds' risk premia as we do here. Zaghini (2019) finds that this program had a significant effect on targeted corporate bond yield spreads in the short-term (between June 2016 and June 2017) by utilizing quarterly data of asset-swap spread. Whereas herein, we use monthly and daily data of Z-spread and G-spreads – two different measurements of corporate credit risk. These papers focus on the CSPP's short-term effect on

corporate bonds and not its lasting long-term effect; they also do not control for other monetary policies[46] or external shocks[47].
In this chapter, we aim to fill this gap in the literature by addressing these issues.

To demonstrate the ambiguity in the data over the CSPP's lasting effect, Figure 4.1 shows the difference between European corporate bond yield and the German government yield (5 years). As shown, despite the decline in the spread in early 2016, it rose in 2017 and during parts of 2018.

Figure 4.1: Spread of 5 yr. Europe's corporate investment-grade over 5 yr. generic German bunds 2013-2019



Source of data: Bloomberg. (black dotted line—first announcement of the CSPP, red dotted lines, the period in which the CSPP was executed).

[46] Some of these policies include the PSPP and the targeted longer-term refinancing operations or TLTRO; the TLTRO aimed to provide banks with loans that targeted households and non-financial firms. The ECB introduced two series of TLTRO, the first on June 5, 2014, and the second on March 10, 2016.
[47] Some of these shocks include the U.K. referendum to leave the European Union and changes to the Federal Reserve's monetary policy.

Arce *et al*. (2017, 2018) and Abidi and Ixart (2018) focus their analysis on the CSPP's impact on Spanish companies' bond yields, corporate bond issuance, and bank lending channel. Whereas herein, we expand the research to all European firms and focus on bond spreads rather than yields.

Borio and Zhu (2012) analyze a critical channel for the transmission of monetary policy – the risk-taking channel. According to Borio and Zhu, rising market liquidity (due to asset purchase programs and central bank loans) and low real interest rates may lead banks to lend to small and medium-sized enterprises (SMEs) that otherwise are not able to issue bonds. Bartocci *et al*. (2017) find that the CSPP raised bank lending to the non-financial sector. However, in their paper, they mostly focus on quantitative easing (QE)'s impact on macroeconomic variables (e.g., GDP, inflation). Grosse-Rueschkamp *et al*. (2019), demonstrate that companies whose bonds were eligible under the CSPP lowered their bank loan holdings in exchange for borrowing in the bond market. A report by the European Commission[48] also finds firms whose bonds were eligible under the CSPP issued bonds in exchange for bank loans. According to Grosse-Rueschkamp *et al*., because targeted firms (firms whose bonds the ECB purchased) swapped their bank loans for bonds, banks started to offer riskier loans to ineligible firms under the CSPP, including SMEs. As a result, the liquidity of non-targeted firms (firms whose bonds the ECB did not purchase), mostly SMEs, improved. Moreover, the CSPP reduced non-targeted firms' bond yields. Arce *et al*. (2018) reach a similar conclusion for Spanish companies; they also conclude that the CSPP may have "crowded in" bank loans to SMEs because of banks' higher liquidity and softer demand for loans from targeted firms. In this process, banks raised their leverage and sought out higher risk (see also Dell'Ariccia *et al*. (2014), and Jiménez *et al*. (2014)). In short, this asset purchase program may have led to an adverse selection for banks offering loans to riskier companies. Montagna and Pegoraro (2019) point out another aspect of risk-taking is in the bond market: The CSPP led to a short-term rally of bond prices for firms that were exposed to higher risk; nonetheless, these firms did not raise their leverage.

[48] European Commission, November 2017.

One of CSPP's goals is to stimulate corporate investment. By reducing debt costs, firms' cost of capital should decline, while their profitability, all things equal, should improve along with their return on investment. In turn, these developments should encourage firms to raise investment spending[49]. As for evidence for the impact of the CSPP (or other purchase programs) on investments, the literature shows mixed results: Arce *et al*. (2018) find that Spanish firms' investment spending rose because of the CSPP. Ferrando *et al*. (2019) also show that the CSPP improved firms' investment as do Demertzis and Wolff (2016), albeit at the cost of reducing banks' profitability. Cohen *et al*. (2019) conclude that QE stimulated corporate investments over the long-term. Conversely, Todorov (2020) does not find evidence that the CSPP improved firms' investments (research and development), in the short-term, and Acharya *et al*. (2019) show that firms that received bank loans from the outright monetary transactions (OMT) did not invest more but rather hoarded cash.

As for other central banks' corporate purchase programs, several papers show the Bank of England (BoE)'s program was effective in lowering UK firms' bond spreads (see Belsham *et al.* (2017), Boneva *et al.* (2018), and Weale and Wieladek (2016)), improving liquidity of corporate bonds (see Boneva *et al*. 2019), and encouraging corporate bond issuance (see D'Amico and Kaminska (2019)).

4.3 Data and descriptive statistics

Firms and bond data were obtained from Bloomberg. We focus on firms whose bonds (identified by ISIN) the ECB purchased via the CSPP. However, the data also include bonds not purchased by the ECB, as a control

[49] Choi *et al.* (2016) identify two potential inefficacies that could arise from stimulative monetary policy, "investment inefficiency" – where low productive firms ramp up investments – and "hoarding inefficiency" – where high productive firms hoard cash.

group[50]. This group also evaluates the QE's spillover effect into other corporate bonds. All bonds are denominated in Euro.

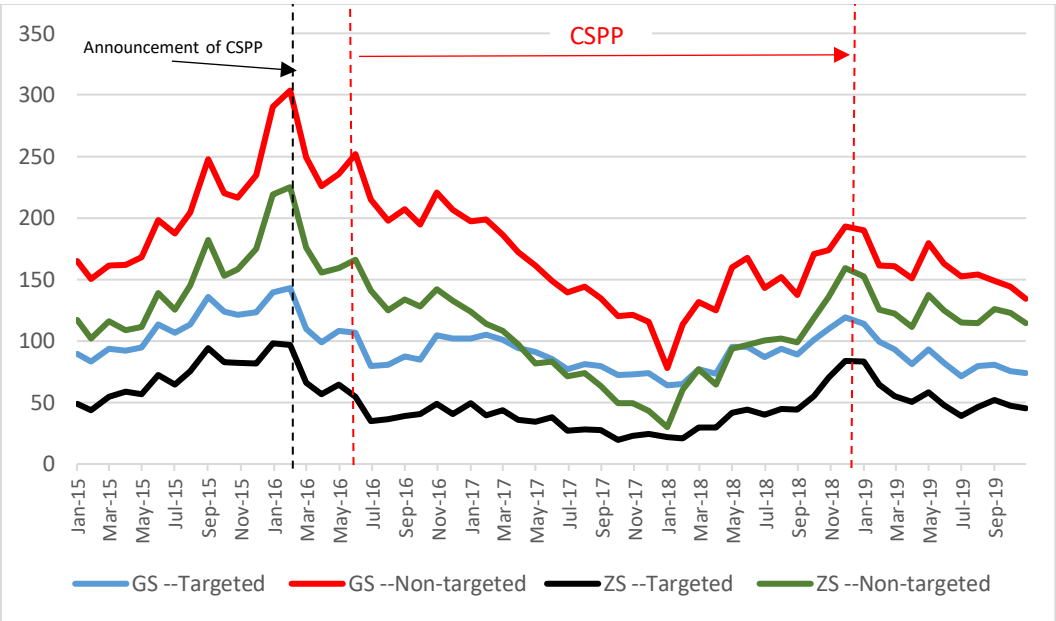
For the daily analysis, we collected data on two bond spreads, the Z-spread and the G-spread. These spreads measure the risk premium the market prices for holding corporate bonds over the risk-free rate, i.e., they estimate corporate credit risk premium. Specifically, the Z-spread calculates the difference between all future corporate discounted cash flow from a bond and the euro interbank offered rate (Euribor) over the entire yield curve, whereas the G-spread is a simple difference between corporate bond yield and the interbank euro rate.
The sample period is from March 1st, 2016, to August 1st, 2016. For the G-spread and Z-spread, we gathered data on 979 and 1,015 bonds, respectively. Of these bonds, 643 and 651 bonds, respectively, were purchased by the ECB (targeted bonds), and 336 and 364 bonds were not purchased (non-targeted bonds).

For the monthly analysis, in addition to the above-mention spreads, we added the scaled bid-ask spread – the difference between the bid and ask prices divided by the mid-price (BA=$\frac{Ask-Bid}{Mid}$). This spread estimates the changes in trading costs of corporate bonds, i.e., it serves to identify the CSPP's liquidity risk channel.

The monthly analysis is from June 2016 to December 2018[51]. For the scaled bid-ask spread, G-spread, and Z-spread, we gathered data on 1,397, 1,277, and 1,601 bonds, respectively, of which 986, 910, and 1,088, respectively, were targeted bonds and 411, 367, and 513 were non-targeted.

[50] We specifically use the term "purchased" and not "eligible" because some bonds in the control group may have been eligible but the ECB did not purchase. This way, we can determine whether firms' bonds that were bought by the ECB were affected more than bonds – some of which may be eligible – that were not purchased.
[51] Incudes end of the month data on bonds.

