ECB's Corporate Sector Purchase Programme:
effects on the primary bond market

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Abstract

The need to understand the bond market reaction to unconventional monetary policy emerged in conjunction with central banks launching initiatives to buy commercial assets under large-scale asset purchase programmes. A restart of the net purchases under the European Central Bank's (ECB) Corporate Sector Purchasing Programme (CSPP) was signalled on the 18th of June 2019 and then officially announced on the 12th of September the same year. We measure the impact of the ECB's forward guidance on credit spreads on CSPP eligible bonds. Using bond market data, the regression analysis finds evidence supporting a tightening of credit spreads by 62 basis points among eligible bonds in the quarter following the official CSPP announcement. This shows how central bank communication has a substantial impact on credit spreads among eligible bonds. It also shows the interaction between the CSPP and primary corporate bond market through different transmission mechanisms.

Keywords: Unconventional Monetary Policy, Quantitative Easing (QE), Transmission Mechanisms, Credit spreads, Primary Bond Market, European Central Bank (ECB), Asset Purchase Programme (APP), Corporate Sector Purchase Programme (CSPP).

1. Introduction

The past decades' issuance of corporate bonds is ever unprecedented. By the end of 2019, global aggregate non-financial corporate bond outstanding stocks hit an all-time high of $13.5 trillion. Since 2008, the issuance of corporate bonds has averaged $1.8 trillion globally. At the same time, a persistent trend in declining bond quality is also noticeable in every year since 2019. These corporate bond market developments present several emerging risks, such as growing cumulative repayment obligations, poor credit quality in comparison to past credit cycles, and potential relaxation of credit rating standards (Çelik et al., 2019).

Following the Great Recession of 2008, unconventional monetary policy, commonly known as quantitative easing, was extensively employed by the U.S. Federal Reserve and the European Central Bank. Since the crisis, large scale asset purchase programmes have been applied in the U.S., U.K., Eurozone, Switzerland, and Sweden. In an environment of sustained and continuous inflation, and policy interest rates close to, at, or under the zero lower bound, central banks seem to have become more accustomed to unconventional monetary policy. Today, as a response to the recent COVID-19 epidemic crisis, central banks have further begun, extended, or restarted their asset purchase programmes substantially, whereas many more have started to adopt these unconventional methods of monetary policy. Quantitative easing is a measure employed by governments to induce liquidity in financial markets in order to facilitate corporate borrowing during times of crisis. It is an unconventional method said by critics to destabilise the financial system by providing companies with cheap debt. Critics argue that while large scale asset purchases by central banks are successful in providing monetary stimulus and market liquidity in the short run, in the long run, it causes instability and market distortions as investors are forced to search for yields in higher risk classes, contributing to abnormally low borrowing costs.

Today, quantitative easing in the form of large-scale asset purchase programmes seem to affect the economic environment in numerous ways. The literature presents several different economic channels, where QE effects are observable and even distinguishes effects crossing national borders. As central banks, and the ECB in particular, navigate through "uncharted waters" (Borio, 2011), monetary policy has and is being used according to the particular level

of independence and policy framework of the central bank. Notably, the ECB has paved the way for what could be described as the "nuclear option", i.e. employing virtually all monetary policy tools imaginable linked to adjustments of its policy rates in an immense lending operation with drawn-out maturities, what the ECB calls "long-term refinancing operations" (Valiante, 2015). Since the prominence of the European debt crisis in the latter half of 2011, the ECB has continued to tighten its policy rate corridor to rather recent lows, having set the deposit facility rate at -0.5% in 2019 and with the fixed-rate at 0.0% since 2016.

Because of the serious effect it has on financial markets and real economies, quantitative easing is of large significance for macroeconomic theory. It is important both for economists, companies, financial institutions, and decision-makers to understand the different components of QE. In academic literature, it has become common to break down the different elements of transmission into smaller components in order to achieve increased granularity. One very efficient and concrete method to study the direct impact is to study the influence on bond prices and bond spreads. This paper focuses on a specific part of ECB's quantitative programme, the Corporate Sector Purchase Programme (CSPP), which encompasses purchases of investment-grade rated corporate bonds issued by EMU members. The analysis shows how credit spreads are affected by the two most important CSPP-related events in 2019: (1) Mario Draghi's speech on June 18th, when the former president of the ECB signalled that the ECB would restart the Asset Purchase Programme, and (2) the official announcement on September 12th, revealing a definite restart of the CSPP. By focusing on pricing mechanisms, spreads and quantities in the primary bond market, this paper investigates how these formal and rather informal forward guidance events influenced credit spreads at issuance amongst euro-denominated corporate bonds issued before and after the announcements.

1.1 Statement of the problem

The knowledge about the effect and extent of impact under large-scale asset purchases is scarce, much due to the somewhat novelty of the type of policy implementation. Regardless of this, unconventional monetary policy has become quite a recurrent measure in recent decades, evidently due to the prevailing low-interest-rate environment and recent financial crisis. Whereas some programmes have shown to be effective, some have not. There is a large need for an extensive understanding of the actual effects of unconventional monetary policy, and

specifically, those policies which also target the private sector, because of the short- and long-term impact that these may have on financial markets and the real economy. The more we can create an understanding of the extent of influence, the more we can understand the potential positive or negative implications of these methods. Therefore, the study of the CSPP and the estimation of actual effects are of huge importance for future policy implementation.

1.2 Purpose of the study

Our study aims at discovering existing relationships between an intervention programme and its anticipated impact, and thus evaluate the effect of transmission mechanisms and describe aspects of how financial markets are affected by monetary policy. More specifically, the purpose of this study is to contribute to the knowledge about the impact of the ECB's corporate sector large-scale purchases. Through a quantitative regression analysis, the purpose is to quantify the effects on credit spreads and volume of bond issuance, as well as isolating the channels though which these effects were realised. Based on the findings, we aim to provide guidance to further research on the effect of quantitative easing, by contributing to the field of knowledge on the primary bond market and its immediate reaction to monetary policy.

1.3 Statement of the hypotheses

This study rests on the general overarching question: what was the impact of the announcement(s) to restart the Corporate Sector Purchase Programme on bond issuance? Since the study aims at investigating and quantifying the direct impact of the announcement, the hypotheses are based on the anticipated results by the initiating institutions, with other words the aim of the ECB. Also, previous research has come to certain conclusions on the topic, on which the hypotheses are based.

First of all, related literature on the topic has found evidence for an immediate effect on the targeted asset class following an announcement to start or restart a large scale asset purchase programme. This means that although there is normally a broader effect on the bond market at large, the effect has proven to be more extensive on the assets for which the program is intended. Thus, the primary hypothesis is:

H_1: *The announcement resulted in an initial decrease in credit spread, which was larger for bonds eligible for purchase under the CSPP compared to non-eligible*.

However, research also points towards theories which describe favouring of longer-term bonds before shorter, according to the mechanisms of central banks purchases. Therefore, the second hypothesis is:

H_2: *Within the targeted asset class, the decrease in credit spreads was larger for assets with longer maturities compared to shorter maturities.*

Furthermore, another aim of the programme is to stimulate corporate borrowing through inducing liquidity in financial markets, enabling a surge in demand and facilitating for a rise in issuance on debt capital market. Thus, increased liquidity in the market would mean that:

H_3: *The total value of new issues in the CSPP eligible bond segments increased in the period following the announcement as compared to the period before.*

H_4*: The number of new issues in the CSPP eligible bond segments increased in the period following the announcement as compared to the period before*.

These hypotheses will be tested through a regression analysis in chapter (5) *Analysis of data and interpretation of results*.

1.4 Delimitations and limitations

The analysis is delimited to specific segments of financial markets, in order for the result to be as accurate as possible. First, the analysis is concentrated on Euro-denominated bonds. Thus, there is no consideration of exchange rate risk that comes with different currency-denominations. Also, the analysis is focused on corporate bonds issued by non-financial corporations. The reason behind this is that the pricing mechanism differs significantly between non-corporate, financial corporate and corporate bonds. Additionally, financial institutions require a whole other approach of evaluation as well, as they are not eligible for purchase under the CSPP.

Furthermore, the research is limited to a selected time frame, which revolves around the CSPP in particular. The analysis embraces a broader perspective on assets issued under the period from 2015 to 2020, and a more detailed, closer evaluation of the period during 2019. Although there is access to the first quarter of 2020, it cannot be included in the data. This is because of the COVID-19 epidemic crisis that slowly began in January or February and started to have a significant impact on global financial markets in March. It may be challenging to assess when the crisis started to affect the euro bond market, and thus the final cut-off date is allocated with marginal, and 2020 is not included in the analysis.

The study has some limitations. While the analysis of primary bond market data offers a clear and representative insight into the financial conditions for firms, it also has some practical disadvantages. For instance, compared to secondary market data, the data has a rather low frequency with a high level of within-variance. Furthermore, the method used in this paper is not the right method for a quantification of the spill-over effects to other market segments. Although it can be proved that such effects exist, the method used is not the right one for a quantification of those.

1.5 Structure of the paper

The structure of the paper is the following: In chapter 1, the topic is introduced, as well as the problematisation and the hypothesis which lay the foundation for the research. In chapter 2, the institutional background on quantitative easing and CSPP is presented, followed by a section presenting the theoretical spectra which have emerged around the mechanisms of large-scale purchase programmes. Chapter 3 presents and discusses related literature on the topic, ending in a justification for this study. In chapter 4, we describe the sample collection procedure and choice of method, together with a description of the econometric approach. In chapter 5, the results from the quantitative analysis are presented, permitting acceptance or rejection of the hypotheses outlined in section (1.3) *Statement of the hypotheses*. Chapter 6 sums up the research, which culminates in a briefing of the results and a discussion on how these are explained on the basis of various theoretical grounds, and thus the implications for further studies on the subject.

2. Background

In order to provide a background to the problem presented in the previous chapter, the purpose of this chapter is to further explain quantitative easing and how it has developed over time, as well the theoretical landscape which has evolved around it. The first part of the chapter goes through the institutional background, giving a quick review of asset purchase programmes that have been carried out in the U.S., Japan and Europe. The second part of the chapter explains quantitative easing from a theoretical perspective, and clarifies the mechanisms through which it trickles down to financial markets and the real economy.

2.1 Institutional background

Although it can be argued that forms of quantitative easing have been used by central banks as far back as the 18th century, these have not consisted of asset purchases in the secondary market. Thus, it can be argued that quantitative easing, in the shape of central bank asset purchases, was first performed by the U.S. Federal Reserve in the 1930s. The following section provides a short background on programmes carried out in the U.S. and Japan, followed by a detailed description of the ECB's initiatives, and the Corporate Sector Purchase Programme in particular.

2.1.1 QE in the U.S. and Japan

2.1.1.1 U.S. Federal Reserve in 1932-1939

Similar to the aftermath of the 2008 financial crisis, short term interest rates in the U.S. declined to near zero-lower bound in the 1930s. Because of this, the Federal Reserve explored unconventional monetary policy and capital injection for stimulus (Jaremski & Mathy, 2017). Contrary to the fact that the term "quantitative easing" became popularised after 2008, and although few analysts seem to recall that this was not the first time that the Fed used these types of capital injections, in 1932, following the beginning of the great depression, the Fed initiated a purchase programme, purchasing approximately $1 billion of U.S. Treasury securities. In 1933, the U.S. Congress further persuaded the Fed to continue purchasing treasuries by passing legislation that permitted the Fed to use up to $3 billion more to continue purchasing treasuries. Thus, the Fed began purchasing treasuries in the open market at a rate of $50 million each week. As excess reserves continued to increase, the Fed became more reluctant but were

persuaded by President Roosevelt to continue the capital injections (Anderson, 2010). The goal of these capital injections in the 1930s was to stabilise treasury yields. Although the policy was primarily implemented as a mitigation tool to stop high volatility, the interventions also had a portfolio rebalancing effect, and the yield-stabilising effects were noticeable. This, potentially, points towards unconventional capital injections having an effect on real activity in the years between 1934-39 (Hanes, 2019).

2.1.1.2 Bank of Japan in 2001-2006 and 2012

Following the Japanese asset price bubble in 1986-1991, Japan experienced a period of economic stagnation and deflation that lasted between 1991-2000 and 2001-2010, a period often referred to as "the Lost Score". Because of this, the Bank of Japan began decreasing overnight call rates from 6% in 1990 to 0.5% in 1995 and maintained such low rates for the following 4 years. Despite small bouts of hope and phases of recovery the economy began to stagnate further in 1998 and thus, the Bank of Japan decided to decrease the rate even further to effectively 0%, implementing a zero-interest rate policy. After two years of rates at the zero-lower bound, the economy seemed to be in recovery and it was decided to increase the rate. However, when the economy began stagnating, the zero-interest-rate policy was implemented again. In this very constrained economic environment, the Bank of Japan was in a position where more aggressive methods had to be adopted in order to stimulate the economy (Girardin & Moussa, 2011).

Several studies have been conducted to determine the effectiveness and analyse through what channels Q.E. are viewed to affect Japan's two bouts of Q.E. that took place between 2001-2006 and post 2010. Because of the constrained situation, the Bank of Japan decided to launch quantitative easing monetary policy with the intention to purchase Japanese Government Bonds to reach current account balance operating targets (Fasano-Filho et al., 2012). The main difference from the earlier example of a similar policy in the 1930s was that the zero-lower bound nominal interest rate was reached in Japan and thus constricted the central bank from using more conventional forms of monetary policy to stimulate the economy. The purpose of the initiative was to stimulate a stagnant economy and fight off domestic deflation. The Bank of Japan pledged to uphold the policy until the core consumer price index stabilised at a 0% change or positive increase in the following year. The direct effect of the policy was that the

outstanding current account balance held by commercial banks in Japan would replace overnight call interest rates as the primary target for monetary operations (Spiegel, 2006). Long-term government bonds were the primary target for purchase under the programme, making it similar to the Fed programme of the 1930s at the beginning of the programme. However, as the programme developed, the composition of target segments was extended to include also asset-backed securities and commercial papers, as well as private assets held by commercial banks. The purchase of asset-backed commercial papers effectively meant that the Bank of Japan granted credit to small and medium-sized companies (Girardin & Moussa, 2011).

2.1.1.3 U.S. Federal Reserve in 2008 and onwards

Since the financial crisis of 2008, monetary policies similar to those used by the Bank of Japan were implemented by several central banks following in the crisis. The Federal Reserve System held approximately $700-800 billion of U.S. Treasuries before the crisis. In November 2008 the Federal Reserve announced that it would initiate a programme to purchase housing-related obligations of government-sponsored enterprises (GSEs) and mortgage-backed securities (MBS), at a total of $600 billion. This initiative was based on the fact that credit spreads on GSE debt and GSE backed mortgages (MBS) had widened, and the action was taken to reduce the cost and increase the availability of credit in the mortgage market. Thus, creating a credit environment that would support the housing market, which had suffered during the crisis, and further improve financial market conditions (U.S. Federal Reserve, 2008).

In March 2010 the U.S. Federal Reserve's first bout of quantitative easing ended. A couple of months later, the Federal Open Market Committee announced a rollover program to further support the economic recovery and price stability. The decision was to keep constant with the current security holdings and to reinvest principal payment. Just a couple of weeks after, Ben Bernanke, the former Chairman of the Federal Reserve, gave indications of a potential restart of the QE programme. In November 2010, two months after the speech, QE2 was announced. In June 2012 QE2 was terminated, and the U.S. Federal Reserve had purchased $827 in U.S. Treasuries.