Figure 4.2: Average G-spread (GS) and Z-spread (ZS) of targeted bonds and non-targeted bond by the CSPP 2015-2019 (basis points)

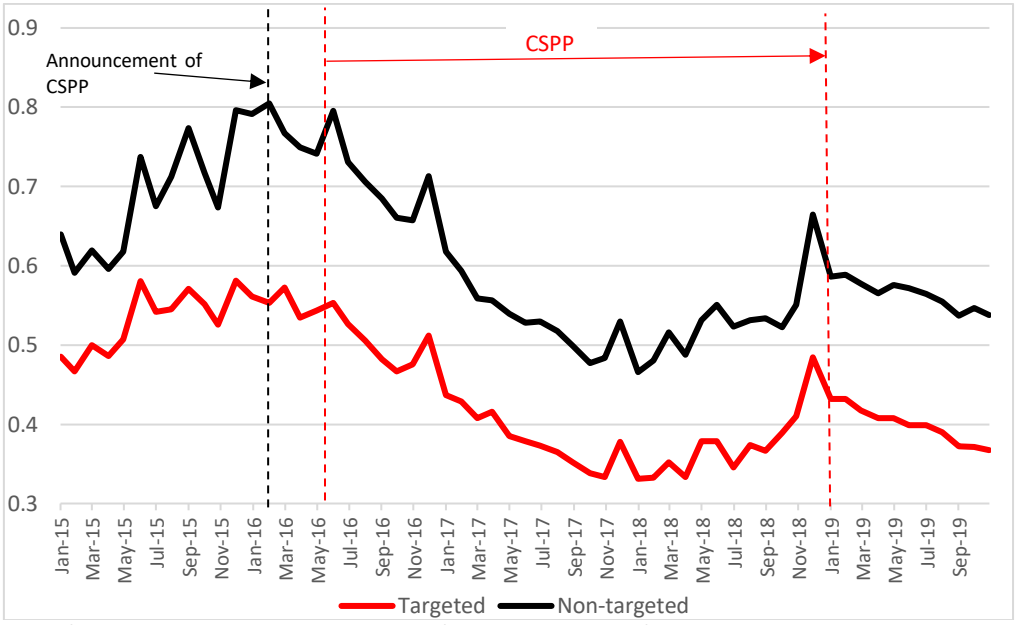


Source of data: Bloomberg (black dotted line—first announcement of the CSPP, red dotted lines, the period in which the CSPP was executed).

In Figure 4.2, the G-spread and Z-spread of targeted and non-targeted bonds declined until early 2018 before they started to rise throughout most of 2018 only to fall again in 2019.
Figure 4.3 presents the scaled bid-ask spread. The figure shows a similar pattern of falling spreads throughout most of 2017-2018 for all bonds, followed by a rise in the second half of 2018.

The corporate variables analyzed are capital spending, dividends, shareholder yield, cash, and short-term investment holdings, total debt, long term debt, cost of debt, and net interest expense. The corporate ratios examined are capital spending-to-revenue, cash and short-term investment-to-assets, current ratio, dividend-to-revenue, debt-to-asset, long term debt-to-debt, debt-to-EBITDA, and net interest expense-to-debt. Variables names and their sources are in Appendix G.

Figure 4.3: Average scaled bid-ask spread for targeted and non-targeted bonds, 2015-2019



Source of data: Bloomberg (black dotted line—first announcement of the CSPP, red dotted lines, the period in which the CSPP was executed).

The data on corporations[52] are quarterly. We included a short-term analysis from 2015Q4 to 2017Q1 to assess the CSPP's immediate impact on corporate decisions. For the corporate data long-term analysis, the period tested is 2016Q1-2019Q3[53]. A broader view is required to assess the impact of the CSPP on firms' decisions on debt, investment, and dividends that tend to be made over extended periods, taking several quarters or even years. For these analyses, we excluded financial firms, private firms, and quarters with missing data. After making these exclusions, 149 firms remained whose bonds were purchased by the ECB (targeted firms). For the control group, we collected data on publicly traded European non-financial firms that did not issue bonds or whose bonds were not purchased by the ECB (non-targeted firms). We tried to match market capitalization and industry to the targeted firms' characteristics. In the end, we collected data on 186 NFCs. In total, the

[52] As for subsidiaries whose primary purpose is financing the parent company's operations, we used the parent company's data.
[53] To control for companies' heterogeneity, we included firms' characteristics of country of origin, credit rating, and industry.

data set comprises of 335 NFCs. Table 4.1 presents the central tendency and dispersions of the dependent and control variables.

Table 4.1: Summary statistics of main variables

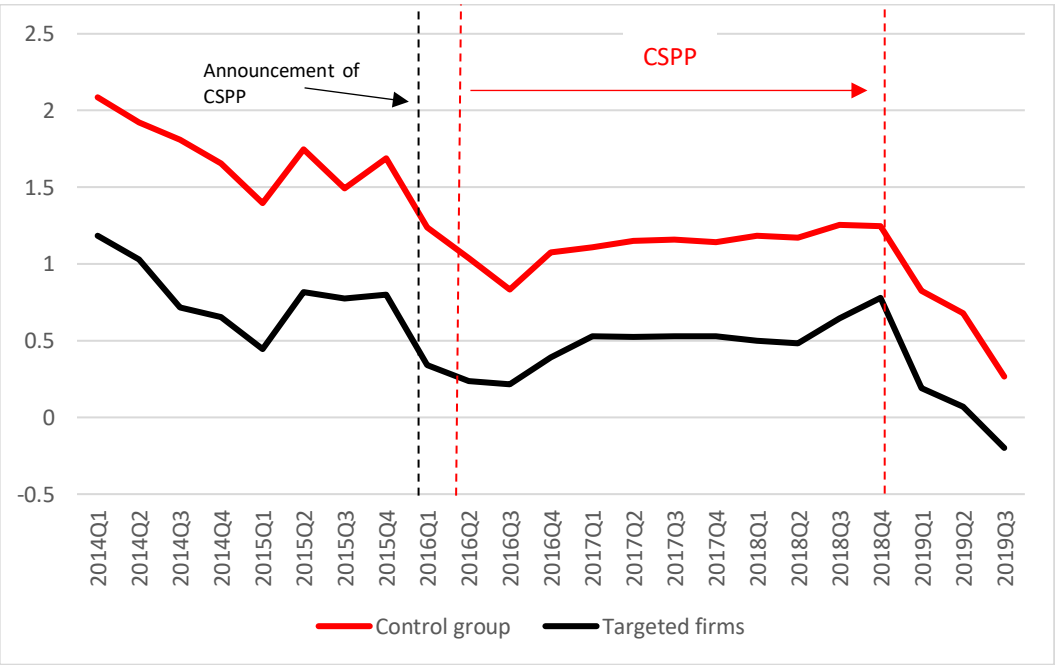
	Min		Max		Median		Mean		Std. Dev.		Bond-Day Obs.	
Panel A: Daily Variables												
	Target	Control	Target	Control	Target	Control	Target	Control	Target	Control	Target	Control
Z-spread(basis points)	-15.54	-1,988	612.88	1,641	43.73	102.78	58.71	168.38	56.62	254.26	71,371	39,490
G-spread (basis points)	26.21	-1,965	649.81	1,678	84.39	145.91	99.22	208.83	56.66	253.29	70,493	36,724
Panel B: Monthly Variables												
	Min		Max		Median		Mean		Std. Dev.		Bond-Month Obs.	
	Target	Control	Target	Control	Target	Control	Target	Control	Target	Control	Target	Control
Z-spread (basis points)	-1,182	-4,779	3,537	4,321	25.81	68.42	38.41	99.92	59.69	249.59	29,625	13,089
G-spread (basis points)	-1,249	-4,736	3,383	3,964	76.99	130.98	89.01	159.27	60.44	262.83	26,421	10,754
Bid-Ask spread (%)	0.00	0.00	3.96	3.71	0.36	0.50	0.40	0.57	0.24	0.37	28,042	11,515
Panel C: Quarterly Variables												
	Min		Max		Median		Mean		Std. Dev.		Firm-Quarter Obs.	
	Target	Control	Target	Control	Target	Control	Target	Control	Target	Control	Target	Control
Capital Spending -to-Revenue (%)	0.00	0.00	232.00	244.00	6.09	4.40	14.30	13.20	50.70	26.41	1,969	2,326
Dividend-to-Revenue (%)	0.00	0.00	196.00	219.00	4.90	4.70	14.12	12.19	24.79	20.40	1,207	1,390
EBITDA-to-Revenue (%)	-64.30	-165.0	714.00	585.00	17.90	17.44	35.89	23.43	67.65	29.90	2,124	2,570
Debt-to-EBITDA (%)	-177.8	-115.2	198.38	273.03	8.80	6.64	11.40	10.18	15.35	17.00	2,065	2,398
Cash-to-Assets (%)	0.00	0.00	44.10	47.04	5.60	6.44	6.80	8.30	5.22	7.55	2,121	2,629
Debt-to-Assets (%)	0.00	0.00	74.90	80.79	30.76	25.95	31.11	27.61	12.75	17.94	2,127	2,639
Current ratio (ratio)	0.00	0.00	172.08	247.85	1.02	1.61	2.94	7.14	10.32	21.00	2,081	2,309
Long term Debt-to-Debt (%)	0.00	0.00	100.00	100.00	80.62	81.84	77.63	73.93	17.17	26.12	2,124	2,582
Net Interest Exp.-to-Debt (%)	-4.62	-29.74	12.15	13.85	0.96	0.99	1.05	0.83	2.23	9.25	1,081	1,144
Cost of debt (rate)	-0.79	-0.99	14.18	13.75	0.45	0.50	0.60	0.78	1.02	1.20	2,046	2,574
Shareholder yield (rate)	-52.52	-59.77	67.07	71.47	2.62	1.88	1.66	1.50	11.14	11.32	1,856	2,204
Total Assets (millions of euros)	103.0	0.0	489,715	336,287	19,139	6,613	43,790	18,675	66,149	38,520	2,127	2,641
Total Debt (millions of euros)	2.2	0.0	202,513	89,085	4,638	1,799	13,687	5,027	24,535	9,809	2,124	2,582
Long term Debt (millions of euros)	1.0	0.0	95,230	76,772	3,626	1,440	9,230	4,270	14,253	8,655	2,092	2,476
Revenue (millions of euros)	0.9	0.6	97,453	89,017	3,724	1,300	8,512	3,905	12,876	7,882	2,128	2,571
Capital Spending (millions of euros)	1.0	0.0	3,919	3,974	212	70	477	230	1,006	471	1,954	2,403
Dividend (millions of euros)	0.0	0.0	5,132	3,624	180	87	498	264	793	514	1,195	1,459

Panel A presents summary statistics for the daily-level panel for the bonds that were purchased by the ECB ("targeted") and bonds that were not purchased ("control"). Panel B presents the summary statistics of monthly variables. Panel C presents the summary statistics of quarterly variables. All variables in panel C are calculated as weighted averages of the total assets of each firm; Observations are for firm-day, firm month, and firm-quarter for the respective timeframes; The period for each Panel A, B, and C is from March 1st, 2016 to August

1st, 2016, June 2016-December 2018, and 2016Q1-2019Q3, respectively. In some variables, there are missing data.

We also include herein a couple of figures to illustrate the developments in the sampled firms' borrowing costs and overall debt from 2014 to 2019. Figure 4.4 shows the average cost of debt[54] of targeted and control groups. The announcement of the CSPP appears to coincide with the decline in the cost of debt of targeted firms. However, the groups' borrowing costs did not move throughout 2017-2018 and only started to fall again in 2019.

Figure 4.4: Cost of debt of targeted and control groups in the sample (percentage point), 2014Q1-2019Q3

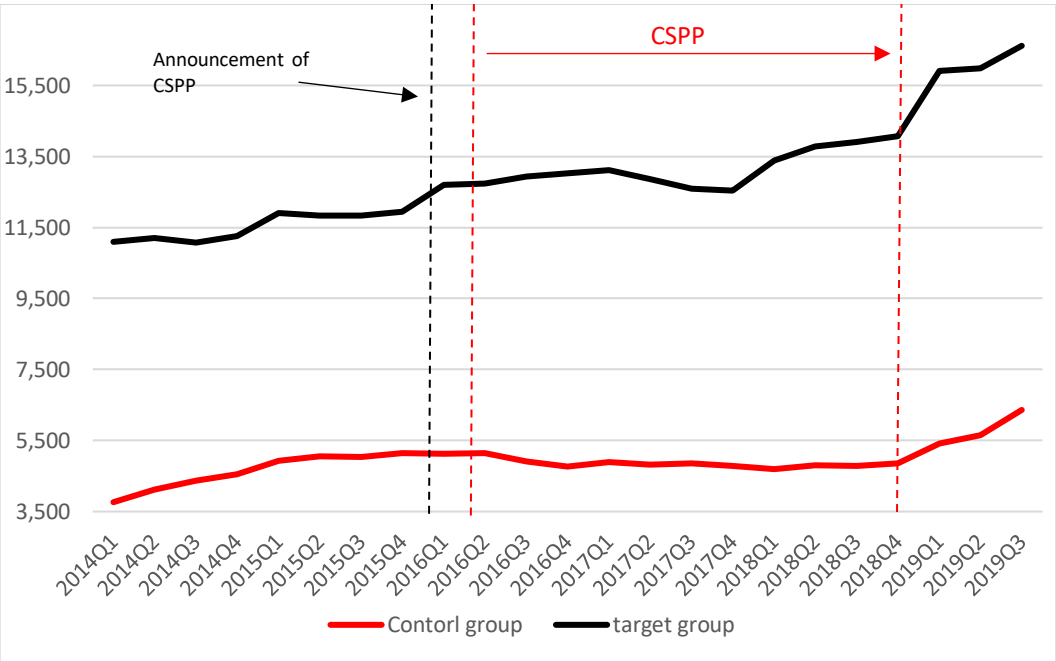


Source of data: Bloomberg (black dotted line—first announcement of the CSPP, red dotted lines, the period in which the CSPP was executed).

The debt of NFCs (see Figure 4.5) has not risen much throughout 2016-2017. Debt levels of targeted firms started rising in 2018 and for the non-targeted firms in 2019.

[54] The cost of debt is the weighted average cost of debt a firm pays. It is calculated using government bond rates, a debt adjustment factor, and a firm's proportions of short- and long-term debt to total debt. It is one of the components of the WACC.

Figure 4.5: Debt levels of targeted and control groups in the sample (millions of Euros), 2014Q1-2019Q3



Source of data: Bloomberg (black dotted line—first announcement of the CSPP, red dotted lines, the period in which the CSPP was executed).

4.4 Econometric methodology

In this section, we introduce the econometric methodology for examining the changes in bond spreads, and firms' decisions on debt, investments, and capital distribution.

The bond market analysis encompasses a set of regressors that include bond characteristics, bond issuers' creditworthiness, and market conditions. We selected the regressors based on the traditional factors affecting bond risk premium and liquidity cost[55]. We also controlled for the ECB's other monetary policies that have been implemented concurrently to the CSPP,

[55] Numerous papers were written on this subject. For further reading, see Elton *et al* (2001), Collin-Dufresne *et al* (2001), and for papers on the analysis of risk premium for euro-bonds see Sironi (2003) and Zagahini (2016).

such as the Public Purchase program (PSPP), and changes to short-term interest rates by including changes to ECB's balance sheet and 1-week Euribor.
Developments in monetary policies and political events outside the European Monetary Union (EMU) may have affected corporate bond spreads and firms' decisions: The Federal Reserve started tightening monetary policy in late 2015 by raising rates and then reducing its balance sheet. The Federal Reserve change in policies, which also diverted from ECB's policies at the time, may have had a spillover effect onto foreign financial markets (see Alpanda and Kabaca (2015), Albagli *et al.* (2019), and Gilchrist *et al.* (2018)). We aim to account for possible pass-through of the Federal Reserve's changes in monetary policy to European financial markets by using the Federal Reserve's shadow rate.

The Brexit vote on June 23rd, 2016 (in the same month the ECB started the CSPP) could have affected, even for a short-term, European corporate bond spreads. Therefore, we included the British pound's 30-day implied volatility for the short-term analysis, and the 30-day implied volatility of the Euro for the short-term and long-term analysis.

Two of the CSPP's transmission channels to corporate bonds are tested: Credit risk and liquidity risk. Companies' bonds carry a credit risk, which is priced as the premium over government bond[56]. As Blinder (2010) pointed, the rationale for central banks to use unconventional monetary policies such as quantitative easing is to shrink the interest rate spreads of corporate bond yields over risk-free treasuries. By doing so, companies' interest payments may decline. To identify this channel, we divide the analysis into the credit

[56] The identification of the risk premium of corporate bonds as the market price of default risk was first made by Fisher (1959).

risk premium as priced in the bond market and firms' credit risk[57] – as measured by debt covenants[58].
The CSPP's demand boost for corporate bonds should reduce not only corporate bond prices but also improve market liquidity and liquidity costs. For the liquidity risk channel[59], we focus on the cost of trading bonds – an essential aspect of market liquidity – by testing the QE's impact on the scaled bid-ask spread of corporate bonds. If the QE was successful in improving corporate bonds' liquidity, then the gap between the bid and ask prices should have contracted and should have reduced the trading cost of corporate bonds. We also examine the CSPP's effectiveness in influencing firms' corporate decisions on debt, investment, and capital distribution. Here too, we use data on targeted firms and non-targeted firms as a control group.

In sub-section 4.4.1, we present the methods used to determine the QE's impact on bond prices. In sub-section 4.4.2, we explain the methodology to identify the CSPP's effect on companies' decisions.

[57] One way to consider how the CSPP may reduce firms' default risk by improving their debt covenants is as follows: As the ECB shores up financial markets through QE, firms' financial liquidity may improve; QE may encourage firms to exchange short-term loans for long-term at lower yields – thus raising firms' debt maturity; the lower cost of debt could also improve firms' profits and improve firms' ability to pay off their debt.
[58] We have considered using firms' historic credit rating as a dependent variable for the default risk channel; however, this would have created several challenges. First, many firms do not have a credit rating – especially firms with little debt in the bond market or small cap firms. Second, not all firms have credit rating of all three major credit rating agencies S&P, Moody's, and Fitch. Some use only one or a couple of these rating agencies and others use other agencies; while all credit rating agencies use similar methods to evaluate risk, their methods vary and so does the comparison of changes in firms' credit ratings. Third, some firms stop using a credit rating agency for another, making a time series analysis non-continuous. Four, credit rating agencies tend to update their rating on a firm's debt only if a major factor warrants it and not for small changes in a firm's risk profile. For these reasons, debt covenants are more suitable herein. They may not explain all the risks a company faces; however, they provide an even scale to evaluate the developments of firms' credit risk over time.
[59] For further reading on the liquidity risk channel see Drechsler *et al*. (2014) and Bianchi and Bigio (2014).

4.4.1 Bonds and cost of debt

This sub-section investigates the effect of the CSPP on bonds' credit risk premium and liquidity. Towards this end, we divided the analysis into the short-term, focusing around the CSPP announcement, and long-term analyses.

For the credit risk, we use the Z-spread and G-spreads – two different measures for bonds' risk premium. For liquidity risk, we focus on trading costs as measured by the bid-ask spread.

We estimate the following regression model for the short-term analysis:

$$y_{i,t} = \beta_{0,i} + \beta_1 Inter_t + \beta_2 Post_t + \beta_3 (T * Inter_t) + \beta_4 (T * Post_t) + \beta_5 X1_t + \beta_6 X2_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $y_{i,t}$ denotes firm i's G-spread(dif.), and Z-spread(dif.) at time t. $\beta_{0,i}$ is the individual (bond) fixed effect. The timeframe is from March 1st, 2016 to August 1st, 2016. $Inter_t$ is the dummy variable for the period following the initial announcement of the CSPP on March 10th, 2016, up to April 21st,2016 – the day the ECB announced details about bonds' eligibility criteria. The $Post_t$ a dummy variable is for April 22nd,2016, up to August 1st, 2016. The CSPP started on June 8th, 2016. The T is a dummy variable for targeted firms (set as a dummy variable with 0 for control firms and 1 for targeted firms). These regressions include macroeconomic and monetary policy variables, as mentioned at the start of Section 4, and are noted as vector $X1_t$ [60].

We also included firm-specific variables that are noted as $X2_{i,t}$. These variables include the age of the bond (in years), country of origin of the bond issuer, and credit rating. The countries are Germany, France, Italy, and Spain – each as a dummy variable. Credit rating is divided into five dummy variables for AAA to AA rating (denoted as "AAA to AA"), A+ to A-

[60] Control variables include lagged of each 1-week Euribor (dif.), volatility of Euro (EVZ), volatility of pound, and Stoxx600 30-Day implied volatility.

(denoted as "A"), BBB+ to BBB- (denoted as "BBB"), BB+ to B- (denoted as "BB to B), and CCC+ to DDD- (denoted as "CCC").