However, in September the same year, the Federal Reserve announced a new bond purchasing program (QE3) where MBSs would be purchased at $40 billion per month, starting in January 2013. In December 2013, it was announced that tapering strategies were to begin, reducing the amount of MBSs1 purchased from $40 to $35 billion. In October 2014, on the basis of improved labour market outlook since the start of QE3, the programme was terminated. In 2017, the Federal Open Market Committee announced that the Federal Reserve expected to embark on a balance sheet normalisation, due to the economy has developed as expected. This normalisation lasted until rather recently when in March 2019, it was announced that holdings of U.S. Treasuries would be reduced by having the cap on monthly redemptions from $30 billion to $15 billion (Yardeni Research, n.d).

2.1.2 QE in Europe

2.1.2.1 ECB and the APP

The economic damage deriving from the global financial crisis of 2008, and policy interest rates closing in on or hitting the zero lower bound, forced central banks all over the world to extend their monetary policy instrument toolbox. Whereas traditionally, monetary policy has revolved around adjusting policy interest rates, in recent years, QE has become a common measure. One of the main targets of the ECB is their inflation target at a rate just under 2%. To succeed in this, the central bank uses several types of monetary policy tools to steer the EMU towards the target (Abidi & Miquel-Flores, 2018). As markets remained stressed due to the crisis, the ECB introduced particular tools for easing debt constraints amongst both banks and governments, in order to relieve market tensions, particularly to continuously support and facilitate the interbank money market in the EMU. This initiative consisted of:

1. Unrestricted provision of liquidity under the Fixed Rate Tenders with Full Allotment (FRFA), that allowed banks with rightful collateral unlimited access to central bank liquidity at general refinancing rates
2. An expansion of acceptable collateral for refinancing (COLL).
3. A continuation of Long-Term Refinancing Operations (LTRO) maturities in order to mitigate uncertainty and further increase liquidity for banks (Olijslagers et al., 2019).

Following these initiatives, in the second quarter of 2009, the ECB expanded its operations to the covered bond market. The initiative began as the Covered Bond Purchase Programme (CBPP1), which encompassed direct purchases of covered bonds. In late 2011 the ECB also established a complement to the regular EMU open market operations in the form of further refinancing initiatives known as the Main Refinancing Operations (MRO), with the aim to guide short-term interest rates and further cement the new monetary policy stance. Thus, banks gained full access to debt on differing types of collateral. The distressed national debt was also eased later on, with the Securities Market Programme (SMP) which consisted of the ECB purchasing EMU sovereign debt. The SMP was carried out by the ECB in two major rounds. In the first phase between mid-2010 and mid-2011, the purchases were made in three of the most distressed EMU countries, namely Greece, Ireland and Portugal. The second round lasted from Q3 2011- Q1 2012 after Italian and Spanish solvency decreased. However, the SMP was discontinued in Q3 2012 and replaced with Outright Monetary Transactions (OMT), a programme in which the ECB would set off to purchase sovereign bonds in secondary markets (Ibid, 2019). The programme was introduced on July 26th 2012 by Mario Draghi in his famous speech, where he proclaimed the following (Draghi, 2012):

"/../ the ECB is ready to do whatever it takes to preserve the euro.
And believe me, it will be enough."

The OMT was never put into practice, and no sovereign bonds were purchased as part of the programme. Contrary to the communication around the SMP, it was not as straight forward a practical policy, but was rather used to intervene and it seemed that ECB used communication without actually intervening. About a year later, the ECB actually adopted forward guidance as a form of improved monetary policy communication approach. The existing programmes were deemed insufficient, and the ECB adopted further QE initiatives in the form of a Credit Easing Package (CEP) based on long-term refinancing for both financials and non-financials as well as the acquisition of asset-backed securities and CBPP3 (Olijslagers et al., 2019). In September 2014, after a severe decrease in inflation rates and a threat of deflation, it was announced that asset-backed securities should be added to ECB's balance sheet. Finally, in January 2015, because of no sign of recuperation of the inflation rate, ECB announced the Expanded Asset Purchase Programme. Today, the APP consists of four programmes (Gambetti & Musso, 2017):

1. The Third Covered Bond Purchase Programme (CBPP3),
2. The Asset-backed Securities Purchase Programme (ABSPP)
3. The Public Sector Purchase Programme (PSPP) and
4. The Corporate Sector Purchase Programme (CSPP)

The Expanded Asset Purchase Programme was introduced as a means to get the inflation back on track, to just below the target level of 2%. As a response to the financial crisis and the euro crisis, ECB implemented standard interest rates cuts in the initial lending facility rate, from 4.25% in 2008 to 1% in 2009, and 1.50% in 2011 to 0.00% in March 2016. These cuts led to negative rates in individual lending facilities. Low inflation expectations, together with signs of recovery in economic activity, suggested that the prevailing low inflation would last even during a more extended period (Gambetti & Musso, 2017).

Figure 1. Cumulative net purchases

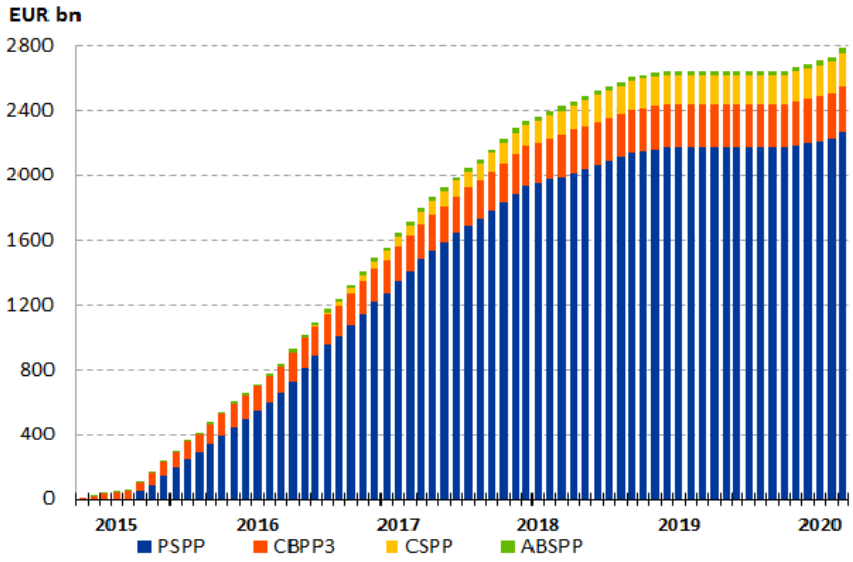
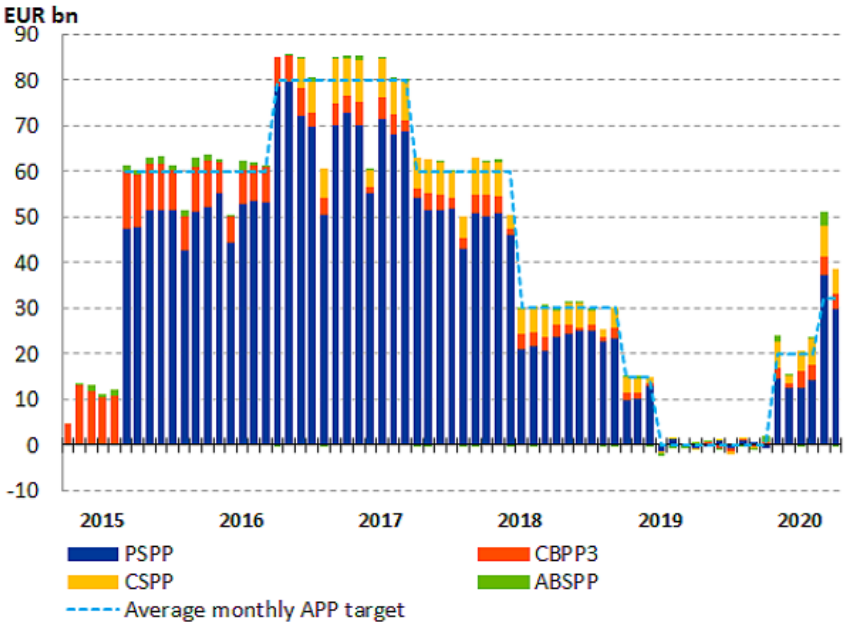


Figure 2. Monthly net purchases



Source: ECB (2020)

From March 2015 until around September 2016 (or until there were signs of inflation near 2%), ECB's purchases amounted to €60 billion monthly, as a total of purchases in the private and public sector. During that period, purchases amounted to €1.14 trillion, equivalent to 11.3% of nominal GDP in the euro area as of 2014 (Gambetti & Musso, 2017). Since the first announcement of the APP in 2015, the programme was re-calibrated on numerous occasions (December 2015, March 2016 and December 2016) with adjustment to net asset purchases and altering of the frameworks. The purchases of private and public securities under the programme amounted to around €60-80 billion per month until 2018 (Gambetti & Musso, 2017).

Although the sub-programmes in themselves vary considerably, especially by size, they also share some commonalities. First, all programmes within the APP are in pre-eminently open-ended with the underlying intention to carry on as long as necessary, i.e. until the ECB deemed that the inflation rate target is sustainably met. Initially, the intention was that the APP would last until September 2016, then in 2018, the former president of the ECB Mario Draghi stated that it was planned to expire in June 2018. Yet, the programme and its individual sub-programmes have since been extended and are still running to this day. Second, it is essential to note that there are regulations behind eventual losses stemming from the assets purchased by the ECB as part of the programme. As is the case with national central banks, the ECB is

not under ownership by any nation-state but by all different national central banks in each E.U. member state. This rather particular and unique structure of the ECB and the institutional structure of the EMU means that most hypothetical losses would be covered by individual member state central banks and not the ECB as they are liable for only around 20% of all asset purchases that are part of the APP (Urbschat & Watzka, 2019).

The overall aim of the programme is, according to ECB, to trigger the monetary policy transmission mechanism through longer-term asset purchasing and thus stimulate price stability. The presence of a significant investor in the euro bond market is meant to boost new issuance volumes on the primary bond market and increase the available liquidity on the secondary bond market (Steeley, 2015). Through the programme, ECB aims to encourage investment, job creation and overall economic growth (De Santis et al., 2018). According to the ECB (2019), the investments eventually trickle down to the real economy through three main channels. First, direct pass-through is initiated through asset-backed securities and covered bonds. The increased demand triggers a price increase, which incentivises banks to make more loans and create and sell more of these assets. Second, the portfolio rebalancing effects contribute to yield compressions in the market, which makes bond debt increasingly accessible to a broader range of companies through lower borrowing costs. This results in banks reallocating their loans, and an increasing number of smaller firms and households can benefit from lower borrowing costs. Finally, through the signalling effect, asset purchases signal that interest rates will be kept down for a prolonged period, thus reducing volatility in financial markets.

2.1.2.2 The CSPP

The Corporate Sector Purchase Programme, which was the last addition to the APP, is sometimes referred to as corporate quantitative easing since it targets private sector corporate bonds. In order to be considered for purchase under the CSPP, the asset needs to meet specific eligibility criteria. These are laid out in the Euro system's collateral framework (ECF):

(1) The security needs to be denominated in euro and issued by non-financial corporation (i.e. not a credit institution, bank, asset management or insurance firm, nor a subsidiary of such a firm) established in euro area countries.
(2) The bond must be valid as collateral for EMU credit operations.

(3) The debt security must have a remaining maturity of minimum 6 months and maximum 30 years and its yield to maturity must be above the deposit facility rate.
(4) The asset needs to have a long-term rating of at least equivalent to the credit assessment of grade 3 (S&P's BBB- or equivalent), obtained by an external credit rating agency being one of the following: S&P, Moody's and Fitch.
(5) There is no minimum required amount of issuance volume, allowing for all issues by also small firms to be purchased.
(6) Have minimum outstanding maturity of 6 months and a maximum of 30 years at the time of purchase (Abidi & Miquel-Flores, 2018).

Transactions under the CSPP are to be made on both the primary and secondary bond market. ECB has a limit of 70% share of the outstanding amount on each individual security. ECB also applies an issuer group limit in order to ensure a diversified portfolio. The purchases are coordinated by ECB through central banks in Belgium, Finland, France, Germany, Italy and Spain (Ertan et al., 2019). The purchases and holdings are declared on a weekly basis in order to ensure transparency. Whereas the CSPP allows the ECB to purchase corporate bonds on both the primary and secondary market, a majority (around 85%) of the purchases are in secondary market securities (Grosse-Rueschkamp, 2018).

Having totalled upwards to €200 billion in purchases, the CSPP plays a rather momentous role in European commercial credit markets, having the potential to affect not only particular debt issuers but a broader set of actors on the market, both firms and investors (Ertan et al., 2020). The bond pricing mechanism in the euro-area suffered during the financial crisis and the euro-crisis. This was particularly significant for sovereign debt as government bond spreads spiked in some countries as a result of the turbulent times. The stress subsequently spread to the corporate bonds via "transfer risk", causing a deterioration in corporate funding. However, this effect was unequally distributed among countries, resulting in further national segmentation of the euro bond market (Zaghini, 2017). This, together with the divergence between policy rates and banks' lending rates led to an increase in bond spreads that did not represent the fundamental characteristics of the assets.

In the year following the announcement of the CSPP, the volume of bonds issued experienced a sizable quarterly increase. Despite the financial turmoil and the European sovereign debt

crisis, the volume of bonds issued on the primary market experienced a significant increase during the period from before the global financial crisis, from around 300 billion euros in 2006 to 700 billion in 2017. Since before the financial crisis, there has also been a shift in bond issuers. Whereas banks used to be the most common issuers of bond debt, non-bank corporate issuers have increased since before the crisis and are now the more frequent borrowers on the euro bond market. There is much evidence pointing towards the fact that the increase in corporate bond issuance and total bond issuance in 2016 and 2017 was an effect of the implementation of the corporate sector purchase programme (Zaghini, 2019).

In July 2017 net purchases as part of the CSPP totalled at $92 billion and primary market purchases were at a total of 14% of total purchased, but over the average in May the same year when primary market purchases totalled 23%. Importantly the central bank holdings had broadened and there where holdings practically throughout the whole eligible spectrum of bonds. In other words, the ECB made purchases of around 90% of the eligible bonds (Ainouz & Bertoncini, 2017). In January 2018, the ECB had begun tapering in regards to the CSPP as monthly purchases had decreased from $80 billion to €65 billion. At this time, however, Draghi did state that the ECB would continue to purchase bonds as part of the programme. Also, during the course of the programme, BBB rated bonds had grown the most in total non-financial debt in the form of IG-rated corporate euro bonds (Bertoncini, 2018). In mid-December 2018 the ECB Governing Council announced that they would end net asset purchases under the APP. Thus, also ending the net asset purchases of the CSPP (Deutsche Bundesbank, 2018).

2.1.2.3 Important dates

Below follows an overview of the key dates in the chronology of CSPP ECB monetary policy, which led up to the announcement in 2019 and the current situation (ECB, 2020b):

March 10th 2016: The ECB announced that it will add the corporate sector purchase programme (CSPP) to the Asset Purchase Programme (APP). They also announced that aggregate size of purchases under the APP would be increased to €80 billion/month.

April 21st 2016: The ECB announced details of the CSPP in the beginning of June 2016, as a part of the asset purchase programme (APP), with the intent to run it until the end of

March 2017. The programme was implemented with the intent to purchase corporate bonds on the secondary market.