Next, for the long-term analysis, we estimate the following model:

$$y_{i,t} = \beta_{0,i} + \beta_1 D(Lg(CSPP_t)) + \beta_2 T * D(Lg(CSPP_t)) + \beta_3 X1_t + \beta_4 X2_{i,t} + \varepsilon_{i,t} \quad (2)$$

For this model, in addition to the Z-spread (dif.) and G-spread (dif.), we include the bid-ask spread (level) as dependent variables $y_{i,t}$. The $D(Lg(CSPP_t))$ represents a first difference of the log of the ECB's monthly accumulated corporate bond purchases. We add a dummy variable for the targeted firms (T)[61], much like in equation (1). Moreover, we include macroeconomic and monetary policy control variables that are noted as $X1_t$ [62] (a detailed account is in the notes of the tables of results). In $X2_{i,t}$, we also control for age of bond (in years) and as dummy variables, country of origin, credit rating[63], and industry. Whereas, for the industry, we divide firms into eight industries and then form eight dummy variables for each industry[64].

4.4.2 Impact on corporate decisions

To analyze the CSPP''s short-term impact on firms' finances and financial ratios, we utilize a similar regression model as in (1); the model is as follows:

$$y_{i,t} = \beta_{0,i} + \beta_1 Post_t + \beta_3 (T * Post_t) + \beta_4 X1_t + \beta_5 X2_{i,t} + \varepsilon_{i,t} \quad (3)$$

[61] This variable's value is 1 for targeted firms and 0 otherwise.
[62] Control variables include lagged of each 1-week Euribor (dif.), Fed's shadow rate (dif.), ECB's balance sheet (dif.), volatility of Euro (EVZ), and Stoxx600 30-Day implied volatility.
[63] Country of origin and credit rating are dummy variables formalized the same as in the daily analysis.
[64] The list of industries are Technology, Healthcare, Communications, Real Estate, Utility, Industrials, Consumer, and Materials. Each dummy variable receives the value 1 for its industry and 0 otherwise.

where $y_{i,t}$ stands for firms' finances and financial ratios, and *Post* is a dummy variable for the period when CSPP was implemented (from Q2 2016 and onwards it equals 1, and 0 otherwise); *T* stands for *Targeted* or the firms whose bonds were purchased by the ECB. The $X1_t$[65] is a vector of monetary policies and macroeconomic control variables, and $X2_{i,t}$ represents the log of firm i's assets (lagged by one period). The period analyzed is from 2015Q4 to 2017Q1.

For the long-term analysis of QE, we collected data on firms' debt costs, financial ratios, and financial information. The model is the same as in equation (2).

Whereas $y_{i,t}$, the dependent variable, is firms' total debt, long-term debt, cash and short-term investment, capital spending, dividend, shareholder yield, cost of debt (as part of the Weighted Average Cost of Capital or WACC), and net interest expenses. We use, much like in equation (2), the $D(Lg(CSPP_t))$. The $X1_t$ vector represents control variables related to monetary policies and macroeconomic conditions (the same as in the short-term analysis) and the $X2_{i,t}$ vector stands for corporate characteristics[66]. The sample is from 2016Q1 to 2019Q3 and includes data of publicly traded targeted firms and non-targeted firms.
We include debt covenants that measure firms' debt burden and financial strength. These debt covenants are used by rating agencies and investors to measure a firm's financial resilience, and its ability to pay its debts. Although they are not the only firm-specific ratios needed to determine a firm's credit risk, they are comparable and measurable. The covenants are debt-to-assets, long-term debt-to-debt, current ratio (the ratio of short-term (ST) assets to short-term debt), and debt-to-EBITDA. If the CSPP improved these debt covenants, then it may have been successful in ameliorating firms' financial conditions and reducing their risk of credit.

[65]Control variables include lagged of each 1-week Euribor (dif.), Fed's shadow rate (dif.), and ECB's balance sheet (dif.).
[66] These firm-specific variables include lagged of each return on assets (dif.), WACC, profitability, and log of assets.

Other ratios tested include dividend-to-revenue, net interest expenses-to-debt, cash and ST investment-to-assets, and capital spending-to-revenues. These ratios provide another perceptive for the QE's impact on corporate finances.

4.5 Empirical results

4.5.1 Credit risk channel

This part analyzes the chapter's first topic, namely, the CSPP's impact on bond premium risk pricing, i.e., the credit risk channel. To measure this effect, we look at Z-spread and G-spreads' daily data for the short-term analysis and monthly data for the long-term analysis. For the latter, we also examine the CSPP's effect on firms' debt covenants. We start by estimating equation (1) for daily data of Z-spread and G-spread (see Table 2).

The results[67] show that following the CSPP announcement (post-period), targeted bonds' Z-spread fell by 3.5 basis points and their G-spread by 4.1 basis points[68]. One way to interpret these results is that the Z-spread and G-spread declined by 2.6% (based on targeted bonds' mean average before the CSPP stared at 136 basis points [69]) and 4.2% (based on an average of 98.18 basis points), respectively, in the post-period announcement. Even during the interim period, spreads declined by 2.1 and 2.5 basis points, respectively. The coefficients for the *Inter* and *Post* suggest the CSPP had an overall significant impact on all corporate bond spreads – not only on targeted bonds. The regressions without *Inter* and *Post* as intercepts[70] for Z-spread and G-spread, respectively, show the CSPP lowered theses spread by 2 and 2.3 basis points, respectively. These results suggest the CSPP had significantly reduced

[67] See Table 4.2, columns (1) and (6).
[68] These calculations include the sum of the *Post* and *Post*Targeted* coefficients.
[69] We use the average of the dependent variables before the CSPP started (from February 1st to March 9th) as a baseline to evaluate the CSPP's impact.
[70] See Table 4.2 column (2) and (7).

corporate risk premia not only in the interim period but also in the post-announcement period.

Table 4.2: Results for the G-spread and Z-spread daily regressions analysis

Dependent Variables	D(Z-Spread)	D(Z-Spread)	D(Z-Spread)	D(Z-Spread)	D(Z-Spread)	D(G-Spread)	D(G-Spread)	D(G-Spread)	D(G-Spread)	D(G-Spread)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
AAA to AA				0.81***					0.77***	
A				0.41***					0.42***	
BBB				-0.051					-0.05	
BB to B				-0.76***					-0.85***	
CCC				-2.13***					-4.47***	
AAA to AA X Targeted				-0.590**					-0.561*	
A X Targeted				-0.333**					-0.358*	
BBB X Targeted				-0.268**					-0.276**	
BB to B X Targeted				-0.084					0.007	
Germany					0.2790*					0.268
France					0.024					0.089
Italy					-0.163					-0.068
Spain					-0.58***					-0.47**
Germany X Targeted					-0.173					-0.156
France X Targeted					-0.028					-0.107
Italy X Targeted					0.020					-0.077
Spain X Targeted					0.308					0.206
Targeted			1.31***	1.38***	1.33***			1.19***	1.26***	1.20***
Inter	-1.65***		-0.35***	-0.35***	-0.358*	-2.13***		-0.81***	-0.81***	-0.81***
Post	-2.52***		0.653	0.656	0.65***	-3.08***		0.255	0.257	0.255
Post X Targeted	-1.02***	-2.03***	-1.15***	-1.15***	-1.15***	-1.02***	-2.32***	-1.04***	-1.04***	-1.04***
Inter X Targeted	-0.473**	-1.33***	-0.55***	-0.556**	-0.552**	-0.344*	-1.52***	-0.34***	-0.34***	-0.348
Age of bond	14.9***	10.2***	0.03***	0.03***	0.03***	16.2***	10.8***	0.05***	0.05***	0.05***
Firm Fixed Effects	Yes	Yes	No	No	No	Yes	Yes	No	No	No
Observations (Bond-Day)	100,739	100,739	100,739	100,739	100,739	97,312	97,312	97,312	97,312	97,312
F-statistics	3.17	3.09	107.61	62.01	61.05	3.42	3.30	140.61	79.73	79.14

This table shows the impact of the CSPP on Z spread (dif.), and G spread (dif.). Control variables include lagged of 1-week Euribor (dif.), the volatility of Euro (EVZ), the volatility of the pound, and Stoxx600 30 Day implied volatility. Data are daily for Mar 1st to August 1st, 2016. *, **, and *** indicate statistical significance of 10%,5% and 1%, respectively. Country i =country i =1, 0 otherwise; Credit rating= Credit rating i=1, 0

otherwise; Age of the bond in years; D() indicates first difference; Targeted: firms whose bonds were purchased under the CSPP=1, 0 otherwise; AAA to CCC indicates credit rating; countries indicate country of origin for each bond issuer; Z spread – 1,015 bonds (of which 651 are targeted bonds); G spread – 979 bonds (of which 643 are targeted bonds).

When we controlled for credit rating[71], the CSPP appears to mostly reduce the risk premia of non-investment grade bonds with BB rating or lower. As for the country of origin[72], Spanish bonds seem to react more favorably to the CSPP than bond issuers from other countries. Even after controlling for these variables, the results remain significant and indicate the CSPP reduced corporate bonds' risk premia.

The short-term regression results for firms' debt covenants are presented in Table H2 in Appendix H. The results show that firms' debt covenants did not improve as firms used the added liquidity to raise debt, leading to a higher debt-to-EBITDA ratio. The results also did not show targeted firms' debt covenants had a significantly different reaction to the CSPP compared to non-targeted firms.

Turning to the monthly data analysis (see Table 4.3), the CSPP had a small, albeit significant, impact on the G-spread and Z-spread from June 2016 to December 2018.

For the firms' fixed-effect model, the CSPP appears to raise targeted and non-targeted bonds' G-spreads[73]. However, without controlling for firms' fixed effect, the coefficients for targeted bonds turn negative: The G-spread for targeted firms slightly declined[74] by 0.05% (based 2015 spread averages) for every 10% increase[75] in CSPP monthly purchases. Conversely, non-targeted bonds' slightly rose by 0.03%.

[71] See Table 4.2, columns (4) and (9).
[72] See Table 4.2, columns (5) and (10).
[73] See Table 4.3, column (5).
[74] Based on results of Table 4.3, columns (6).
[75] We use for the monthly analysis a 10% gain in CSPP as a benchmark because its compound monthly growth rate from June 2016 to December 2018 was 12.6%.

Table 4.3 Results for the G-spread, Z-spread, bid-ask spread monthly regressions analysis

Dependent Variables	D(Z-Spread)	D(Z-Spread)	D(Z-Spread)	D(Z-Spread)	D(G-Spread)	D(G-Spread)	D(G-Spread)	D(G-Spread)	B/A Spread	B/A Spread	B/A Spread	B/A Spread
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
"AAA to AA" X D(Log CSPP)			0.374				0.5***				-0.04***	
"A" X D(Log CSPP)			0.191				0.212				0.03***	
"BBB" X D(Log CSPP)			0.516				0.7***				0.01***	
"BB to B" X D(Log CSPP)			1.52				1.8***				0.03***	
"CCC" X D(Log CSPP)			1.07				-3.9***				0.071**	
"AAA to AA" X Targeted X D(Log CSPP)			-0.379				-0.380*				0.04***	
"A" X Targeted X D(Log CSPP)			-0.468				-0.37**				-0.03***	
"BBB" X Targeted X D(Log CSPP)			-0.8***				-0.9***				-0.002	
"BB to B" X Targeted X D(Log CSPP)			0.67***				0.536				0.004	
Germany X D(Log CSPP)				-0.075				0.479				0.02***
France X D(Log CSPP)				-0.26**				-0.43***				0.006
Italy X D(Log CSPP)				1.199*				1.482*				-0.003
Spain X D(Log CSPP)				0.207**				-1.15***				0.000
Germany X Targeted X D(Log CSPP)				-0.373				-0.93***				-0.04***
France X Targeted X D(Log CSPP)				0.240*				0.38***				-0.01***
Italy X Targeted X D(Log CSPP)				-1.063*				-1.465*				-0.004
Spain X Targeted X D(Log CSPP)				-0.283**				1.00***				-0.009
Targeted		0.78***	0.78***	0.78***		0.81***	0.78***	0.78***		-0.16***	-0.16***	-0.16***
D(Log CSPP)	1.88***	-0.37***	-0.47***	-0.17**	0.95***	0.51***	0.39***	0.81***	0.02***	0.02***	0.01***	0.01***
D(Log CSPP) X Targeted	-2.3***	-0.9***	-0.6***	-0.9***	-0.8***	-0.8***	-0.53	-0.8***	-0.01***	-0.01***	-0.005***	0.006
Age of bond	5.58***	0.005	0.005	0.005	3.131***	0.033***	0.008	0.007	-0.045***	-0.013***	-0.012***	-0.013***
Firm Fixed Effects	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No
Observations (Bond-Month)	42,147	42,147	42,147	42,147	36,816	36,816	36,816	36,816	39,557	39,557	39,557	39,557
F-statistics	2.28	371.66	196.10	208.01	2.61	183.04	134.99	143.31	134.06	647.84	311.18	325.51

This table shows the impact of the CSPP on Z spread (dif.), G spread (dif.), and Bid-ask spread (level, BA spread). Control variables include lagged of 1-week Euribor (dif.), the volatility of Euro (EVZ), the volatility of the pound, and Stoxx600 30 Day implied volatility. Data are monthly (end of month prices) from June 2016 to December 2018. *, **, and *** indicate statistical significance of 10%,5% and 1%, respectively. Country i =country i 1, 0 otherwise; Credit rating= Credit rating i=1, 0 otherwise; Age of the bond in years; D() indicates first difference; Targeted: firms whose bonds were purchased under the CSPP=1, 0 otherwise; AAA to CCC indicates credit rating; countries indicate country of origin for each bond issuer; B/A spread (= bid-ask spread divided by mid-point) includes 1,397 bonds; Z spread – 1,601 bonds; G spread– 1,277 bonds.

The results are similar for the Z-spread: For the firms' fixed-effect model[76], the CSPP lowered Z-spread by 0.06% for every 10% monthly increase in

[76] Based on results of Table 4.3, column (1).

corporate bond purchases; however, non-targeted bonds' spread rose by 0.14%. Based on Table 4.3 column (2) results, the CSPP reduced targeted bonds by 0.13 basis points for every 10% increase in the CSPP. These findings for the long-term analysis suggest the CSPP was less effective in maintaining an economically significant impact on corporate bonds' risk premia.

An analysis of the CSPP's long-term ramifications on corporate debt covenants[77] reveals that the CSPP slightly elevated targeted firms' LT debt-to-debt and current ratio. The CSPP lowered targeted firms' debt-to-EBITDA by 0.5 percentage point for every 50% rise in the CSPP[78] – a similar result to non-targeted. Overall, the CSPP affected all firms similarly on debt covenants. Therefore, the CSPP improved firms' debt covenants based on the long-term analysis results.

Over the short-term, the CSPP reduced bonds' risk premia but barely so in the long-term, although firms' debt covenants have ameliorated over the long-term. How to interpret these results? One explanation might be the bond market reacted initially favorably to the QE announcement, even during the interim period before the criteria for the eligible bonds were released. However, the CSPP's impact did not last long, as other factors (e.g., geopolitical developments, other monetary policy changes, rising trade tensions) may have crowded out its impact on bond spreads. Despite the eroding effect on bonds' risk premia, the CSPP had a positive and lasting impact on firms' debt covenants that tend to be less sensitive to these transitory factors.

[77] Based on results of Table 4.5.
[78] For the quarterly analysis we use a 50% increase in CSPP as a benchmark, because its compound quarterly growth rate from Q2 2016 to Q4 2018 was 49.4%.

4.5.2 Liquidity risk channel

In this section, we analyze the CSPP impact on market liquidity risk, as measured by the scaled bid-ask spread. The results are presented in Table 4.3 (columns (9) to (12)).

Although targeted bonds' bid-ask spreads were lower compared to non-targeted bonds (see Figure 4.3), the results suggest the CSPP did not reduce the spreads over the long-term and did not improve corporate bonds' liquidity. Therefore, while Todorov (2020) finds that the CSPP shrank targeted bonds' bid-ask spreads in the short-term, the results herein suggest the impact was transitory.

For robustness checks, we included control variables for bonds' credit rating and country of origin. Even with these control groups, the conclusions regarding the impact of the CSPP on credit risk and liquidity risk channel remain intact.

4.5.3 Corporate decisions

In this part, we examine the effect of the CSPP on firms' financial data and financial ratios. For the short-term analysis, the results are displayed in Tables H4.1 and H4.2 in Appendix H.

Over the short-term, the CSPP appears to encourage targeted firms to borrow more, especially long-term debt, as the cost of debt[79] declined. Targeted firms seem to use the added liquidity to pay their shareholders – as firms' shareholder yield, dividends, and dividends-to-revenue rose during the period – and not towards capital spending[80]. Moreover, targeted firms appear

[79] This conclusion is based on the results of the cost of debt, net interest exp.-to-debt ratio, which have showed the CSPP lowered these variables from Q4 2015 to Q1 2017 for targeted firms.
[80] The results show that CAPEX and CAPEX-to-revenue have declined for targeted firms during the CSPP period.

to use market liquidity to hoard cash[81]. The results for the long-term analysis are shown in Tables 4.4 and 4.5.

The main findings for the long-term analysis are that the CSPP lowered the cost of debt and firms' debt payments (see Tables 4.4 and 4.5): For every 50% quarterly increase in CSPP, net interest-expenses-to-debt[82] rose, on average, by 0.8%, net interest expenses[83] fell by 0.7%, and cost of debt[84] (part of the WACC) declined by 1.3 pp. (based on the mean of targeted firms in 2015). In comparison, non-targeted firms' cost of debt was less affected by the CSPP. These findings may seem at odds with the results reported in sub-section 4.5.1 regarding bond spreads (see Table 4.3), in which over the long-term, the CSPP reduced firms' borrowing costs, even though it did not have a discernible impact on corporate spreads – a key component of firms' debt costs.

Table 4.4: Main results for selected corporate variables regressions analysis

Dependent Variables	Debt	LT Debt	Cash & ST Invest.	Capital Spending	Dividend	Shareholder Yield	Cost of Debt^	Net Interest Exp.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
D(Log CSPP)	-17.897	40.465	50.913***	26.165***	-46.818***	-0.468***	-0.014***	0.294
D(Log CSPP) X Targeted	-234.59**	-173.94**	-38.96***	-1.164	-3.645	0.223**	-0.011***	-1.573***
Observations (Firm-Quarter)	4,320	4,277	4,313	3,996	2,431	3,901	4,167	2,089
F-statistics	537.89	329.41	138.76	114.59	32.96	10.23	84.93	71.38

This table presents the impact of the CSPP on various corporate variables. Control variables include monetary variables as well as firm-specific variables. Specifically, we included lagged changes in each of 1-week Euribor, U.S. shadow rate, ECB balance sheet – for related monetary variables, and return on assets (dif.), WACC, profitability, and log of assets – for firm-specific variables. All regressions are OLS with Firm Fixed Effects. Dependent variables in columns (1) to (5) and (8) are in millions of euros, in columns (6) and (7) in percentage. Data are for 2016Q1 to 2019Q3. *, **, and *** indicate statistical significance of 10%,5% and 1%, respectively. ^The period is from 2016Q1 to 2019Q2.

[81] Based on the results of cash holdings – see Table H4.1 column (3).
[82] Based on results of Table 4.5 column (6).
[83] Based on results of Table 4.4 column (8).
[84] Based on results of Table 4.4 column (7).

Table 4.5: Main results for selected corporate ratios regressions analysis

Dependent Variables	Debt-to-Assets	LT Debt-to-Debt	Current Ratio	Debt-to-EBITDA ^	Dividend-to-Revenue	Net Interest Exp.-to-Debt	Cash-to-Assets	Capex-to-Revenue
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
D(Log CSPP)	-0.419*	0.085	0.072***	-0.064**	-1.968***	0.041***	0.1693***	-0.016
D(Log CSPP) X Targeted	-0.066	0.268***	-0.034***	-0.042*	-0.390***	-0.059***	-0.160***	0.334**
Observations (Firm-Quarter)	4,370	4,320	4,119	4,392	2,445	2,076	4,357	4,020
F-statistics	114.42	27.80	236.41	171.31	18.99	38.80	57.99	32.65

This table shows the impact of the CSPP on various corporate variables. Control variables include monetary variables as well as firm-specific variables. Specifically, we included lagged changes in each of 1-week Euribor, U.S. shadow rate, ECB balance sheet – for related monetary variables, and return on assets (dif.), WACC, profitability, and log of assets – for firm-specific variables. All Dependent variables are in percentage. All regressions are OLS with Firm Fixed Effects. Data are for 2016Q1 to 2019Q3. *, **, and *** indicate statistical significance of 10%,5% and 1%, respectively. ^The period is from 2015Q4 to 2019Q3.