June 2nd 2016: The ECB announces that the non-standard policy measures of the CSPP will begin on June 8th.

October 6th 2016: The ECB announces in an account that the implementation phase of the CSPP had gone smoothly and had been underpinned by an active primary market with good liquidity in the secondary market. At this time the portfolio size of the CSPP had already outgrown the asset-backed securities purchase programme (ABSPP).

January 19th 2017: The ECB announces that no asset purchases will be conducted with yields below the interest rate on deposit facility (DFR) as part of the CBPP3, ABSPP or the CSPP.

October 25-26th 2017: After facing criticism claiming that the CSPP discriminates against SMEs, the ECB Governing Council clarifies that the purchases have and are conducted in a non-distortive and non-discriminatory manner.

December 13th 2018: The ECB Governing Council announces that it would aim to maintain the size of its cumulative net purchases under each branch of the APP, i.e. the PSPP, ABSPP, CBPP3 and the CSPP, in the end of December 2018, and thus effectively ending net purchases of the CSPP as part of the APP.

September 12th 2019: The ECB Governing Council announced that net purchases as part of the APP (including the CSPP) would be restarted at a monthly pace at €20 billion starting on 1 November 2019. The ECB Governing council also stated that they expect these net purchases to run for as long as necessary to keep enforcing the accommodative impact of policy rates and to end only when ECB begins raising interest rates.

2.1.2.4 Beyond official dates

When looking at financial market movements, it is important to be aware of events that might have pre-emptively triggered effects believed to stem from future official announcements. Such might be the case in the relaunch of the CSPP on September 12th in 2019. When looking at ECB and associated events in 2019, it is evident that Draghi first hinted the possibility of a QE restart after an ECB governing council meeting after which he stated:

> *"Several members of the Governing Council raised the possibility of rate cuts, others the possibility of restarting the APP or the extension of forward guidance." (ECB, 2019c)*

Later in June, Mario Draghi signalled future stimulus during his speech on the 18th of June 2019, quoted with stating that (Draghi, 2019):

> *"In the absence of improvement, such that the sustained return of inflation to our aim is threatened, additional stimulus will be required /.../ we remain able to enhance our forward guidance by adjusting its bias and its conditionality to account for variations in the adjustment path of inflation. This applies to all instruments of our monetary policy stance. Further cuts in policy interest rates and mitigating measures to contain any side effects remain part of our tools. And the APP still has considerable headroom. /.../ If the crisis has shown anything, it is that we will use all the flexibility within our mandate to fulfil our mandate – and we will do so again to answer any challenges to price stability in the future."*

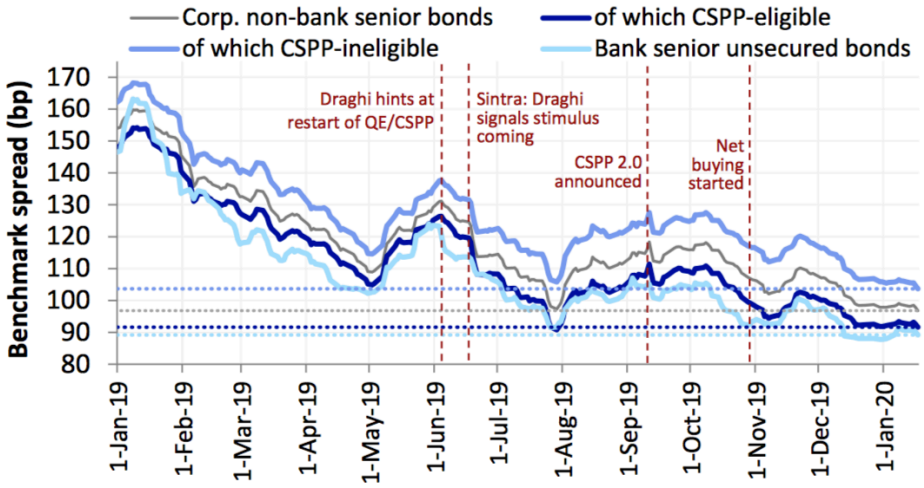
Following this speech by Mario Draghi, the European corporate bond market rallied on ECB QE restart speculation and investors caused the €1.7 trillion corporate bond market to record highs in the days following the speech, causing record low yields. Individual fixed-income investors have also stated that the CSPP has a significant impact, that they were positioned towards ECB restarting the CSPP for at least 6 months prior and that they see it as highly likely that the ECB will restart the CSPP later in 2019, which they did (Ramnarayan, 2019). Furthermore, other investors predicted the QE to resume in October 2019 with monthly asset purchases amounting to €20-30 billion for 6-12 months, at the time of the announcement the ECB owned around €178 billion in corporate debt out of the $700 billion in eligible bonds, which also further suggest they had leeway for restarting the CSPP (Ranasinghe et al., 2019). The drop is also visible in the S&P Eurozone Investment Grade Corporate Bonds Index that displays average:

Figure 3. S&P Eurozone Investment Grade Corporate Bonds Index

The vertical red line represents Draghi's speech on the 18th of June 2019. Source: S&P Indices, 2020

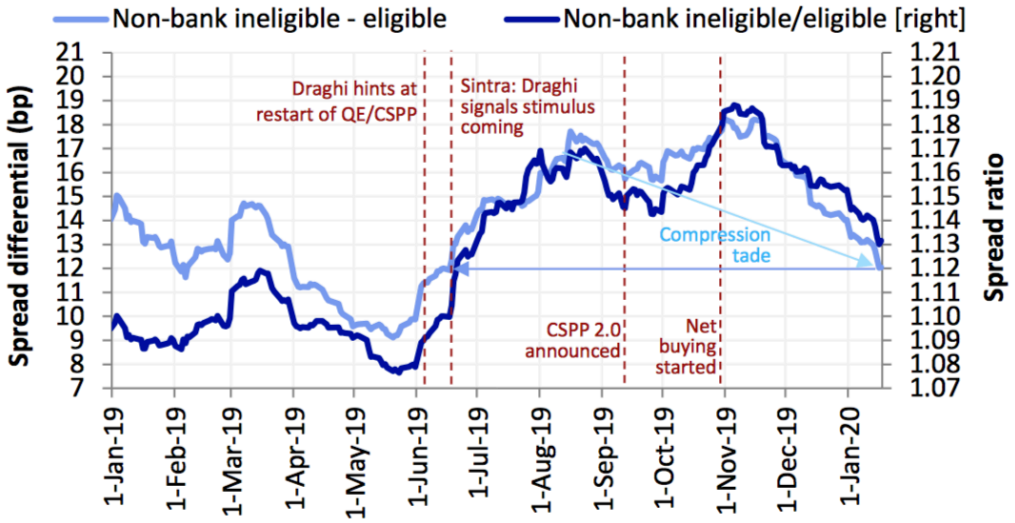
Speculation during this time also revolved around the ECB cutting interest rates, which would leave Draghi's potential successor at the hands of restarting the APP deemed necessary. Because the CSPP has been deemed by many to be the most effective tool in the APP toolbox it is possible that speculation at this time was mostly directed towards the corporate bond market, the ECB states in its 2018 report that examines the CSPP that ample analytical studies point towards the CSPP having a significant impact on the tightening of corporate bond spreads and an increase in bond issuance (De Santis et al., 2018). Furthermore, another 2018 ECB report states that despite not being a part of the explicit CSPP targets, the CSPP has had a considerable effect on green corporate bond spreads tightening that can be attributed to the purchases of the programme (De Santis et al., 2018b). When the CSPP was restarted in November of 2019, the ECB took advantage of high market liquidity and made a rather sizeable first weekly purchase of €2.5 billion. Also, the spread between eligible bonds and ineligible where at the same levels as they were just after Draghi's June 18th Sintra speech (Deutsche Bank Research, 2020). This can be seen in the figures below that allows for comparison of spreads at the time of the speech and announcement.

EUR IG bonds – CSPP eligible and ineligible



Source: (Deutsche Bank Research, 2020)

CSPP eligible and ineligible and their spread differential & ratio



Source: (Deutsche Bank Research, 2020)

2.2 Theoretical background

2.2.1 Understanding QE

Quantitative easing is an umbrella term describing monetary policy used by central banks to purchase, often predetermined, financial assets such as government bonds or corporate bonds. Amongst different forms of monetary policy, it is often used when inflation is very low or in times of deflation when conventional expansionary monetary policy such as lowering interest rates is not adequately successful. The term was first coined denoting the Bank of Japan's strategy dealing with the deflationary pressures following the burst of a real estate bubble, and refers to the shift in focus towards the target of quantity. In conventional forms of monetary policy, the fluctuations in the volume of the reserve, resulting from open-market operations of the short-term interest rates, is not the focus of attention. Quantitative easing is implemented through central banks' large-scale purchases of assets on financial markets, which targets a high level of reserves in the central bank. Thus, the quantity of reserves is the focus for quantitative easing. The aim is to trigger a price increase for the targeted assets, which results in a yield decline enabling ease in credit conditions (Joyce et al., .2012).

2.2.1.1 Unconventional Monetary Policy

According to Borio and Disyatat (2009), there are two fundamental elements of monetary policy. The first implies ways in which the central bank communicates intended policy measures to the real economy, whereas the second involves operations which make use of the central bank's balance sheet to execute a policy measure. Up until recently, or more specifically before the global financial crisis, the only way in which central banks carried out monetary policy was through short term interest rates, often overnight rates. A crucial aspect of interest rate policy is its independence from the level of bank reserves in the central bank, which means that interest rate mediation does not require any open market operation. This is referred to as the "decoupling principle", which explains how balance sheet policy is separated from interest rates. In contrast to interest rate policy, balance sheet policy has a direct effect on the central bank's reserve in terms of risk and structure. The reason is that balance sheet policy targets assets which are well outside the scope and control of the central bank conventional portfolio. Balance sheet policy impacts long term rates, which is often considered as a driver for productivity within the private sector.

Furthermore, Borio and Disyatat (2009) distinguish between four different types of balance sheet policies: (1) Exchange rate policy, which targets the foreign exchange market and impacts net foreign exchange exposure in private sector balance sheets, (2) Quasi-debt management policy, targeting bond debt and securities through influence on public sector claim composition (3) Credit policy, targeting private credit and securities through influence on the private sector or composition of public vs private sector and (4) Bank reserves policy, targeting the bank reserves. Credit policy includes different types of measures, and these are divided into two main categories based on their market impact: (1) Influence on interbank market conditions, which includes measures such as inter-central bank foreign exchange swap lines, and (2) Influence on the non-bank credit market, which includes funding and purchase of commercial paper, asset-backed securities, corporate bonds and other securities. The latter is the credit policy often referred to as quantitative easing. Compared to more conventional forms of balance sheet policy, such as foreign exchange intervention, the unconventional element of this balance sheet policy is its targeted market segment. That said, the approach through which central banks influence the transmission mechanism, apart from interest rate policy, is a conventional measure taken by central banks.

2.2.1.2 Side effects and risks

The unconventional nature of QE as a monetary policy gives room to legitimate discussion and questions regarding potential inimical consequences for global and national economies, such as effects on financial stability, the credibility of the central bank, and social and economic equality. The full scope economics encompassing QE is complex and difficult to analyse. However, by dissecting the components of asset purchase programmes, certain side effects can be found (Tuori, 2019). Most mentioned risks revolve around rather extreme scenarios. However, these are important to note as empirical findings around specific components affected by QE programmes might help either mitigate these risks or identify them.

There are specific risks with different types of balance sheet policies. Just like exchange rate policy carries exchange rate risk, credit policy is associated with credit risk. For instance, central bank purchases of long-term debt involve duration risk, which increases the probability of losses on the central bank's balance sheet, which could also affect financial markets. Furthermore, excessive financing activity by a central bank can result in the questioning of

central banks' financial independence, impacting its operational autonomy. These concerns around operational autonomy manifest themselves through the hypothetical impact of losses stemming from the holdings of the central bank. Important to note is that these risks can be very country or region-specific as it is dependent on recapitalisation rules, the political and economic environment, as well as other factors. For a political-economic purpose, it is crucial to understand the long-term inflationary risk associated with balance sheet policy, which is particularly high in countries that have undergone an extended period of severe economic stagnation. (Borio and Disyatat 2009)

Central banks losing autonomy might have especially grave consequences in economies that are coming out of protracted periods of financial strain and low economic activity. This is because the appeal of "inflating away" the issues of debt may become stronger, hence for political-economic purposes, inflation risks from long-term perspective should not be completely overlooked. Furthermore, exiting and tapering can have inherent risks, the shift in market functioning and potential decreased central bank autonomy cause factors such as timing and avoidance of ambiguous communication. One risk is, for example, for central banks to exit too early or even, worse too late. Due to the risk build-up stemming from more permanent market shifts (Borio and Disyatat 2009).

Claeys & Leonardo (2016) bring potential risks to light in regards to the ECB's QE programmes and emphasizes concerns related to risks of financial stability. The motivation behind the various unconventional policies that were used after the global financial crisis to fend off a large-scale liquidity crisis, was to create a financial environment with relaxed monetary conditions to increase productivity. Still, prolonged periods of accommodative monetary policy can encourage excessive risk-taking, when, in fact, it should be avoided due to external forces, which are out of control of the central bank. It may be difficult to determine the appropriate level of risk-taking and the appropriate level of leveraging amongst banks, as, for instance, excessive risk-taking in the EMU could cause unanticipated divergence to the central banks' QE strategy.

Furthermore, extensive purchases by central banks in the private sector can result in another seemingly hazardous effect, which is a disconnect from traditional fundamentals amongst asset

prices. The intervention of a large investor might alter the fundamental pricing mechanism and the risk and return trade-off, causing unrealistic assessment of risk in financial markets. Though it might be true that markets have peaked and trended higher globally in the past few years, there are varying opinions and no certainty around whether there are immediate or concrete signs of over-valuation. There is also critique against ECB strategies in the academic community, Bofinger (2019) calls the two-pillar "economic/monetary" strategy of the ECB inadequate, stating that abundant complexity in the macroeconomic environment is caused by the ECB's current policies.

Additionally, excessive quantitative easing could reduce the profitability of financial institutions. If this were to happen, it could result in decreased financial stability across markets and society. For example, numerous insurance companies in the EMU have liabilities with maturities that exceed their asset. Thus, they have an exposure against decreasing interest rates. These worries were countered by Mario Draghi, former ECB, who stated that even though the ECB is closely monitoring low rate policy impact, it is not their mandate to ensure that specific financial institutions remain profitable, especially if this is caused by unsustainable business models based on maturity disparities (Clayes & Leonardo, 2016).

2.2.2 Transmission Mechanisms

Central banks affect the economic system using different policies, tools and forward guidance with various aims, often connected to the inflation. These effects can be quantified by investigating specific components of tools, changes in market assets or market environments or by insulating particular financial aspects. In the academic literature surrounding quantitative easing, these mechanisms are most often referred to as channels through which the type of monetary policy has effects. There are various distinct channels through which economists and researchers have investigated these effects, and many of them are used across the literature. However, they sometimes overlap and are referred to with mixed terminology.

2.2.2.1 Signalling channel

The first way through which monetary policies have an impact is the broad so-called signalling channel. Through asset purchases, the central bank conveys a message of commitment to low-interest rate and high future inflation targets, which is intended to encourage investment and

consumption. When the central bank executes large scale asset purchases, it increases its exposition to the risk of losses on the balance sheet. An announcement of such policy measures, therefore, sends the message to financial markets that interest rates will not be raised anytime soon. In that way, announcements of asset purchases can strengthen the credibility of the central bank's intention to keep interest rates at a low level. However, as pointed out by Gern et al. (2015), these measures, due to their unconventional nature, may also be interpreted as a signal that the economic situation is in a bad state and that extremely expansionary monetary policy measures are needed.

Gern et al. (2015) also refer to the signalling channel as the "forward guidance communication strategy", extensively used by central banks during the latest years to impact investors' expectations of future short-term rates. According to Borio and Disyatat (2009), the signalling effect is heavily dependent on the central bank's ability to communicate its policy intentions. In the case of unconventional monetary policy, some researchers argue that the only way in which the central bank can achieve a sustainable signalling impact is if their commitment to keeping interest rates low even during recovery is apprehended to be credible (Gauti & Woodford. 2003). The signalling of central banks' large-scale asset purchases influences all bond spreads in all classes. The extent of the effect depends on the asset duration.

2.2.2.2 Liquidity channel

The liquidity channel describes how the contribution of large sums into financial markets contribute to a higher level of liquidity and demand. In sum, the increased demand in the market enables firms to issue more debt. More specifically, the liquidity channel describes the potential effects on liquidity premiums demanded by investors in order to hold any type of security deemed to have the slightest lack of liquidity. Moreover, the liquidity premium of a specific security can be viewed as the investors' required yield for undertaking the risk of potentially having to prematurely sell off assets at a distressed price point. This could, for example, happen in times of market volatility caused by uncertainty or a generally unstable market environment where arbitrageurs or market makers are capital constrained. This hypothetical constrained environment is necessary because under normal market conditions, liquidity premiums are driven by normal market forces, such as the un-coordinated market activity conducted between participants in the market. Now, if a central bank initiates an asset purchase programme, this

creates a deviation from the aforementioned “normal” market conditions, because suddenly an agent with seemingly endless resources enters the market as a highly committed purchaser. Thus, probable consequences caused by this new agent entering the market arise in the form of potentially shifting the outcome of the omnipresent uncoordinated market activity that typically decides the liquidity premiums for the particular securities. This view is, of course, based on the assumption of participants across markets acting as rational agents, and thus, sellers are able to undertake alternate routes when encountering undesirable pricing of assets in the market. These alternate routes can consist of sellers, instead of putting out bids amongst securities that are part of the particular QE programme (Christensen & Gillan, 2007).

However, when central banks begin tapering towards the end of QE programmes, the manifest effects that have been noticeable through the liquidity channel, could begin acuminate due to central bank purchases decreasing or coming to a complete stop and the market returns to the aforementioned “normal” mode of un-coordinated market activity. For specific assets, the significance and weight of effects noticed through the liquidity channel could differ; this difference is driven by several factors. To begin with, the magnitude of the effect is most likely positively correlated with the purchasing ratio in the asset, i.e. the central bank purchases to total market capitalisation in the particular asset. Furthermore, the less friction associated with the purchases, the greater the effects and capacity of the QE programme to absorb liquidity shocks that would otherwise cause investors that hold eligible assets to close positions and thus create negative pressure on prices. That is, decreasing market liquidity premiums will have a positive effect on prices, causing them to increase. Another important factor mentioned is that the pre-existing liquidity premiums in the eligible asset classes can be of importance. However, because liquidity premiums amongst relevant securities such as investment-grade corporate bonds and government bonds are rather low, this might have received a lack of attention amongst researchers. Lastly, in relation to other mechanisms, no portfolio balance effects need to exist through the LASP, as liquidity channel effects rely on financial market frictions (Christensen & Gillan, 2018).

The theory says that increased liquidity in the market supplies the private sector with the liquidity required to increase aggregate demand since financially constrained firm’s consumption level relies on the available liquid assets. However, there is criticism of the

efficiency of the liquidity channel, also reaching firms that do not have access to financial market financing. Eggertsson & Ostry (2005) doubts the fact that an increase in the monetary base would properly affect short-term liquidity amongst small and medium-sized firms. The main reason is that monetary expansion takes place in an environment, i.e. securities market, where increased liquidity does not actively end up increasing the liquidity of firms, but rather frees up capital amongst investors in the securities market. Because both money and bonds can be considered perfect substitutes in times of zero lower bound policy rates, a definition of liquidity should include both (Eggertsson & Ostry, 2005).

2.2.2.3 Portfolio rebalancing channel

The portfolio rebalancing channel refers to the process of investors realignment of risk and asset allocation as a response to changing market rates. The theory explains how investors might reallocate investments in the search for higher return, often as a consequence of a low yield environment. This involves, for instance, a reallocation of cash flow from long-term bonds to the equity capital markets or foreign currencies. The mechanism is connected with the preferred-habitat theory, which holds that investors have a preference for a specific asset segment. It is presumed, that investors in markets have various "preferred habitats", and thus might prefer holding in assets of different maturities. When a central bank begins purchasing assets with different maturities, investors have to either accept that their preferred investments become more expensive or chose to invest in other assets. When the latter takes place, the central bank effectively pushes investors to choose other assets, which causes the effects to spread to assets other than the targeted, leading investors to choose riskier assets (Vayanos & Vila, 2009).

The rebalancing effect relies on the precondition of imperfect asset substitutability. When a central bank buys long-term government bonds, the term premium is automatically lowered, initiating arbitrage processes resulting in spreading the effect to similar assets. If the central bank buys private sector assets result in a direct effect of declining risk premiums. As large-scale purchase programmes normally targets a specific asset class, such as treasuries, asset-backed securities or corporate bonds, the immediate increased liquidity causes a price increase and yield decline, forcing prior holders of that asset class to rebalance their portfolio, searching for the equivalent yield in riskier asset classes. This search for yield results in a similar yield-

reducing effect in the next asset class (Joyce et al. 2012). Various sub-channels, for instance, duration risk, and local supply channel, are closely connected to the portfolio rebalancing channels.

2.2.2.4 Duration risk channel

Large-scale central bank purchases reduce private-sector holdings of bonds and thus decrease exposure to duration risk amongst owners of bonds which then, in turn, leads to decreasing yields of all securities that are of a specific term length in the particular asset class. This is relevant under the assumption that the credit curve is increasing as bond terms increase, i.e. that there is an increasing risk premium under the foundation of time (Titzck & van den End, 2019). More specifically, the rationale underpinning the duration risk channel is that longer-term assets carry more significant risk because the holder of such assets is exposed to risk of policy interest rates digressing in unfavourable directions. Additionally, longer time to maturity means that the period under which an asset can default is longer. Yet, there are controversies. Krishnamurthy & Vissing-Jorgensen (2011), for instance, argue that the effect of large-scale asset purchases should be most significant on medium-term bonds since the intention to keep rates low would only last until the economy recovers and the central banks have the possibility to sell its bond holdings. However, as the central bank executes purchases of long-term assets, it sends a message that interest rates will not rise, thus decreasing the risk of unfavourable interest rates for the holder of long-term assets. The duration risk channel is closely related to the default risk channel, which, similarly, proposes that the effect of purchase programmes are more significant in higher default risk assets (Cahill et al., 2013).

2.2.2.5 Local supply channel

Conversely to the portfolio balance channel, the theory on local supply channel refers to the tightening effect on bond spreads amongst targeted securities and holds that the asset class targeted in a central bank purchase programme is the asset class which profits from the largest effect. The theory states that spreads only contract amongst the securities purchased as part of the purchase programme (Titzck & van den End, 2019). The local supply theory is oftentimes contrasted against various other theoretical channels, as for instance the portfolio balance channel, to evaluate whether the impact of quantitative easing results in spill-overs effects to

the anticipated degree or if the effect stays within the boundaries of the targeted asset class (Cahill et al., 2013).

2.2.2.6 Capital structure channel

The capital structure channel refers to the process of firms' capital structure being restructured as a consequence of a surge in bond demand, which is caused by large scale asset purchase programmes. Since central bank purchases of private sector assets contribute with a sudden increase in the demand for debt, it enables more firms to enter or expand their placings in debt capital markets. Thus, the capital structure channel theory holds that quantitative easing leads to a restructuring of firm debt from bank loans to bond debt. In turn, alters the balance sheets of financial institutions. Since the same level of interest income is no longer is available from preceding corporate clients, banks are forced to look for interest income from firms in other risk classes. The capital structure channel culminates in theories on financial institutions' level of risk-taking, which is of high importance for the stability of the financial sector and the real economy (Grosse-Rueschkamp et al., 2019).

2.2.3 Bonds, yields and spreads

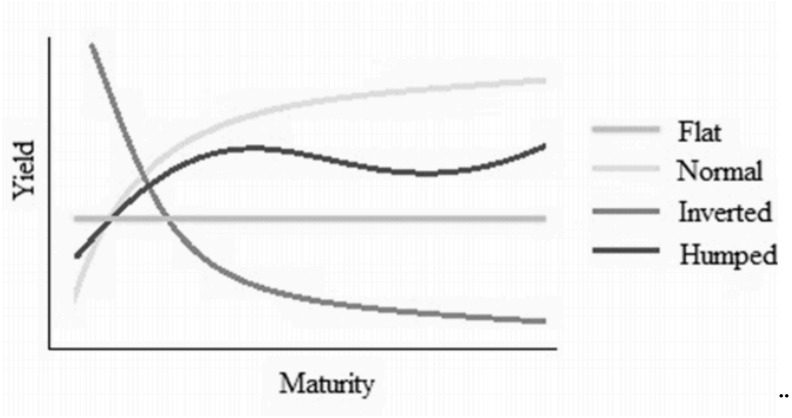
In this paper, we refer to the credit spread, or simply spread, as the difference between a corporate bond yield and the yield on a maturity-matched German government bond. The term is sometimes used interchangeably with yield spread, and in some cases the definition of these terms vary. The credit spread can be computed using different techniques. Since bonds in the euro bond market often are priced benchmarked on government bond rates, the techniques used in this study is the Interpolated spread, or I-spread. The I-spread is defined as the difference between the yield to maturity of a bond and the linearly interpolated yield of an appropriate maturity-matched reference yield curve. We use German bund rates as reference yield curve (O'Kane & Sen, 2004).

2.2.3.1 Yield curves and market effects

The yield curve is a curve that displays interest rates associated with different maturity type assets, for particular asset classes. One such example can be German bund rates. It can be used to understand the relationship between the time to maturity of the asset and the yield of that term in order to gain an understanding of how yield changes over the different maturities.

Typically, yield curves are upwards sloping (normal), as displayed in the graph below. This indicates that investors seek higher yields on longer-term maturities, and that yields increase the longer maturity the asset has. Contrarily, an inverted yield curve shows that yields decrease the longer maturities assets have and happens when long-term maturity yields fall below the short-term maturity yields, it can sometimes be considered as a predictor of economic recessions. This is because it is believed investors are ready to settle for lower yields as they might believe economic outlook is bleak. A flat yield curve displays that maturities are similar regardless of term-length. This can occur when markets have high confidence and are not as an effect by risk duration premia. Lastly, a humped yield curve reflects a situation where short-term yields first increase to then decrease amongst medium-term bonds, to then again to flatten out or begin increasing again amongst longer-maturity yields. Just as an inverted yield curve, this can point towards turbulent times or recession. Of course, yield curves can take other forms, but the below are the most common. The shape of a yield curve can aid market participants to garner information on fitting investments.

Figure 4. Shape of the yield curve



Source: (Vrdoljak, 2016)

Yield curves go back to at least Durand (1942) who fit corporate bond yields to maturities and found both normal, flat and inverted yield curves. Durand also defends examining yields instead of prices on the logic that prices and price movements amongst bonds are only of interest to the extent that they actually determine the yields and yield movements. However, bonds are, of course, most often quoted on a price basis and the price is thus of interest for short-term investors seeking to make a quick profit. The use and need for a parsimonious yield

curve model were mentioned by Friedman in 1977, on the basis that examining the complete term structure of yields in asset classes can be useful in a more digestible format, for example, to understand money demand (Friedman, 1977).

2.2.3.2 Determinants of spread

A common way to evaluate the bond market is to look at the credit spread. It tells us much about various dimensions of the surrounding environment: the risk level of the firm, the state of the economy and level of sentiment, demand and risk awareness in the market. In the secondary market, the spread can be interpreted as a sign of the market's assessment of a specific trade at a specific moment in time. More importantly, at issuance, the credit spread tells us about the borrowing cost for the issuing firm, and the level of return that the investor requires for the extra risk carried.

The credit spread measures the difference between a corporate bond compared to a so-called risk-free equivalent. The risk-free alternative is most commonly referred to as government bonds. While taxes make up for some significant part of that difference, the remaining part of the spread is based on features related to the risk associated with the bond, the issuer, or the broader market conditions. Fundamentally, corporate bonds have three characteristics which separate them from government bonds. First, corporate bonds carry a default risk which government bonds do not. Second, corporate bonds are subject to tax premiums requiring interest payments to be taxed. Third, corporate bonds also carry a risk premium compared to government bonds since a substantial part of the risk is systematic across the corporate bond market segment (Elton et al. 2001).

The establishment of price and coupon rate of corporate bonds at issuance depends on several factors. Morgan and Stiroh (2001) proposes a model built on traditional theory for the determinants of credit spread, which separates the drivers in three sets; bond features, firm characteristics and market condition:

$$spread = \beta_0 + \sum_k \beta_k V_{i,k}^{bond} + \sum_l \beta_l V_{i,l}^{issuer} + \sum_z \beta_z V_{i,z}^{market}$$

The group of variables, $V_{i,k}^{bond}$, refers to factors connected to the features of the bond. The time to maturity of the bond is expected to be positively associated with the bond spread, because a longer time to maturity is connected to a higher interest rate risk for the holder. However, this relationship is only valid under conditions where the credit curve is significant for the longer duration bonds. Moreover, a better bond credit rating is associated with a lower spread, as it reduces the risk for the bond holder, and the amount issued can also have an impact, as it can affect the transaction costs associated with the bond issue.

In terms of firm-level characteristics, $V_{i,l}^{issuer}$, the creditworthiness of the corporation has an important significance. This is often expressed in terms of credit rating by one of the major professional rating institutions, Moody's, Fitch and Standard & Poor's, but can also be assessed looking at firm's composition of debt to equity, where higher leverage is associated with a larger spread. The set may also include, for instance, the issuer's size, which is negatively related to the spread, as an indicator of how large firms often are able to reduce risk through diversified business operations. They are also subject to government support in times of distress if their default is considered to have a substantial effect on the rest of the economy. Furthermore, there is evidence that firms that do not often issue bonds pay a premium at issuance (Zaghini (2017).

The group $V_{i,z}^{market}$ describes various indicators of market condition. During times of good economic activity, firms can take advantage of favourable financing conditions, as the demand for debt is high. Therefore, the model should include variables that describe the state of the market. As for example indicators of the business cycle, and indices measuring the conditions of financial equity and debt capital markets.

Zaghini (2017) adds another group of variables to the model, referring to variables measuring market fragmentation:

$$spread = \beta_0 + \sum_k \beta_k V_{i,k}^{bond} + \sum_l \beta_l V_{i,l}^{issuer} + \sum_z \beta_z V_{i,z}^{market} + \sum_j \beta_j V_{i,j}^{fragment}$$

The group, $V_{i,j}^{fragment}$, captures variables that track country-specific effects of the bond issuer. The theory holds that in case of perfect market integration, there should not be any differences across countries. Although the establishment of the European monetary union in 1999 contributed to significant integration of financial markets through elimination of exchange risk, Zaghini finds that during the financial crisis and in the years of the European Sovereign crisis, the where undeniable evidence of market fragmentation across national borders. Whenever there are country-specific dependencies, the law of one price is violated. The euro bond market is a market consisting of countries that are in various financial conditions, and the level of risk to an issuer might very well be affected differently according to different country origins.