Based on Figure 4.2, the Z- and G-spreads declined in 2016-2017; however, they started to climb in 2018, whereas the cost of debt (Figure 4.4) remained stable in 2018 and resumed its downfall in 2019. One explanation for this difference could be that spreads were more sensitive to market conditions, i.e., bond spreads tend to react more abruptly to monetary, economic, and geopolitical developments[85] that could crowd out the CSPP's impact. Conversely, the cost of debt includes bank loans that are less prone to market volatility. Moreover, changes to bond prices affect firms' borrowing costs mostly upon debt issuance and less so in the secondary market[86].

As for debt, over the long-term, the CSPP appears to adversely affect targeted firms' overall debt holdings and long-term debt, as each of these measures declined by 1% for every 50% increase of quarterly bond purchases. Nonetheless, Figure 4.5 shows that, on average, all firms' overall debt rose during the sampled period. While the CSPP initially motivated firms to

[85] These developments include rising tension over trade in 2018-2019, Brexit uncertainty, and concerns over a possible recession in Europe in the second half of 2018.

[86] Other factors to consider include, the CSPP may have had a lagged effect that became more apparent in 2019 for firms' cost of debt. Targeted firms may have also changed their composition of debt – from bank loans to debt issues, and in that process, lowered their borrowing costs.

borrow and debt costs in the short and long-term fell, it did not have a lasting positive impact on debt levels. In other words, the CSPP did not motivate firms to borrow more beyond its initial stimulus in the first few quarters.

Although the CSPP did not lift firms' debt holdings or debt burden (e.g., debt-to-asset), it did raise targeted firms' LT debt-to-debt ratio. These findings suggest the CSPP led targeted firms to substitute short-term debt for long-term debt, i.e., elevating their overall debt holdings maturity.

The long-term analysis also reveals that the CSPP motivated firms to elevate their capital spending[87]. Indeed, for every 50% increase in ECB's quarterly purchases, capital spending rose by 3.8%. For Capex-to-revenue, only targeted firms appear to react favorably to QE – rising by 1% for every 50% rise in corporate bond purchases. However, the CSPP did not appear to stimulate firms to raise their dividends[88]. One explanation for this result is that firms were more inclined to invest because lower interest payments improved their return on investment, and funding costs of new projects declined. Conversely, firms' profitability plateaued by late 2017 – which may have led firms to be less willing to raise dividend distribution[89].

From 2016 to 2019, non-targeted firms' cash holdings[90] appear to react favorably to the CSPP: Cash holdings and cash holdings-to-assets increased by 2.2% and 1%, respectively, for every 50% rise in QE. Targeted firms' cash holdings slightly also rose due to the CSPP; however, its impact was not economically significant.

For robustness checks, we added the credit rating of firms' debt, country of origin, and type of industry as control variables. The results are presented in Appendix I. Even after controlling for these factors, the overall conclusions about corporate finances and financial ratios remain intact.

[87] Based on results of Table 4.4, column (4) and Table 4.5 (8).
[88] See Table 4.4, column (5) and (6) and Table 4.5 column (5).
[89] In a supplementary file we included regression results of the Return on Assets (ROA), EBITDA, and EBITDA-to-revenue that show the CSPP's impact on firms' returns and profits.
[90] Based on results of Table 4.4, column (3) and Table 4.5 column (7).

The results of investment-grade firms[91] show that the CSPP had a significantly weaker impact on investment-grade firms' cost of debt, capital spending (Capex-to-revenue), and debt-to-EBITDA. These findings may indicate that investment-grade firms did not benefit from the CSPP as non-investment grade firms did.

As for the country of origin[92], a couple of insights worth mentioning: the CSPP had a stronger significant impact on French and Italian companies' Capex-to-revenue than companies from other countries. Moreover, Italian NFCs' cost of debt fell by a considerably higher margin compared to German, French, and Spanish firms.

Finally, when examining firms' type of industry[93], the CSPP mostly affected real estate, materials, healthcare, and communications firms' leverage. It lowered the debt cost of targeted materials and healthcare firms. Real estate and communications firms reacted favorably to QE by raising their investment spending more so than other industries (based on Capex and Capex-to-revenue).

4.6 Concluding remarks

In this chapter, we investigated the short and long-term effects of the CSPP on non-financial firms' bond spreads, capital structure, and capital allocation. The results show the CSPP reduced targeted corporate bonds' risk premium after its announcement by 3.5 basis points to 4.1 basis points. However, from June 2016 to December 2018, the CSPP had a somewhat muted effect on bonds' risk premium: it lowered the z-spread by 0.13 basis point and the G-spread by 0.03 basis points for every 10% monthly increase in bond purchases, and it did not reduce corporate bond liquidity risk. Nonetheless, the CSPP mainly lower targeted firms' credit risk, as some debt covenants such as debt-to-EBITDA, reacted more favorably to the CSPP.

[91] See Table I4.1a and I4.2a in Appendix I.
[92] See Appendix I Tables I4.1b and I4.2b.
[93] See Appendix I Tables I4.1c and I4.2c.

In the short-term (2015Q4-2017Q1), the CSPP appears to reduce debt costs, encourage firms to borrow, and use this liquidity to pay dividends but not raise investment spending.

However, from 2016Q1 to 2019Q3, while the QE appears to reduce targeted firms' borrowing costs, it did not encourage firms to raise their debt holdings or their overall leverage. Nonetheless, targeted firms used lower debt costs to elevate their debt maturities. The CSPP also did not motivate firms to pay more dividends, but rather to boost their investments.

These findings indicate that from 2016 to 2019, the CSPP was less effective in changing corporate bond spreads and more so in reducing firms' borrowing costs and stimulating capital spending. Unconventional monetary policies require further research to appreciate their long-term effects on the real economy so that policymakers could employ efficient tools and find new ways to encourage economic growth in times when interest rates are at the ZLB.

Appendix F: The CSPP's outline

The CSPP was announced on March 10th,2016. The ECB provided exact details of eligible bonds' criteria on April 21st,2016. The CSPP started on June 8th,2016, and ended on December 19th, 2018.

Its goals were to improve corporate financial conditions by raising market liquidity in the bond market, reducing borrowing costs, and encouraging firms to invest.

The rules for eligible bonds were 1) a bond listed in euro; 2) a remaining maturity of at least six months (and no greater than 31 years) when purchased; 3) a minimum credit rating of BBB-; 4) issued by a corporation (not a credit institute) established in the Euro Area.

Under this program, the ECB purchased non-financial corporate bonds (denominated in Euro) at an average monthly pace of 5.8 billion euros to a total of 178 billion euros (December 2018) of nearly 1,300 corporate bonds from nearly 265 non-financial firms.

The ECB has not been the sole central bank to purchase corporate bonds. Bank of Japan (BoJ) and BoE have also done so. However, the CSPP has been more substantial: It accounts for nearly 4% of the ECB's balance sheet[94], whereas the BoJ and BoE's corporate purchase programs represent 0.5% and 2% of their respective balance sheets. Moreover, the ECB's non-financial companies' (NFCs) bond holdings account for 12% of the total market value of NFCs' bonds in the EMU; whereas, the BoE and BoJ's corporate bond holdings account for 2.5% and 4% of Sterling and Yen NFC's bonds, respectively[95].

[94] Based on data as of Q2 2019.
[95] Source of data: BoJ, ECB, and BoE for data on asset purchase programmes, and Bank of International Settlements for data on NFCs' bond data.

Appendix G: Description of variables and data sources

Variable	Description	Source
1-week Euribor rate	The weighted average rate of a 1-week libor in euros	FRED
Bid-ask spread	The spread between the bid and ask divided by mid-price of a bond	Bloomberg
Capex-to-Revenue	A firm i's Capital spending to revenue	Bloomberg
Capital Spending	A firm i's Capital spending	Bloomberg
Cash & ST Invest.	A firm i's cash holding and short-term investments	Bloomberg
Cash & ST Invest. To Assets	A firm i's cash and short-term investment to total assets ratio	Bloomberg
Cost of debt	A firm i's weighted average cost of debt as measured in the debt component of WACC	Bloomberg
Country of Origin	Dummy variable of Country of Origin of company or issuer of bond X equals 1 and 0 otherwise. X stands for Germany, France, Italy, and Spain	Bloomberg
Credit Rating	Dummy variable of credit rating X equals 1 and 0 otherwise. X stands for "AAA to AA," "A," "BBB," "BB to B," and "CCC."	Bloomberg, Moody's, S&P, and Fitch
Current Ratio	A firm i's cash and short-term investment to short term debt ratio	Bloomberg
Debt	A firm i's total debt	Bloomberg
Debt-to-Assets	A firm i's Debt to asset ratio	Bloomberg
Debt-to-EBITDA	A firm i's total debt to a firms' EBITDA	Bloomberg
Dividend	A firm i's Dividend payment	Bloomberg
Dividend-to-Revenue	A firm i's total dividend payment to revenue ratio	Bloomberg
ECBASSETS	ECB's balance sheet, in millions of euros	FRED
EVZ	Euro Currency Volatility Index or Euro VIX, which measures the market's expectation of 30-day volatility of the Euro/dollar exchange rate	CBO
G-spread	Nominal spread – the gap between corporate bond yield and Euribor rate	Bloomberg
Investment-grade	Dummy variable of firms whose bonds have a credit rating BBB- or higher (i.e., investment grade) equals 1 and 0 otherwise.	Bloomberg, Moody's, S&P, and Fitch
Lg(CSPP)	Log of the total accumulated purchases under the Corporate sector purchase programme (billions of euros)	The ECB
LT Debt	A firm i's long-term debt	Bloomberg
LT Debt-to-Debt	A firm i's long-term debt to debt ratio	Bloomberg
Net interest Exp.	A firm i's Net interest expenses	Bloomberg
Net Interest Exp. to Debt	A firm i's net interest expenses to total debt ratio	Bloomberg
Shareholder yield	A firm i's Total distribution of capital in dividends and buybacks to a shareholder as a proportion of the stock price	Bloomberg
The Federal Reserve's Shadow Rate	Wu-Xia Federal Reserve shadow rate	Jing Cynthia Wu's website
V-Stoxx	30 Day implied volatility of the Stoxx600	Bloomberg
Vol Pound	30 day implied Volatility of the British Pound Currency	CBO
WACC	The weighted average cost of capital of firm i	Bloomberg
Z-spread	Zero volatility spread – the gap between the discounted cash flow of a bond and a Euribor rate	Bloomberg