3.Literature Review

Based on the background and theoretical foundation outlined in the previous section, the object of this chapter is to provide an insight into the current academic knowledge that surrounds quantitative easing. In the section below, related literature is introduced. The first part (3.1.1) *Transmission channels*, presents some significant findings and conclusions that have been made on the CSPP. The second part (3.1.2) *Announcement effects on bond yields* discusses the various findings related to the CSPP and impact on bond spreads. The impact on commercial banks and firms' financing conditions is discussed in the section (3.1.3) *Firms' capital structure and financial institutions*. Lastly, the topic of this paper is deliberated on, contrasted to the literature discussed.

3.1 Related Literature

Today, there is a rather large and continuously developing array of literature on quantitative easing and the mechanisms through which it impacts the financial market and the economy. The start of the unconventional policies of the Bank of Japan's first QE programme raised academic attention already in 2001, and after the financial crisis in 2008-09 when the U.S. Federal Reserve, the ECB and the Bank of England initiated asset purchase programmes, as well as the restart in the Bank of Japan's, the amount of literature on the subject soared.

A first group of research studies the impact of different quantitative easing programmes, by assessing the effects according to transmission mechanisms and various theoretical explanations. Much of the early research on CSPP in particular, studies the effect of announcements related to the CSPP, through evaluating indicators on the primary and secondary bond market. While the analyses carried out in this field are implemented through similar methodologies, their aims diverge. A second group of researchers investigate the effect of quantitative easing programmes on firm's financing decisions, and the impact on financial institutions. The most significant findings are discussed below.

3.1.1 Transmission channels

Most research has focused on exploring the various ways in which the effect of large-scale asset purchase programmes are noticeable in the rest of the economy. One branch of the

literature on the effect of asset purchase programmes over the last decade concentrates on the liquidity effect. Many researchers find evidence for an upsurge in demand of particularly assets targeted by the programme, but also on non-targeted assets, as well as an increase in bond placement. Duffie et al. (2007), for instance, show that better bargaining power amongst sellers in the market, initiated by central bank purchase programmes, can decrease market frictions in OTC3 markets and thus create decreased illiquidity price discounts. Thus, sellers amongst affected securities are less likely to be pinched during the programme, which causes an aggregate decrease in liquidity premiums across markets, allowing for an increase in bond placements among corporate issuers.

Christensen and Gillan (2007) provide research that explores the liquidity channel as a separate transmission through which QE affects long-term interest rates. They identify liquidity effects as distinct and more enduring than those noticeable through other channels, for instance, the local supply channel. Yet, Beirne et al. (2011), who find that the ECB's purchases under the CBPP gave rise to increased liquidity in the covered bond market, argue that contributions from the liquidity channel mostly benefit the targeted markets. This is because investors become more incentivised to purchase securities in the targeted market since they know the likelihood of there being potential buyers increases with the decreased risk premia. Also, other asset classes can be affected. For instance, if investors are priced out or seek higher yields, they might be forced to look into other assets. Thus, liquidity increases are transferred to these assets.

According to Abidi and Miquel-Flores (2018), a rather common measure in the literature of estimating liquidity is to examine the magnitude of bid-offer spreads, as a percentage of averages, in the market. The issue with using this measure, however, is that it can only be applied to securities that have recurring or very frequent bidding, i.e. securities traded on exchanges that have set market makers. In the secondary market, one can also measure liquidity by looking at the traded volume of particular securities, either nominal or by using the percentage turnover, which is data that unfortunately is seldom available and extremely time-consuming to manually gather. However, when looking at the primary market, where there are no available bid-offer spreads, a reasonable measure of liquidity is the quantity of new issues, as is done by Zaghini (2019).

Furthermore, Abidi & Miquel-Flores (2018) state that the CSPP as a specific part of a QE programme presents the opportunity to understand interactions between the liquidity channel and portfolio rebalancing channel as mechanisms and use the aforementioned definition to build on the research concerning the liquidity channel. More importantly, together with portfolio rebalancing effects, the liquidity channel can have an effect on credit spreads in other asset classes such as high yield bonds through reducing the bargaining power of sellers in relation to buyers. These effects can take hold in markets where CSPP eligible assets are traded as the ECB is expected to hold bonds to maturity and thus reduce the supply of eligible bonds for sale on the secondary market.

In fact, many researchers have studied and found evidence for the existence of a portfolio rebalancing channel (Abidi and Miquel-Flores, 2018; Albertazzi et al., 2016). As for instance, Abidi and Miquel-Flores (2018) investigates the CSPP announcement in March 2016 and find a decline in interest rates in debt capital markets as evidence in support of portfolio rebalancing effects. This is because although the effect is most significant among the assets targeted by ECB, there is a small however remarkable effect in riskier asset classes. Particularly affected are assets that are perceived as the closest to eligible by their rating category. This effect is also investigated by Albertazzi et al. (2016), who studies the evolvement of the ECB's APP. They find evidence for the portfolio rebalancing effect, however primarily for investors established in countries subject to slow economic growth, where the level of risk-taking is below the optimal degree. It is noted that, although portfolio rebalancing is the desired effect when launching large-scale asset purchase programmes, the direct consequence is increased risk appetite in financial markets. Albertazzi et al. (2016) argue that increased risk appetite should only be a desired effect in economies that are subject to a below optimal level of risk-taking, in order not to jeopardise long-term financial stability.

Additionally, Fratzscher et al. (2016) analyse the portfolio effect of QE programmes carried out by the Federal Reserve, on financial markets in the US and globally. They find that QE1 resulted in a rebalancing effect towards US assets while QE2 and QE3 rather shifted portfolios towards assets outside of the US. From this, they draw the conclusion that when market conditions are favourable, meaning there are good liquidity and low uncertainty in the market,

QE has a more intense transmission effect to markets outside of the US. The tendency of large-scale asset purchases to achieve amplification of transmission effect when markets are in a certain stage is also recognised by other researchers (Altavilla et al., 2015).

Moreover, there is a significant portion of research carried out evaluating the effects under the duration risk channel, studying the variation of impact across different maturities. Altavilla et al. (2015) analyse the effects of the ECB's APP. They discover that the APP announcements effectively lowers the whole term structure of both German Bunds and other long-term sovereign bond asset classes, measured using CDS4-adjusted government bonds. The research proposes that these effects on term structure and yields are mechanisms arising from alteration of the duration risk in the market, as a consequence of unconventional monetary policy intervention. Similarly, Andrade et al. (2016) find evidence in support of duration risk channel mechanisms, when looking at the announcement of the ECB's PSPP in January 2015 and the implementation of the same programme in March 2015. Looking at the secondary bond market, the analysis shows that average bond yields dropped 13 basis points after the announcement and by 14 basis points further after the implementation. Remarkedly, the effect is more pronounced in the long-term length bonds segment, among maturities of 10 years or more. This segment demonstrates a drop of around 22 basis points at the announcement and 25 basis points at implementation. The results imply that the effects are taking hold in the market through the duration risk channel.

Valiante (2015) instead look at yield curves that include all sovereign euro bonds and finds effects through an ex-ante duration risk channel. It is believed that the ECB's forward guidance contains information on asset purchases that include the purchase of long-term securities and that the market expectations around the announcement reduce term premiums and thus flattens the yield curve. Simply put, large scale asset purchase programmes contribute to a decrease in long-term security yields. Because of this, duration risk channel effects could also have fiscal policy implications, by incentivising government debt management branches to issue more long-term debt in the form of securities when purchase programmes are active, or restructuring debt to extend outstanding debt maturities.

Likewise, Vayanos and Vila (2009) lay the groundwork for a theoretical model connected to the mechanisms of the duration risk channel. They design a one-factor model that produces the risk premium for a bond's maturity and the price of duration risk, as a function of the duration risk borne by the market investor and the particular investor's level of risk aversion. They implement the model on bond data under the intervention of the QE programmes of the U.S. Federal Reserve and come to the conclusion that the purchases under the programme of long-term debt such as U.S. Treasuries and MBS lead to an alteration of the yield curve, not only amongst securities eligible under the QE programme but also specifically on other long-term assets such as corporate bonds. Gagnon et al. (2010) implement Vayanos and Vila's model from a broader perspective and use it on a more holistic level for the fixed income market. They make two important findings that can be used for forecasting. First off, asset purchase programmes cause yields on all assets with long-term maturities to decrease, including corporate bonds, MBS, government bonds and agency bonds. Second, the effects intensify for longer-term assets. In a later paper, Gagnon et al. (2011) quantify the effects and find evidence that the U.S. Federal Reserve's QE programme results in a decrease of term premium by between 30 and 100 basis points.

Looking beyond a frictionless asset pricing models, Vayanos and Vila's (2009) model rests on the important assumption that there are sub-categories of investors with specific preferences of different maturities, the earlier mentioned "preferred habitat demand" as well as another sub-set of arbitrage seeking investors, who constitute the marginal pricing duration risk investors that contribute to the model mechanisms (Krishnamurthy and Vissing-Jorgensen, 2011). This assumption is, however, a reason for concern, as it is unsure whether it is relevant only to a specific category of assets, for instance only targeted assets, or applies more broadly to several types of assets, i.e. both targeted and non-targeted (Greenwood and Vayanos, 2010).

Some findings in previous research related to the impact of duration risk relative to the local supply channel. Cahill et al. (2013) do an event study on QE programmes in the U.S., distinguishing between the importance of the duration risk channel compared to the local supply channel when looking at transmission effects on the supply. They find that the decline in yields is estimated to 4.5 basis points per $100 billion U.S. Federal Reserve purchase, only looking at specific differences deriving from duration variation. If also taking into account the

differences deriving from the local supply channel, the decline intensifies to 9 basis points. Furthermore, they find that when pre-announcement expectations are controlled for, the duration risk channel shares equal weight towards yield reactions as the local supply channel amongst U.S. Treasury yields. The findings suggest that it is not solely the size of the quantitative easing programme that lies behind effects on yields, but also its particular design concerning the term weights amongst purchases that are part of the programme.

Altavilla et al. (2015), investigate the APP by the ECB. Using a theoretical model that is used to analyse bond supply effects on term structure, they find that in the presence of investors that prefer certain bonds and specific maturities, a decrease in the market supply of these particular bonds leads to a hike in asset prices and thus a contraction of yields amongst the affected securities. The model analyses the intraday trading activity on the day of the announcement. Surprisingly it is found that in the announcement of purchases of securities with maturities in the range of 2-30 years, led to an increase in yields amongst securities with maturities of 10 years or less, while it led to a yield decrease amongst securities with maturities longer than 10 years. In line with the local supply channel, this means that what is in fact observed is a total decrease in yields amongst all term structures and that these market movements are in line with those of the duration risk channel. Although this model analyses very fast and short-term market movements, it can still point a finger towards how large-scale asset purchases affect securities through the local supply channel.

Turning attention to the U.S. Federal Reserve QE1 in 2009, D'Amico et al. (2012) investigate the local supply channel rather similarly, albeit on different grounds. Their paper looks at the rather noticeable local supply effects in U.S. Treasury term structure. The yields on particular securities that were purchased under the programme decreased, together with yields in other similar securities with the same term lengths. The analysis shows an initial 3.5 basis points yield decrease amongst only "eligible" securities, and that the U.S. Federal Reserve QE1 ultimately caused the yield curve to decrease by approximately 30 bps. On the other hand, Altavilla et al. (2015) find that the low level of distress in financial markets at the time of the announcement of the APP in January 2015, while weakening the effect of the local supply channel, permitted for a spill-over effect to non-targeted assets.

3.1.2 Announcement effects on bond yields

The rather novel nature of the CSPP and the targeting of corporate bonds has given way for additional groundwork in further analysis of large scale asset purchase programme and the effects on both financial markets, financing and corporations. Although the literature on CSPP announcements and its effect on both primary and secondary markets, at large, is rather limited, there are several papers that chronicle a tightening of credit spreads of eligible corporate bonds, following official CSPP announcements (Arce et al., 2017; Cecchetti, 2017; De Santis, 2018; Li et al., 2019; Grosse-Rueschkamp et al., 2019; Todorov, 2018; Rischen & Theissen, 2018). Some studies also point towards an immediate decrease in bond yields amongst both eligible and non-eligible bonds following the CSPP announcements (Abidi & Miquel-Flores, 2018; Zaghini, 2019).

In the literature there are works that find evidence for the immediate effect of the initial CSPP announcement in March 2016, on yields of both eligible and ineligible bonds with similar characteristics on the secondary market. Grosse-Rueschkamp, Steffen and Streitzc (2019) find that the announcement reduces corporate bond credit spreads amongst eligible bonds, as well as an increase in the amount of CSPP eligible corporate bonds issued, from an average of 49 each quarter before the announcement to 69. Through a regression discontinuity design framework that uses the difference in the credit assessment framework between the ECB and investors, Abidi and Miquel-Flores (2018) show that credit spreads decreased by circa 15 basis points when the CSPP was officially announced in 2016. They find that the impact was most noticeable amongst eligible bonds perceived as high yield by the market. Their regression also points towards the CSPP, having increased the issuance volume of corporate bonds. These results are, according to the authors, evidence in support of the portfolio rebalancing and liquidity channel. Furthermore, these results show that the CSPP does not appear to discriminate nor establish any serious disadvantages for non-eligible bonds, in comparison to eligible bonds (Abidi & Miquel-Flores, 2018).

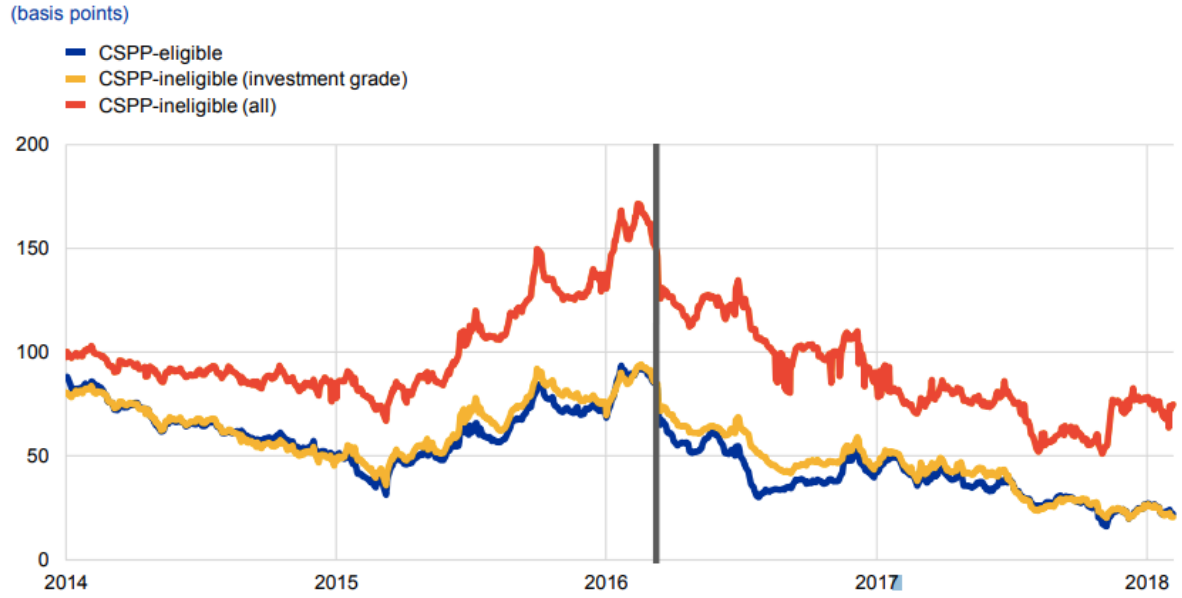
Zaghini (2019) also finds evidence for a sharp and evident decline in credit spreads in the time following the first announcement. The research evaluates the impact of the CSPP during a 12-month period, beginning in June 2016 when the purchases under the CSPP began, focusing on the primary bond market. Furthermore, to analyse the impact of the CSPP on primary market

bond yields, the paper takes an econometric approach and includes bonds issued by non-financials in the EMU. By looking specifically at the asset swap spread, the paper finds that the CSPP announcement had an effect of 35 bps decrease on both eligible and non-eligible bonds and a 70 bps decrease amongst eligible bonds. Li et al. (2019) develop a regression discontinuity research design that aims to estimate the causal effect of the CSPP on corporate bond spreads in the primary market. Their research suggests an even higher negative effect on bond spreads for eligible bonds at issuance, a greater effect than the one suggested by Abidi and Miquel-Flores (2019).

Cecchetti (2017) proposes an econometric model used to break down corporate bond spreads into discount rates by investors for unpredictable shifts in the credit environment. The model is used to analyse the reason behind the decrease in corporate bond spreads, following the 2016 launch of the CSPP. The question is whether the effect on spreads is a result of the fact that the programme influences risk appetite amongst investors and reduce their risk premiums, or if the programme minimises the expected default losses, by calming investors on the economic and financial state of corporate bond issuers. The paper subsequently builds on the notion that amongst the ECB unconventional monetary policy initiatives, the CSPP has shown most successful towards a decrease and tightening of corporate bond spreads. Cecchetti (2017) finds that the variation between the day before and after the announcement of the CSPP contributes with an average of a 16.7 bps decrease of risk premiums amongst investors and find that there is a decrease of 3.7 bps in the CDS prices for firms included in the iTraxx Europe index.

De Santis et al. (2018) review the impact of the CSPP on the corporate bond market and financing in the EMU amongst non-financial corporations (NFCs). First, they look at corporate bond spreads in the secondary market by comparing CSPP eligible with ineligible bonds and find that the CSPP announcement and its subsequent rolling out accounted for an average 25 bps decrease in corporate bond spreads for eligible bonds and a 10 bps decrease for non-eligible bonds, in the period between the announcement on the 10th of March 2016 and December 2017. De Santis et al. (2018) also looks at net issuance of long-term debt securities that are euro-denominated and finds that the CSPP seems to have contributed towards growing supply in the primary corporate bond markets, especially when looking at eligible issuers (see figure 5).

Figure 5. Corporate bond spreads



The vertical line is the first announcement of the CSPP, 10 March. Source: De Santis et al. (2018)

Todorov's (2018) analyses the impact of the 2016 CSPP announcement on debt issuance, liquidity and prices in the European corporate (secondary) bond market. The research reaches the conclusion that, amongst eligible bonds, yields declined by 30bps, or 8%, in the 3-month period following the announcement, it is also discovered that bid-ask spreads were tightened in the same period by up to 6 bps or 45%. Furthermore, the data shows that firms issued 25% more in CSPP eligible bonds than prior to the CSPP announcement. This seems to stem mostly from the phenomenon of firms switching to CSPP eligible debt and is more noticeable amongst credit-constrained firms issuing longer-term bonds. This is also Arce et al. (2017) investigate the effect on the financing of Spanish firms after the CSPP announcement and found that the tendency of bond issuance increased significantly, together with a decline in bank financing.

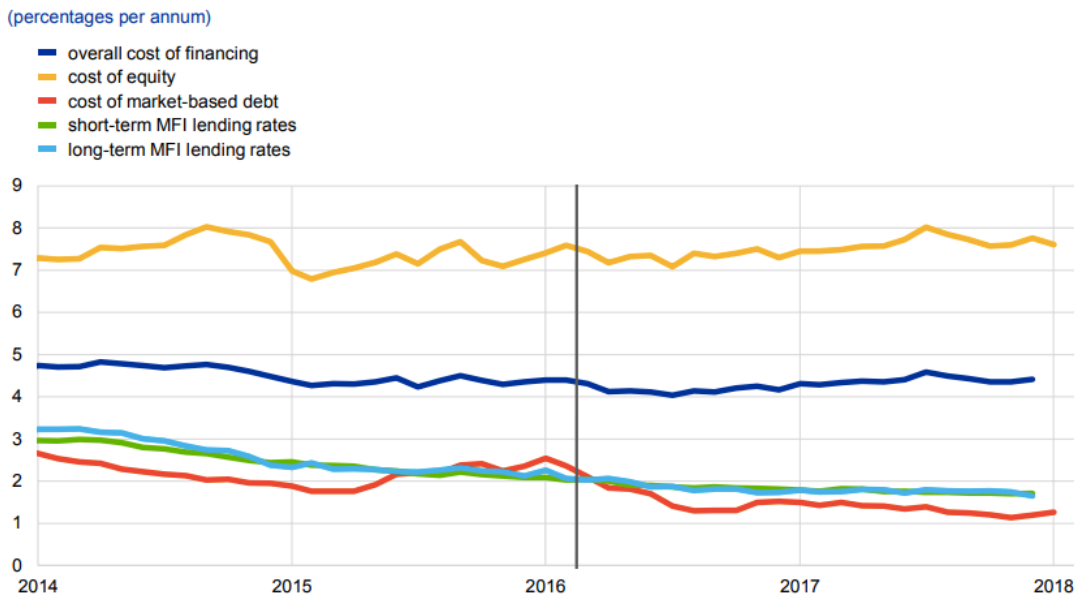
Rischen & Theissen (2018) turn their research towards under-pricing of bonds caused by under periods of unconventional monetary policy programmes. They investigate the potential under-pricing of debt by analysing a sample of EUR-denominated corporate bonds issued between 2002 and 2017, finding evidence that points towards reduced under-pricing as a result of ECB programmes, particularly concerning CSPP eligible bonds. Also, the data suggest that it is the eligibility of bonds under the CSPP that causes the decrease in under-pricing and specifically

the ECB purchasing the bond. The paper measures under-pricing by looking at individual bonds' excess return over a value-weighted index (2018).

3.1.3 Firms' capital structure and financial institutions

Up until now, the mentioned literature has largely revolved around the theoretical reasoning behind the effects of central bank purchases and the empirical research aimed at quantifying the impact on bond pricing mechanisms. Naturally, it is important to consider how these effects trickle down to the real economy. Many researchers have emphasised the fact that lower interest rates, which arises as a consequence of asset purchase programmes, can influence bank leverage and banks' risk-taking behaviour. For instance, the long period of low-interest rates before the financial crisis is said to, among other things, have initiated financial intermediaries to increase leverage and opened up for excessive risk-taking (Dell'Ariccia, et al., 2017; Taylor, 2009; Farhi and Tirole, 2012). As bond debt becomes more available to firms because of the increased liquidity and lowers interest rates in the market, firms shift from bank to bond debt and consequently, banks' lending constraints are relaxed, permitting them to take on more debt, lending to risker firms. The direct effect on yields that follows after the CSPP has an indirect effect on firms' cost of financing. This can be seen in financial condition indices (see figure 6).

Figure 6. Cost of financing*



*For non-financial corporations in Europe, ** The vertical line is the first announcement of the CSPP, 10 March. Source: De Santis et al. (2018)

Grosse-Rueschkamp, Steffen and Streitzc (2019) explore the capital structure channel of large-scale asset purchases, investigating ECB's CSPP programme following the March 2016 announcement. By exploring credit spreads of new issues and capital structure of euro area firms pre and post the announcement, the authors find support for the hypothesis that central banks' purchases of corporate bonds trickles down to a shift in corporate debt structure, initiating firms to take on more bond debt as a consequence of lower interest rates in the bond market. According to the study by Grosse-Rueschkamp et al. (2019), this reallocation of debt results in a higher level of risk-taking in banks' lending behaviour.

Evidence for the negative correlation between the higher interest rate and risk-taking in the banking sector is, in fact, found in a wide range of research. Jiménez et al. (2014) investigate the effect of declining interest rates on risk-taking among banks. Consistent with a search for yield theory, they find that lower overnight monetary policy rate leads less capitalised banks to commit to credit agreements with higher risks and fewer collateral requirements, drawing the conclusion that monetary policy can alter credit risk-taking within bank credit supply. Thus, Jiménez et al. emphasise the responsibility of central banks in "macro-prudential supervision". Similarly, Ioannidou et al. (2015), when investigating the impact of policy rates on loan supply in Bolivia, find that loans are granted to a larger extent to borrowers with worse credit history which are subject to higher credit risk when interest rates are low, and the effect is more noticeable among small firms that borrow from several different banks.

Dell'Ariccia, et al. (2017) find evidence, conversely to earlier findings, for increased risk-taking among banks with high capital underpinned by a theory of the risk-taking channel of monetary policy. Although previous findings differ in whether more or less capitalised banks are more prone to take on higher risk in a lower interest environment, they agree on the fact that lower interest rate has a positive general effect on risk-taking within financial intermediaries. Following these findings, recent academic debate is emphasising the need for policy frameworks to include financial stability considerations (Dell'Ariccia, et al. 2017).

However, there is no absolute consensus on the actual effect of increased risk-taking in banks' lending pattern on financial stability. Hoshi (2001) analyses a period of relaxed regulation in Japanese financial institutions in the 1980s, and find that the facilitation of bond issuance

enabled a shift in firm capital structure from bank to bond debt, which subsequently led to banks increasing their lending to the real estate industry, small firms and foreign-based companies. Hoshi argues that the intensifying risk-taking behaviour in lending prior to the Japanese recession in the 1990s was an important reason why banks suffered excessive losses during the "lost decade". While this is a recognised concern among many researchers, there is not yet enough empiric proof of the actual effects connected to modern large-scale asset purchase programme initiatives.

Though, there is evidence that financial intermediaries in distress can have detrimental effects on the economy. In the early 1990s, academic attention was drawn to how distress in financial institutions had an impact on credit supply in the economy. A decline in real estate prices primarily starting in the U.S. in the late 1980's had placed banks in financial distress, consequently limiting their ability to provide credit for private and public corporations. The bank credit crunch-initiated literature exploring monetary policy and the bank lending channel and its impact on the real economy. Indeed, research has shown that constraint lending behaviour among banks can have a detrimental effect on the rest of the economy (Peek and Rosengren, 2015). Peek, and Rosengren (2000) argue that effects on the real economy are heavily dependent on banks' behaviour in terms of balance sheet structure and their clients' access to different types of capital structure, and that there is evidence that economic recessions are more severe when they are accompanied by financial institutions in distress, and that credit availability is of utter importance during times of crisis.

3.2 Summary of Literature Reviewed

Previous research has investigated various aspects of quantitative easing, and specifically, the unfolding of the corporate sector purchase programme carried out by ECB in 2016. The research reaches over various topics related to the subject: the impact on yields, the channels through which this impact has been enabled, and on consequences for lenders and borrowers, or banks and corporations. A few main conclusions emerge.

There is not yet a general consensus on the effects of large-scale asset purchases on financial markets and the real economy, or on the efficiency and predictability of transmission channels. However, many researches are conclusive on the fact that price effects are produced following

the announcement of programmes rather than when purchases are actually carried out, supporting the existence of a signalling channel. Also, there is large evidence supporting the fact that quantitative easing programmes contribute to large liquidity effects though boosted demand and bond placements by firms.

From the existing literate (Krishnamurthy & Vissing-Jorgensen, 2011) we know that if quantitative easing also affects bonds that are not the targeted assets of the programme, these effects will probably be larger on assets which are similar to the targeted assets. The portfolio balance effect takes many shapes and forms, but perhaps the most evidence is the duration risk channel. There is large evidence, arising from previous research, in support of a duration risk channel. In other words, that the fall in yields is larger on longer duration assets (Andrade et al., 2016). Additionally, it is generally noted that the effect of transmission might be heavily dependent on the assets purchased and the extent of market segmentation in the targeted market (Di Maggio et al., 2016). Finally, many researchers seem agree on the fact that programmes that are introduced in periods of financial turmoil have shown to be the most effective (Altavilla et al., 2015; Zaghini, 2019; Di Maggio et al., 2016).

3.3 Justification for the Study

Research regarding the recent announcement to restart the CSPP, and particularly its effect on primary markets is limited. Previous research is valuable for creating an understanding of the theorised field of quantitative easing. It is, however, not wholly comparable due to the different characteristics related to the time of the announcements, the particular market environment and the composition of target segments.

We build on previous research to assess the impact of the announcement to restart the APP in general and CSPP in particular. We complement the existing literature by investigating the effects of ECB's second large-scale asset purchase programme on bond spreads in the euro market, which has not yet been done. One important aspect of the CSPP compared to programmes targeted for government bonds is that it also allows for purchases on the primary bond market. While a significant part of previous research on ECBs asset purchase programme has focused on evaluating the secondary bond market, we focus on the primary bond market. While the secondary bond market is representative of market assessment of specific trades and

most likely has a large impact on the issuance pricing mechanism in subsequent periods, the primary bond market is where the actual cost of financing is determined and where borrowers receive funds from investors. In that way, we hope to isolate the potential easing of firms' borrowing costs.

4. Research Design

Inspired by previously mentioned authors and researchers, this study aims at estimating effects in the primary bond market, caused by the ECB's announcements related to the CSPP. Considering the nature of financial data, the approach best suited to arrive at this aim, is to carry out a research through a quantitative evaluation study, using both descriptive and inferential statistical analysis, as have been done before by various authors.

The purpose of this chapter is to provide an explanation of the research which lies behind the empiric results. First, we describe how data was collected and the motivation behind decisions on sample limitation and time intervals, as well as how the collected data was sorted and prepared for analysis. Then, the method is presented, describing the general models, the econometric approach and the process for the testing of hypotheses.

4.1 Sample

4.1.1 Data collection

We collected bond issue data from Bloomberg. These data include statistics connected to the bond or issuer. Since all ratings are not available on Bloomberg, we complemented the data with rating information from Capital IQ. We gathered company information from Compustat Global. Several indices were gathered from various sources: the stock market volatility index Euro stoxx 50 was obtained from Bloomberg, systemic stress index from ECB (Statistical Data Warehouse, 2020), business cycle index from the Banca d'Italia (CEPR, 2020), uncertainty index from EPU (Economic Political Uncertainty, 2020) and corporate risk index from Banque de France (2020). All high-frequency data referring to the state of the market and the economy are gathered at the time of issuance of the specific bond issue, while all data referring to the eligibility of the bond issued, is gathered as it was before the announcement date. Rating information was obtained as it was at the beginning of the time period studied.

4.1.2 Sample delimitation

While some previous research on the subject implements similar methods as in this paper have limited their sample by a definition of the European bond market according to the issuer's geographic location in Europe, we limit our sample according to the euro currency

denomination of the bond. This is based on the fact that firms that issue euro-denominated bonds do so because they either have interests in the European market, or they have interests in the euro currency, which in turn is heavily dependent on the state of the European economy.