Appendix H

Table H4.1: Main results for selected corporate variables regressions short-term analysis

Dependent Variables	Debt	LT Debt	Cash & ST Invest.	Capital Spending	Dividend	Shareholder Yield	Cost of Debt	Net Interest Exp.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	-352.06*	-286.52***	-208.1***	-154.6***	200.82***	2.08***	-0.065	3.8
Post X Targeted	1087.9***	608.9***	232.7***	-13.359	71.22***	-0.28	-0.06***	-6.15
Observations (Firm-Quarter)	1,854	1,787	1,858	1,727	948	1,543	1,831	898
F-statistics	344.62	409.20	100.49	46.17	15.36	12.41	61.38	35.88

This table presents the impact of the CSPP on various corporate variables. The Post is a dummy variable for the period 2016q2 to 2017Q1. Control variables include lagged changes in each of 1-week Euribor, U.S. shadow rate, ECB balance sheet, and log of assets. Dependent variables in columns (1) to (5) and (8) are in millions of euros, in columns (6) and (7) in percentage. All regressions are OLS with Firm Fixed Effects. Data are for 2015Q4 to 2017Q1. *, **, and *** indicated statistical significance of 10%,5% and 1%.

Table H4.2: Main results for selected corporate ratios regressions short-term analysis

Dependent Variables	Debt-to-Assets	LT Debt-to-Debt	Current Ratio	Debt-to-EBITDA	Dividend-to-Revenue	Net Interest Exp.-to-Debt	Cash & ST Invest. -to-Assets	Capital Spending-to-Revenue
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post	0.46	-1.38***	-0.788	2.651***	10.409***	0.29***	-0.48***	-3.373
Post X Targeted	0.062	-0.545	0.2216	-1.095	0.9535	-0.35***	0.379**	-0.829**
Observations (Firm-Quarter)	1,880	1,815	1,705	1,752	920	898	1,870	1,697
F-statistics	92.77	21.48	9.79	4.60	7.19	21.71	33.96	12.63

This table presents the impact of the CSPP on various corporate ratios. The Post is a dummy variable for the period 2016q2 to 2017Q1. Control variables include lagged changes in each of 1-week Euribor, U.S. shadow rate, ECB balance sheet, and log of assets. All Dependent variables are in percentage. All regressions are OLS with Firm Fixed Effects. Data are for 2015Q4 to 2017Q1. *, **, and *** indicated statistical significance of 10%,5% and 1%.

Appendix I

Table I4.1: Main results for selected corporate variables regressions analysis

Dependent Variables	Debt	LT Debt	Cash & ST Invest.	Capital Spending	Dividend	Shareholder Yield	Cost of Debt*	Net Interest Exp.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Table I4.1a								
Investment Grade X C(Log CSPP)	-152.378***	-47.348	11.669	-10.213	31.797	-0.1367***	-0.021	-1.638
Investment Grade X Targeted X C(Log CSPP)	109.157	-375.19***	-171.701***	7.1906**	-98.747***	0.144***	0.101***	-0.510
C(Log CSPP)	128.135	89.686	78.325***	47.730***	-112.16***	0.018	0.028	1.968
C(Log CSPP) X Targeted	-294.33*	226.64*	123.17***	-22.282**	80.598**	-0.0642*	-0.101***	-3.135*
Observations (Firm-Quarter)	2,534	2,515	2,510	2,355	1,455	2,227	2,423	1,263
F-statistics	184.795	226.747	185.982	151.590	64.95	16.82	32.56	47.16
Table I4.1b								
Germany X C(Log CSPP)	-80.252	-161.579***	-20.954*	0.036	2.233	-0.097	0.0091	-2.3456***
France X C(Log CSPP)	156.09***	-58.333	-20.159	17.384***	-10.926***	0.4111*	0.0159*	-1.5092***
Italy X C(Log CSPP)	134.40**	-70.836	-39.22***	6.447	-25.566***	0.2169*	-0.086***	-2.745***
Spain X C(Log CSPP)	251.31***	-23.825	-76.72***	-13.690***	-2.790	0.135	-0.015	86.220
Germany X Targeted X C(Log CSPP)	-100.737	405.87***	13.787	-6.1235*	-43.014	0.4586***	0.0289*	0.207
France X Targeted X C(Log CSPP)	187.27**	491.55***	21.514	-11.97***	-24.438	0.011	0.055***	-2.201***
Italy X Targeted X C(Log CSPP)	13.787	418.35***	-64.1828***	0.486	22.146	0.513**	0.0488*	3.719**
Spain X Targeted X C(Log CSPP)	46.923	421.60***	23.498	14.290	-3.624	0.5914***	0.0393**	-82.278
C(Log CSPP)	-15.854	173.616**	89.906***	30.056***	-56.106***	-0.2044*	0.0311***	1.339*
C(Log CSPP) X Targeted	-227.895*	-546.682***	-59.944**	-2.478	8.188	-0.095***	-0.0567***	-2.875***
Observations (Firm-Quarter)	4,309	4,266	4,302	3,985	2,426	3,890	4,157	2,078
F-statistics	123.499	146.399	127.033	117.877	53.178	6.577	184.329	42.164
Table I4.1c								
Technology X C(Log CSPP)	1560.079***	-152.739	500.869***	60.377***	198.227***	-0.062	-0.022*	7.0291***
Healthcare X C(Log CSPP)	1808.708***	240.724***	401.897***	45.206***	207.273***	-0.383	0.068***	8.3410***
Communications X C(Log CSPP)	1338.858***	-100.619	343.913***	121.92***	250.528***	0.3333***	-0.002	-3.069
Real-estate X C(Log CSPP)	1328.843***	-145.086*	333.721***	58.714***	219.411***	-2.0749***	0.0376***	-2.876
Utility X C(Log CSPP)	944.062***	-356.473**	391.56***	56.674***	181.667***	-0.150	0.081***	0.984
Industrials X C(Log CSPP)	838.685***	-586.322***	263.963***	19.77***	143.232***	0.215	0.025	5.4539***
Consumer X C(Log CSPP)	836.513***	-487.721***	444.710***	68.452***	185.695***	0.848***	0.0489***	5.720***
Materials X C(Log CSPP)	1910.101***	380.361***	432.99***	90.77***	188.536***	0.9877***	0.070**	15.729***
Technology X Targeted X C(Log CSPP)	-1465.873***	263.077*	-461.01***	-79.65***	-109.768***	0.548***	0.006	-7.427***
Healthcare X Targeted X C(Log CSPP)	-1113.757***	492.180**	-483.66***	-31.328***	-196.415**	0.441***	-0.1542***	11.306
Communications X Targeted X C(Log CSPP)	892.104***	2042.66***	-320.034***	-68.984***	-208.598***	0.932**	0.008	38.049**
Real-estate X Targeted X C(Log CSPP)	159.044***	1098.882***	-447.394***	-17.904***	-147.192**	1.883***	-0.029	12.018*
Utility X Targeted X C(Log CSPP)	555.357***	1825.09***	-492.486***	-13.267***	-170.232***	1.346***	-0.0673**	21.878***
Industrials X Targeted X C(Log CSPP)	357.118***	1660.611***	-166.906***	-2.289	-111.869**	0.967***	-0.0654**	-5.907**
Consumer X Targeted X C(Log CSPP)	2581.577***	1772.561***	-374.565***	7.672	-72.870	-0.771**	-0.0802***	-4.331*
Materials X Targeted X C(Log CSPP)	-1134.228***	214.30*	-599.962***	-61.530***	-189.814***	-1.276***	-0.1173***	NA
C(Log CSPP)	-1213.998***	339.22**	-295.948***	-25.831*	-243.617***	-0.225*	-0.001	-4.43**
C(Log CSPP) X Targeted	-593.636***	-1543.643***	320.464***	12.947***	121.569**	-0.098***	0.0373**	-3.945
Observations (Firm-Quarter)	4,309	4,266	4,302	3,985	2,426	3,890	4,157	2,078
F-statistics	113.561	133.707	127.412	118.247	51.527	8.019	63.311	41.350

This table shows the impact of the CSPP on various corporate variables. Control variables include monetary variables as well as firm-specific variables. Specifically, we included lagged changes in each of 1-week Euribor, U.S. shadow rate, ECB balance sheet – for related monetary variables, and return on assets (dif.), WACC, profitability, and log of assets – for firm-specific variables. Data are for 2014Q3 to 2019Q3. *, **, and *** indicate statistical significance of 10%,5% and 1%, respectively. Dependent variables in columns (1) to (5) and (8) are in millions of euros, in columns (6) and (7) in percentage. All D(CSPP) stand for the log of the first difference of accumulated CSPP purchases. Industry notations: Tech—Technology; HC –Healthcare; Mat.—Material; RE—real estate; Comm. – Communications; Ind. – Industrial; Con.—Consumer; Utility as is. Country notation: DE—Germany FR – France; IT – Italy; ES –Spain. ^ The period is from 2016Q1 to 2019Q2.