This delimitation is preferable because it also helps offset the endogeneity of the group identification. This is due to the group possibly being endogenous due to the IG-rating criteria. A possible instant demand for IG-rated bonds could impact the credit spread, which would be independent of the CSPP announcements. However, through including also IG-rated non-eligible firms in the control group, we minimize the potential endogeneity caused by rating specific demand fluctuation. Additionally, we also include controls and fixed effects to study the sensitivity.

4.1.3 Time interval and sample size

We use two different time frames to our sample. The first, larger sample includes all euro-denominated non-financial corporate bonds that were issued during the period 01.01.2015 - 01.04.2020. The sample is used to obtain a longer-term perspective on trends , i.e. the evolution of amount issued and the number of issues, as well as the composition of the groups studied. In this sample, 6738 ISIN[1] codes were extracted. The second time-frame applied is intended for a regression analysis of the announcement effect. In this case, it was needed to tackle the issue of cut-off dates. When looking at financial market movements, it can be necessary to be aware of events potentially being priced in, and such might very well be the case when looking at the restart of ECB's CSPP on the 12th of September 2019. After reviewing the secondary bond market trends during 2019, it was grasped that the announcement of a restart of the CSPP might have been anticipated following Mario Draghi's speech on the 18th of June. This is discussed in section (2.1.2.4) *Beyond official dates*.

Based on the previous discussion, we use two periods in the analysis, in order to uncover if there were any impact already before the official announcement. This approach is inspired by Todorov (2018), who uses two periods when evaluating the effect on secondary bond market yields, following the initial announcement of the CSPP in March 2016, and the announcement of criteria approximately one month later. In the regression analysis, the period between the

[1]ISIN = International Security Identification Number

speech on the 18th of June 2019 and the CSPP restart announcement on the 19th of September is defined as the *Interim* period and the period following the announcement as the *Post* period. Due to this happening over the summer when market activity usually is relatively low, we use 3 months-periods in order to capture effects. Therefore, the samples time interval starts one quarter before the first cut-off date, and terminates one quarter after the second cut-off date, in other words, including all bonds issued during the period 18.03.2019-12.12.2019. This sample, reaching over approximately nine month, consists of 1360 individual securities. 790 of these have zero or fixed coupon rates. The sample also includes variable or floating rate bonds, these ISINs are however not included in the credit spread analysis, but the bond value analysis.

4.1.4 Data preparation

The first step is to categorize the data according to whether an individual bond issue is CSPP eligible before the announcement of the programme, to define the treatment and control group. The data is sorted according to the eligibility criteria provided by ECB as described in section (2.1.2.2) *The CSPP*, i.e. bond issues are filtered according to issuer country of risk, as only euro area residents are considered to be eligible according to the framework of the programme. Then, all issues are categorized by the "first-best" credit rating. The "first-best" credit rating method is in line with the methodology used by ECB when evaluating eligibility for purchase under the CSPP. However, in the presence of conflict between issue rating and issuer rating, the former has priority over the latter. Since there is no total outstanding amount limit to the programme, all amounts are considered for eligibility. However, bonds with less than six months to maturity are excluded as these are not eligible under the programme framework.

The second step is to obtain values on our variables of interest. In the descriptive and inferential statistical analysis, we focus on three main variables, namely credit spread, bond value and the number of issues. Whereas the amount is provided by the database and number of issues is easily computed, Bloomberg does not provide yield to maturity at issuance for all ISINs, but provide the issue offer price, years to maturity, coupon type and coupon amount. Here, we only use fixed or zero-coupon bonds, as proposed by Elton et al. (2001), because bonds with floating or variable rate bonds may cause disturbance to the sample. According to Elton et al. (2001), the preferred way to measure spreads is to use the spot rates on zero-coupon corporate bonds.

However, due to the small sample, it is believed that the analysis would profit from larger sample size, and we, therefore, include also fixed coupon bonds.

We construct yield to maturity at issuance, by using the face value, the price and the coupon amount of the bond. The calculation method of yields is based on the coupon type of the bond, whether it is fixed or zero-coupon. For zero-coupon and fixed coupon rate bonds, we use the following formulas, where *n* is number of years to maturity:

$$Yield\ to\ maturity_{zero\ cpn} = \left(\frac{FV}{Price}\right) \wedge \left(\frac{1}{n}\right) - 1$$

$$Yield\ to\ maturity_{fixed\ cpn} = \frac{\left(\frac{FV - Price}{n}\right) + C}{\left(\frac{FV + Price}{2}\right)}$$

Then, we calculate the spread using an I-spread technique. In the formula, y_C is the yield to maturity of the corporate bond and n_C is the maturity of the corporate bond, n_{G1} and n_{G2} are the maturities of two government bonds, and y_{G1} and $y_{G2}$are the yields on those government bonds (O'Kane & Sen, 2004):

$$I - spread = y_C - \left[y_{G1} + \left(\frac{y_{G2} - y_{G1}}{n_{G2} - n_{G1}}\right)(n_C - n_{G1})\right]$$

We thus obtain credit spreads (I-spread) at the time of bond issuance, using the yield to maturity at issuance, and comparing this to the maturity-matched risk-free yield, we use generic German government bonds yields sourced from Bloomberg as reference yield curve.

4.1.5 Data quality

It is essential to deliberate on the quality of the data gathered for the analysis. The primary source of data is Bloomberg, which is a database extensively used for the evaluation of financial data. However, as earlier mentioned, Bloomberg does not provide rating on all issues, and it was thus necessary to complement the data with rating information from Capital IQ, which is controlled by Standard & Poor's, and thus only contributing with S&P ratings. Thus, there may

be a small divergence in the sample, of firms that are not rated. However, the issue of missing rating data, at its most, implies that the results are in the lower bound.

4.2 Method

The study is executed through estimating differences between a treatment group and a control group over specific periods of so-called intervention. In this case, the intervention is forward guidance by the ECB. Motivated by the aim to estimate the level of impact of announcements, on new corporate bond issuance in the primary euro bond market, the analysis concentrates on indicators before, around, and after the announcement. We specifically look at effects on the pricing mechanism of bonds, and the aggregate volume of issues. The credit spread is a good indicator of pricing mechanisms when assessing the bond market, since it is an expression of the additional interest that a lender requires to be compensated for the additional risk, compared to an equivalent "risk-free" alternative.

We follow the methodologic approach used by Todorov (2018) when evaluating the impact on bond yields following the ECB's announcement to launch the CSPP back in 2016. Like Todorov, we use two periods to evaluate the effect. We take a window of approximately three months before the announcement, as well as a window of three months following the announcement, and compare the development of new issues of CSPP eligible vs non-eligible bonds. The first period is from June 18th, when informal announcements regarding the CSPP were made, until the formal announcement on September 12th. The second period consists of the three months following the formal announcement.

However, contrary to Todorov, who executes his analysis on the secondary bond market of already issued securities, we analyse the primary bond market. In other words, we study the impact on new issues. In related literature, the study of the primary bond market is rather uncommon. This is probably because the secondary bond market offers high-frequency data in terms of both yields and bid-ask spread and also various other indicators. The primary bond market offers limited data, especially under such a limited time period as a couple of months. Still, the primary bond market is where the final cost of financing is determined. Since it is provenly responsive to changes in the economic environment, it is a suitable measure of sentiment amongst investors and paints a fair picture of the prevailing financing conditions for

firms during a specific period. Therefore, the method also draws inspiration from Zaghini (2019), who concentrates on the primary bond market for evaluation of the CSPP (however following events in 2016).

Like Zaghini, we mostly look at bond spreads at issuance to estimate the impact of the CSPP announcement but also include an analysis of the bond issuance volume. We use a step-by-step built on a model in the analysis to estimate the effects. First, we use a difference-in-differences approach. Next, we adjust the model by adding certain control variables, which are connected to the determinants of the credit spread. Then, we estimate the differences using fixed effects, including also time and firm/ bond-fixed effects. It turns out, that the model including control variables and the fixed effects proves more effectful in correctly specifying the data. The approach, the underlying assumption and the model will be closer explained in the next sections.

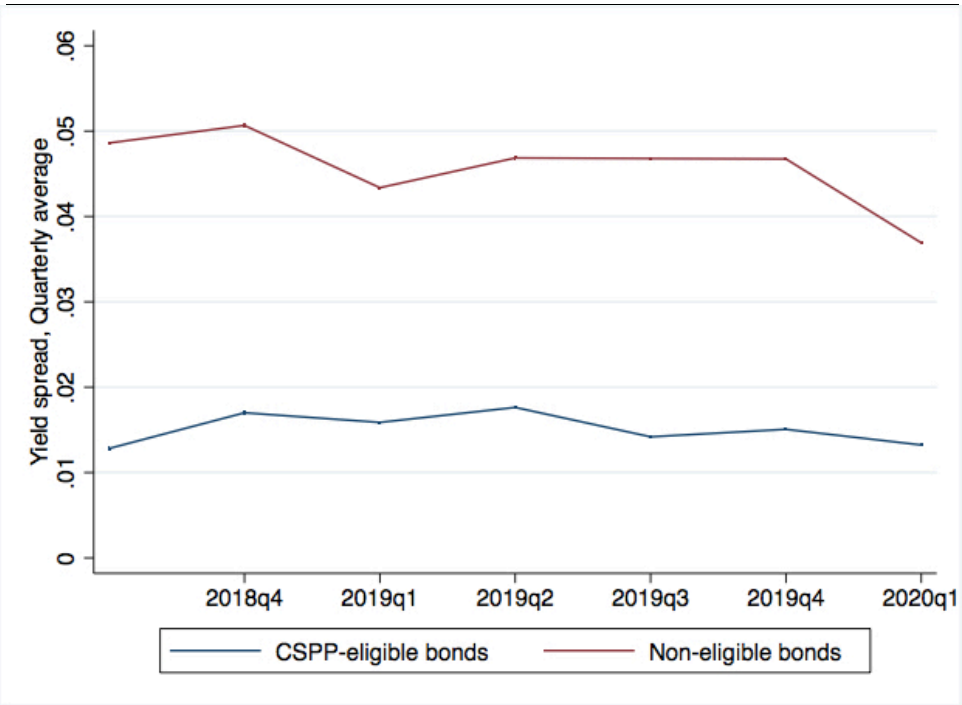
4.2.1 Difference-in-differences

When estimating interaction effects, there is often concern over the inference. Specifically, a common issue when analysing financial market data is that it is very influenced by a lot of external variables, and it can be difficult to single out and isolate a particular element of effect. In order to minimise error in the study, we estimate the effect using a difference-in-differences approach, also known as controlled before-and-after study. Difference-in-differences is a quasi-experimental statistical method using longitudinal data. By measuring the difference between an intervention group and a control group over time, the causal effect of the intervention can be measured. The difference-in-differences method is recurrently used in related literature (Todorov, 2018; Grosse-Rueschkamp et al., 2018) in order to isolate a deterioration of a subset within a larger sample.

In addition to the classical assumptions of OLS regressions, a difference-in-differences approach relies on a critical precondition known as the parallel trend assumption, which separates the model from the aforementioned fixed-effects model. The assumption holds that the treatment group and the non-treatment group follow a similar trend, in order for the analysis of the interaction term to be plausible. We investigate this assumption by looking at the movement of CSPP-eligible vs non-eligible bonds over time. Because of the previous

intervention of the program during 2016-2018, we use a shorter time period to see if the trends between the two groups are in fact, parallel. Looking at a graph depicting the last seven quarters, from Q3 2018 until today, we can see that the parallel trend assumption is satisfied between the two groups.

Figure 7. Parallel trend assumption



Furthermore, the method also presumes that the composition of the treatment and control group is stable. The first part of the analysis investigates this assumption by looking at the different components of eligible and non-eligible bonds over a longer period of time, 2015 until today. Even though there are changes over year to year, the difference does not alter the sample in such a way that it would impact the analysis.

Lastly, for the analysis to be reliable, the difference-in-differences analysis holds that there can be no spill-over effects. The issue of endogeneity of treatment is also referred to by Grosse-Rueschkamp et al. (2019) in their study on the capital structure channel in relation to the CSPP. Similar to Grosse-Rueschkamp et al., we use an "intention-to-treat" approach, defining the treatment group as the bonds within the sample that are potential candidates to be purchased under the program. The "intention to treat"-method is the preferred approach when investigating large scale asset purchases by central banks since the method accounts for the

spill-over effect on bonds that are not actually bought under the program, but yet are eligible for purchase. The approach accounts for the spill-over effect brought on by mechanisms initiated through the portfolio rebalancing channel and duration risk channel as described earlier.

4.2.2 Including fixed effects

Including fixed effects in the model helps us identify differences across categorical variables, and saturate variation that is specific from one group to another. The fixed-effect model allows for cluster robust variance estimation. In the sampled studied, there is a high degree of variance across specific groups. According to previous research focused on bond spread, there are certain variables which are particularly relevant to study for cross-group variation. Energy sector bonds are priced differently, for instance, compared to the manufacturing sector. The fixed effect model used in the regression accounts for the influence of clusters on the standard errors, assuming that the number of categories within the categorical variables stay fixed as the sample grows, which is valid for the categorical variables in the model.

Furthermore, fixed effects regressions are a good way to account for omitted variable bias. If we are to believe that these omitted variables are independent of time, fixed effects can help reduce the bias that may be caused within specific categories. While the above-mentioned model included time and group dummies to identify the time interval of intervention, the fixed-effect model includes time fixed effect. In our model, this is specifically quarterly fixed effects, which identify changes over all three quarters included in the sampled time interval.

4.2.3 General assumptions

The analysis is based on certain assumptions that are common for classic OLS regressions. To start with, it is assumed that the parameters are linear, which is true in our sample. It is also assumed that the sampling of observations is random. Here, there might be some concern, the experiment is not perfect in its execution as the intended treatment group in the sample is not randomly distributed, but based on possibly endogenous variables such as the issue rating and firm rating, size and residency. We minimize the endogeneity by including covariate variables controlling for firm and bond specific fixed effects.

Furthermore, the assumptions hold that the conditional mean should be zero, which mean that the distribution of the error term should not depend on the independent variables in the regression. Moreover, there must be no perfect or multicollinearity between the independent variables in the regression, and heteroscedasticity should not be present in the sample. In our sample, the numerical variables referring to the size of the firm and the total value of the bond both show signs of heteroskedasticity. To solve for higher and biased numbers, we use the logarithmic value of these variables.