Table I4.2: Main results for selected corporate ratios regressions analysis

Dependent Variables	Debt-to-Assets	LT Debt-to-Debt	Current Ratio	Debt-to-EBITDA	Cash & ST Invest.-to-Assets	Capital Spending-to-Revenue	Dividend-to-Revenue	Net Interest Exp.-to-Debt
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Table I4.2a								
Investment Grade X C(Log CSPP)	0.235	-0.197***	-0.094	0.155	-0.091*	0.314*	1.007	0.039
Investment Grade X Targeted X C(Log CSPP)	0.634***	-0.251**	0.049	0.176***	0.115	-0.958***	-2.871**	-0.096**
C(Log CSPP)	-0.688**	0.380**	0.195***	-0.180***	-0.224	-0.391	-3.198***	0.711***
C(Log CSPP) X Targeted	-0.745***	0.139	-0.086	-0.346***	-1.589*	1.157***	2.259**	-0.285**
Observations (Firm-Quarter)	2,554	2,534	2,433	2,457	2,544	2,405	1,477	1,264
F-statistics	30.89	6.79	45.30	73.65	14.94	59.02	31.91	1.71
Table I4.2b								
DE X C(Log CSPP)	0.029	0.304**	-0.037	-0.238	0.217***	-0.030	0.179	0.246***
FR X C(Log CSPP)	-0.133	0.042	-0.082***	0.027***	0.129*	0.675***	0.200	-0.036***
IT X C(Log CSPP)	-0.094	-0.607**	-0.1936**	0.086	-0.110	0.743***	-1.693	0.003
ES X C(Log CSPP)	0.657**	0.119	-0.194***	0.086***	-0.060	0.103	2.801***	8.007**
DE X Targeted X C(Log CSPP)	0.005	-0.062	0.073	0.407***	-0.351**	0.398*	0.107	-0.245***
FR X Targeted X C(Log CSPP)	0.108	0.202	0.050**	0.238***	-0.57***	1.429***	-0.258	0.029
IT X Targeted X C(Log CSPP)	0.416**	1.67***	0.200***	0.450***	-0.395***	0.707***	1.714	0.050
ES X Targeted X C(Log CSPP)	-1.324**	0.579**	0.107***	0.220607	-0.808***	1.972***	-1.746*	-7.99**
C(Log CSPP)	-0.676**	0.359**	0.212***	-0.149**	0.124**	-0.339	-3.507***	0.054***
C(Log CSPP) X Targeted	0.190**	-0.427***	-0.178***	-0.248***	0.142***	-0.397***	0.200	-0.105***
Observations (Firm-Quarter)	4,359	4,309	4,108	4,115	4,346	4,009	2,440	2,065
F-statistics	45.67	23.72	46.52	146.68	26.33	65.34	37.29	3.81
Table I4.2c								
Tech X C(Log CSPP)	1.441***	-1.539	0.048***	-3.816**	2.47***	-0.082	-9.656**	-0.521***
HC X C(Log CSPP)	1.982***	1.671***	0.244***	-3.639**	0.680***	-0.083	-7.927***	0.040
Comm. X C(Log CSPP)	2.445***	1.59***	-0.050***	-3.664**	0.75***	2.294***	-8.444***	0.010
RE X C(Log CSPP)	4.684***	0.616***	-0.117*	-2.035**	-0.544***	9.355***	-5.116	-0.106*
Utility X C(Log CSPP)	2.172***	2.144***	0.379***	-3.358**	0.349***	1.612***	-6.779***	0.064**
Ind. X C(Log CSPP)	1.175***	1.851***	0.149***	-3.678**	0.799***	-0.226	-9.029***	0.037*
Con. X C(Log CSPP)	1.490***	-0.751	0.423***	-4.013**	0.984***	-0.091	-8.314***	-0.199***
Mat. X C(Log CSPP)	2.449***	1.218***	-0.05***	-3.865**	0.641***	0.932***	-7.772***	0.078***
Tech X Targeted X C(Log CSPP)	-1.811***	5.112***	0.852***	3.385**	-2.113***	0.302	12.16***	0.505***
HC X Targeted X C(Log CSPP)	-1.301***	-0.144	-0.35***	3.57***	-1.076***	0.417	8.737***	0.025
Comm. X Targeted X C(Log CSPP)	-0.323	1.529**	0.143***	3.598**	-0.985***	-1.802***	9.279***	0.006
RE X Targeted X C(Log CSPP)	-3.015***	0.930**	0.004	2.123***	0.003	-4.169***	10.34***	0.1440**
Utility X Targeted X C(Log CSPP)	-0.631*	0.516	-0.398***	4.361***	-0.736***	-0.71**	7.111***	0.018718
Ind. X Targeted X C(Log CSPP)	-0.443***	-0.007	-0.129***	3.956***	-0.261***	0.932**	9.634***	-0.048***
Con. X Targeted X C(Log CSPP)	0.175	0.107	-0.443***	4.197***	-0.983***	0.561***	8.972***	0.261***
Mat. X Targeted X C(Log CSPP)	-1.484***	1.256**	0.126***	4.249***	-0.721***	-0.359***	7.829***	NA
C(Log CSPP)	-2.644***	-0.785***	0.019	3.578**	-0.544***	-1.322***	4.573***	0.008
C(Log CSPP) X Targeted	0.952***	-0.584	0.007	-3.985**	0.568***	0.512***	-8.709***	-0.027
Observations (Firm-Quarter)	4,359	4,309	4,108	4,115	4,346	4,009	2,440	2,065
F-statistics	28.96	4.15	39.09	78.24	18.09	60.65	36.02	1.54

This table shows the impact of the CSPP on various corporate ratios. Control variables include monetary variables as well as firm-specific variables. Specifically, we included lagged changes in each of 1-week Euribor, U.S. shadow rate, ECB balance sheet – for related monetary variables, and return on assets (dif.), WACC, profitability, and log of assets – for firm-specific variables. All Dependent variables are in percentage. Data are for 2014Q3 to 2019Q3. *, **, and *** indicate statistical significance of 10%,5% and 1%, respectively. All D(CSPP) stand for the log of the first difference of accumulated CSPP purchases. Industry notations: Tech—Technology; HC –Healthcare; Mat. —Material; RE—real estate; Comm. – Communications; Ind. – Industrial; Con.—Consumer; Utility as is. Country notation: DE—Germany FR – France; IT – Italy; ES –Spain.

Chapter 5 – Concluding remarks

In this thesis comprising of three self-contained but related chapters, we aim to shed light on the effectiveness of the European Central Bank (ECB)'s conventional and unconventional monetary policies on non-financial corporations' (NFCs) financial conditions and decisions on investment, debt, and shareholder distribution.

The main takeaways of this thesis are that the ECB's monetary policies, to varying degrees, have stimulated corporate investments, reduced NFCs' risk of credit, and lowered corporate borrowing costs.

In particular, the ECB's interest rate policies were useful in stimulating corporate investment and borrowing, even as the ECB lowered its cash and deposit rates below the zero-lower bound (ZLB). The asset purchase programmes, especially the corporate sector purchase programme (CSPP) and the public sector purchase programme (PSPP), have also encouraged investment and reduced borrowing costs for NFCs; however, the results are less clear as to their overall usefulness on debt borrowing.

In Chapters 2 and 4, where we investigate the ECB's policies' long-term ramifications on corporate investment, we find that firms responded to the stimuli and boosted investments. However, in Chapter 2, we also find that some of these policies have encouraged firms to payout their investors via dividends and shares repurchases – an outcome the ECB may not have targeted. While NFCs' financial conditions have improved (as shown in Chapter 3 and 4), the results are unclear as to whether these policies have motivated firms to borrow more: In Chapter 2, we show that the ECB's quantitative easing and interest rate policies were effective in encouraging debt borrowing, and in Chapter 4, we find that NFCs leveraged up in the short-term soon after the CSPP was announced; however, the results in Chapter 4 also show that the CSPP did not encourage NFCs to borrow more over the long-term (even as data present NFCs' overall debt levels rose over

recent years). This result suggests that other factors may have "crowded out" the stimulative effect of the CSPP.

The empirical results of this thesis make it hard to offer a simple unifying conclusion over the effectiveness of the ECB's policies in affecting NFCs. After all, monetary policy has its limits; even if unconventional policies are employed, the developed world has been struggling to boost investment growth since the financial crisis. Moreover, the headwinds the European Economic and Monetary Union (EMU) faced (some of which are still hindering)[96], also limited the usefulness of monetary policy. With these reservations in mind, we try to draw an overarching conclusion.

Despite the limitations of monetary policy and the lack of support the ECB received from the fiscal side, the ECB was successful in ameliorating financial conditions and boosting corporate investment. This conclusion does not mean the ECB could not have done more or that some of its policies are beyond criticism. Moreover, perhaps part of its recovery is also due to spillover effects from other countries such as the U.S. and China that employed fiscal and monetary stimuli after the financial crisis of 2009. These stimuli could have eased financial conditions in Europe and supported the ECB's policies. Nonetheless, under the circumstances the ECB has operated, we suspect the recovery of the EMU would have been even more anemic if not for the policies the ECB enacted.

Looking forward, we would like to expand this research by investigating other policies the ECB could consider as interest rates are still at the ZLB, and it may "run out of ammunition" in providing more monetary stimulus it has utilized in the past. The EMU may face another recession in the coming years, and new assets purchase programmes are likely to be less effective, as the ECB's balance sheet is already the largest in the world at over 4.6 trillion euros.

[96] Some of these headwinds include the Greek debt crisis, structural limitations (e.g. language barriers in the labor market, and no unified government), and governments that are reluctant to provide fiscal support.

The ECB could soon reach the limit on the number of government bonds it can purchase in certain countries – set at a self-imposed ceiling of 33% of the share of government debt. The ECB could raise this limit to 50%, however any higher share and it could become a majority creditor of sovereign debt and thus politicize itself – something central banks have been trying to avoid.

The ECB may require utilizing other unconventional policies it has not tried before, like purchasing stocks, raising the inflation target, issuing Euro-bonds, and even "helicopter money".

Other central banks have implemented some of these policies (e.g., the Bank of Japan has been purchasing equities) and their effectiveness is questionable, while other policies, such as "helicopter money", have only been studied in an economics classroom and have not been executed by a large economy.

The ECB will find it hard to implement new policies that stimulate investment, however without fiscal support from countries such as Germany; the ECB will remain "the only game in town" and the newly appointed president of the ECB, Christine Lagarde, will also need to continue the legacy that Mario Draghi left, and do "whatever it takes" to maintain the Euro.

We believe that this thesis makes several significant contributions to the literature of the impacts of monetary policy on NFCs and raises several interesting questions that can hopefully be addressed in future research.

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Chapter 2

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