4.2.4 The econometric approach

The interaction variable is a combination of time dummy and group dummy, and serve as a proxy for the general market condition, which is not dependent on the explanatory variables that are later included in the model. In this sense, the interaction variable measures the effects on only the treatment group. As we are evaluating two periods of interest, named inter and post, both interaction variables must be included in the regression together. The baseline model, without explanatory variables, is the following for observations $i = 1,\ldots, N$ and time periods $t = 1,\ldots, T$ and group g, where s is the credit spread.Analytically:

$$s_{itg} = \beta_0 + \beta_1 Treat_g + \beta_2 Inter_t + \beta_2 Post_t + \beta_3 Treat \times Inter + \beta_3 Treat \times Post_t + \varepsilon_{it} \quad (1)$$

The model is subsequently altered by included various controls. The selection of covariates is based on a framework used by Zaghini (2019), explained in the section (2.2.3.2) *Determinants of credit spread*. The model includes three main sources of risk, namely the bond characteristics, firm-level characteristics and market environment, described analytically in the following regression (from Zaghini, 2019):

$$spread = \beta_0 + \sum_k \beta_k V_{i,k}^{bond} + \sum_l \beta_l V_{i,l}^{issuer} + \sum_z \beta_z V_{i,z}^{market} + \varepsilon$$

$V_{i,k}^{bond}$ represent the K variables that we include in our model to track the specific bond features that impact the spread. In this regard, we include time to maturity, the amount outstanding and the issue rating. $V_{i,l}^{issuer}$ represent the L firm-level characteristics that we include to account for

specific features of the issuer. Thus, we incorporate the following firm-level regressors: size and a variable named "1-timer", describing whether the firm is a regular bond issuer or not. As described in the model, there are also variables controlling for market condition in the regression, which is represented in $V_{i,z}^{market}$. The selection of market controls is also inspired by Zaghini's approach, measuring volatility, business cycle, systemic stress, policy uncertainty and corporate credit risk at a country level.

$$s_{itg} = \beta_0 + \beta_1 Group_g + \beta_2 Time_t + \beta_3 Group_g \times Time_t + \sum_k \beta_k V_{i,k}^{bond} + \sum_l \beta_l V_{i,l}^{issuer} + \sum_z \beta_z V_{i,z}^{market} + \varepsilon$$

As described earlier, for models where there is a possibility for omitted time-invariant variables, fixed effects are preferable. Therefore, we add time fixed effects λ_t, automatically omitting time and group dummies. Thus, the model becomes:

$$s_{itg} = \beta_0 + \beta_3 Group_g \times Time_t + \lambda_t + \sum_k \beta_k V_{i,k}^{bond} + \sum_l \beta_l V_{i,l}^{issuer} + \sum_z \beta_z V_{i,z}^{market} + \varepsilon$$

Next, we add time fixed effects λ_t, where λ_t is the time fixed effect per quarter, omitting time and group dummies. Thus, the model becomes:

$$s_{itg} = \beta_0 + \beta_3 Group_g \times Time_t + \sum_k \beta_k V_{i,k}^{bond} + \sum_l \beta_l V_{i,l}^{issuer} + \sum_z \beta_z V_{i,z}^{market} + \lambda_t + \varepsilon \quad (2)$$

Then, we add industry fixed effects, controlling for across-sector variation which is constant over time. Thereafter, we add country fixed effects, controlling for possible country-specific variation which may cause fragmentation in the euro currency bond market. α_i is the fixed effect per industry and per country? Analytically this becomes:

$$s_{itg} = \beta_0 + \beta_1 Group_g \times Time_t + \sum_k \beta_k V_{i,k}^{bond} + \sum_l \beta_l V_{i,l}^{issuer} + \sum_z \beta_z V_{i,z}^{market} + \lambda_t + \alpha_i + \varepsilon_{gt}$$

We run these regressions using credit spread as the dependent variable, first with the treatment group defined as CSPP-eligibility, then we also look at the treatment group defined as IG-rated. We also estimate the regression on different subsamples. Next, we use the total bond value as the dependent variable.

4.2.5 Procedure for testing hypotheses

The above-mentioned method is used to test the hypothesis 1-4. The first hypothesis, H_1, is related to the credit spread of the bonds specifically targeted by the CSPP programme and states: *The announcement resulted in an initial decrease in credit spread, which was larger for bonds eligible for purchase under the CSPP compared to non-eligible*. Since we investigate two different time periods, we look at both period Post and period Interim. Analytically, for the difference δ in credit spread *s* of the treatment group *T* at the post announcement period *P* or at the interim period *I*, the alternative and the null hypothesis are:

H_1: $\delta s_{TP} < 0$ or $\delta s_{TI} < 0$
H_0: $\delta s_{TP} \geq 0$ and $\delta s_{TI} \geq 0$

The second hypothesis is connected to the duration of the assets: *Within the targeted asset class, the decrease in credit spreads was larger for assets with longer maturities compared to shorter maturities.* Analytically, for the difference Δ of the differences δ in credit spread *s* of the treatment group *T* at time *t* for short-term maturities *ST* and long-term maturities *LT*:

H_2: $\Delta\delta sST_{TP} < \Delta\delta sLT_{TP}$ or $\Delta\delta sST_{TI} < \Delta\delta sLT_{TI}$
H_0: $\Delta\delta sST_{TP} \geq \Delta\delta sLT_{TP}$ and H_0: $\Delta\delta sST_{TI} \geq \Delta\delta sLT_{TI}$

The third and fourth hypothesis is related to the total value and total number of bonds issued. H_3: *The total value of new issues in the CSPP eligible bond segments increased in the period following the announcement as compared to the period before.* Analytically, for the difference δ in bond value *V* of the treatment group *T* at post period *p*:

H_3: $\delta V_{Tp} > 0$

H_0: $\delta V_{Tp} \leq 0$

And H_4*: The number of new issues in the CSPP eligible bond segments increased in the period following the announcement as compared to the period before*. Thus, for the difference δ in number of issues *N* of the treatment group *T* at post period *p*:

H_3: $\delta Number_{Tp} > 0$

H_0: $\delta Number_{Tp} \leq 0$

H_1 is tested in section 1 of the part (5.2) *Hypothesis testing*, whereas H_2 is tested in section 2, and H_3 and H_4 are tested in section 4 of same part.

4.3 Validity and reliability of the method

The method of measuring spreads in order to assess the impact of purchase programmes, according to the above-explained method, has been extensively used by previous authors who investigate the same topic, especially within research carried out on behalf of the ECB itself. This fact brings validity to the choice of method. The spread is a good indicator of the sentiment in the bond market as it measures the premium required by the investor to hold the extra risk. As such, it also tells us about the investment conditions for firms.

However, the method also has some weaknesses. As far as the time intervals is concerned, the results arrived at in the analysis is dependent on the arrangement of time intervals and cut-off periods. As for instance, the cut-off periods used in this paper are approximately quarterly lengths, while other studies have used both longer and shorter periods. Meaning, the results are clearly dependent on the definition of the period under investigation.

The choice of cut-off dates also raises some concern. As discussed earlier, the cut-off dates used in this paper are not only defined by official announcements but also on indicators deriving from the ECB speeches. The case under investigation in this paper does bring some complications, as it was clear looking at indices over the secondary bond market, that it seemed the market had already priced in the effect of the anticipated restart of a QE programme. In

order to minimise the error caused by vagueness of the forward guidance sent out by the ECB, the analysis look at both the pre and post period of the official announcement. Finally, while analysing spreads is an efficient way to measure the instant and short-term effect of programme announcements, it does not in any way provide assessment on the persistence of policy effects.

5. Analysis of Data and Interpretation of Results

The purpose of this chapter is to present the empirical results, which were generated using the method outlined in the previous chapter. First, we evaluate the direct effect on credit spreads on new issues, investigating the difference in changes in spreads between CSPP eligible and non-eligible bonds. Then, we estimate the effects on spreads across different rating classes and across different maturities. Finally, we evaluate the evolution of bond quantity issued during the year of the announcements.

5.1 General Description of Data

The main variables included in the following empirical analysis are presented in table 1, on the next page. The table presents the definition and type of variables as well as the respective measuring units and the frequency of data. Additional information about the sample and the distribution within the sample can be found in the appendices.

Table 1. Description of variables

Variable	Description
Credit spread	Refers to the I-spread of the bond, that is, the difference between the yield to maturity of the bond and the risk-free equivalent, with regards to time to maturity and coupon.
Treat	Describes whether the bond is eligible for purchase under the CSPP or not. This is a dummy variable which takes the value 1 if the bond is eligible and 0 if it is not eligible.
Inter	Describes the period of three months from the speech made by Mario Draghi until the official announcement of the restart of the CSPP, June 18th – September 12th 2019. Dummy variable which takes the value of 1 if the issue is within this period.
Post	Describes the period of three months after the official announcement of the restart of the CSPP, September 12th – December 12th 2019. Dummy variable which takes the value of 1 if the issue is within this period.
Maturity	Refers to the time to maturity of a bond at the time of issuance. The variable is expressed in the amount of days left to maturity.
Bond value	Describes the total amount issued of the bond. The variable is expressed in the logarithmic value of the exact amounts in euro.
Rating	Describes the bond and/or issuer rating according to a scale of 1 - 6, where 1 is best (lowest) credit risk class rating and 6 is worst (highest) credit risk class rating. With regards to the sample size, ratings are grouped by the broader category, i.e. BBB includes both BBB-, BBB and BBB+. All issues that have a rating below B or no rating at all are classified as "Junk" bonds. In case of conflicting ratings, the bond rating takes priority over the issuer rating.
IG	Describes if the bond and/or issuer is Investment Grade-rated. This is a dummy variable which takes the value 1 if the bond or bond issuer is IG-rated and 0 if it is not. In case of conflicting ratings, the bond rating takes priority over the issuer rating.
1-timer	Describes if the firm is a regular bond issuer. The variable is a dummy variable and takes the value 1 if the firm has only issued one bond during the period: January 1st 2015-April 1st 2020.
Size	Refers to the size of the bond issuer. Here, we use turnover of the last 12 rolling months at the time of issuance as a proxy for the firm size. The variable is expressed in the logarithmic value of the exact value in euro.
Country	Country of issuer is defined as the country where the issuing company of the bond is headquartered.
Industry	The firm industry is defined as the issuer industry group, and has 10 categories.
Market volatility	The VSTOXX index measuring volatility in the European stock market, frequency per day.
Business cycle	The New Euro coin index measuring macroeconomic conditions in the European area nowcasting GDP, frequency per month.
Systemic stress	The Composite indicator of systemic stress regularly updated by ECB statistical data warehouse index (2020), frequency per week.
Uncertainty	The EPU index measuring geopolitical uncertainty based on newspapers articles, frequency per month.
Corporate risk	The non-financial corporate credit risk index based on yields on corporate bonds aggregated at a country level, frequency per month.

The dataset exploited in this paper originally consists of 6738 individual securities issued over the period Q1 2015 - Q1 2020, by 1855 individual non-financial corporations. Table 2 provides an overview of the development of bond issuance, reaching over a period starting just before the inception of the CSPP programme Q1 2016 - Q1 2020. The table shows the volume issued, the year over year changes, the cumulative volume over the four last quarters and the total number of issuances each quarter. A distinction is made between bonds that are eligible for purchase under the CSPP and bonds that are not. It appears that after the initial announcement of the CSPP in Q1 2016, eligible bonds experienced a year over year increase in the four quarters to follow (Q2 2016 - Q1 2017). Looking at non-eligible bonds, this positive trend is even stronger, although starting one quarter later, in Q3 2016, and continuing with a year over year increase in each quarter until 2018 Q2.

Interestingly, there are signs of a slowdown of the upwards trend of bond issuance during the course of 2018, noticeable in both segments. It is remarkable, that while the eligible segment slow downed already in 2017, non-CSPP-eligible bond issuance continued way into 2018. As is known, the ECB announced that purchases under the CSPP would terminate in December 2018. However, looking at the table, there are signs of lower primary bond market activity months before that announcement. A possible explanation is that the surprise element of the forward guidance had cooled off, and the supply had adjusted to the new demand in the market.

Looking at the table, it is evident that there has been a steady increase in bond issuance volume over the four years of CSPP activity. From the column depicting cumulative amounts, it appears that the volume of bonds issued has increased on a yearly basis over the years 2016 until 2019, and with quite remarkable amounts, on average more than €100 billion per year. In Q1 2020, the cumulative volume of bonds issued (in both segments) was almost twofold the cumulative amount of Q4 2015, and the total number of issues in 2019 (1640) was 65% more than the total number of issues in 2015 (991). In fact, in 2019, it appears that bond issuance picked up again in Q2, just at the time of new announcements from ECB.

Table 2. Bonds issued by volume and type

	CSPP-eligible bonds				Non-eligible bonds			
	Volume	**YOY**	**CA(4) v**	**Issues**	**Volume**	**YOY**	**CA(4)**	**Issues**
2015 Q4	24 776		120 253	81	37 346		259 562	156
2016 Q1	30 430	-10 057	110 196	52	55 243	-46 182	213 380	124
2016 Q2	62 536	31 683	141 879	121	66 168	-14 150	199 230	168
2016 Q3	32 844	8 707	150 586	69	50 407	9 934	209 164	152
2016 Q4	46 711	21 935	172 521	86	64 168	26 822	235 986	194
2017 Q1	54 569	24 138	196 659	103	74 189	18 946	254 932	182
2017 Q2	44 964	-17 572	179 087	92	89 383	23 215	278 147	277
2017 Q3	32 201	-643	178 444	68	81 603	31 196	309 343	260
2017 Q4	35 973	-10 738	167 706	61	113 488	49 319	358 662	348
2018 Q1	48 490	-6 079	161 628	70	86 773	12 584	371 246	268
2018 Q2	41 621	-3 343	158 285	68	74 531	-14 851	356 395	262
2018 Q3	42 001	9 800	168 085	71	82 159	556	356 951	286
2018 Q4	34 946	-1 027	167 058	57	109 478	-4 009	352 942	315
2019 Q1	59 218	10 728	177 786	83	75 103	-11 670	341 272	197
2019 Q2	46 358	4 737	182 523	85	112 664	38 133	379 405	342
2019 Q3	61 160	19 159	201 682	100	99 716	17 557	396 962	352
2019 Q4	45 625	10 679	212 361	133	124 922	15 444	412 406	348
2020 Q1	40 605	-18 613	193 748	64	108 695	33 592	445 998	280

	Total euro-denominated bonds				
	Volume	**YoY**	**CA(4)**	**Issues**	**CA(4)**
2015 Q4	62 122		379 815	237	991
2016 Q1	85 673	-56 239	323 576	176	
2016 Q2	128 704	17 533	341 109	289	
2016 Q3	83 250	18 642	359 750	221	
2016 Q4	110 879	48 757	408 507	280	966
2017 Q1	128 758	43 084	451 591	285	
2017 Q2	134 347	5 643	457 234	369	
2017 Q3	113 804	30 553	487 787	328	
2017 Q4	149 461	38 582	526 369	409	1391
2018 Q1	135 263	6 505	532 874	338	
2018 Q2	116 152	-18 195	514 680	330	
2018 Q3	124 160	10 357	525 036	357	
2018 Q4	144 424	-5 036	520 000	372	1397
2019 Q1	134 321	-942	519 058	280	
2019 Q2	159 022	42 870	561 927	427	
2019 Q3	160 877	36 716	598 644	452	
2019 Q4	170 547	26 123	624 767	481	1640
2020 Q1	149 300	14 979	639 746	344	

The sample studied in the rest of the paper consists of 1360 bonds issued in the period Q2 – Q4 2019. The sample include bonds issued by 642 individual corporations, from 42 countries, of which 457 are incorporated in countries included in the euro area[2], and 185 corporate issuers that are from outside of the euro area. Table 3 presents the summarized descriptive statistics for the sample. As presented in chapter (4.2.4) *Econometric approach*, the variables that are used in the inferential statistical analysis and presented in Table 3 are included because of their influence on the credit spread. They belong to one of three main categories: bond features, firm-level characteristics and market condition.

Table 3. Summary descriptive statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
YTM	790	0.0253	0.0245	-0.0276	0.180
Credit spread	790	0.0303	0.0250	-0.0194	0.186
Bond maturity	1,359	6.690	5.160	0.253	30.57
Bond value (bn)	1,360	0.362	0.337	0.005	2.057
Bond rating	1,360	4.415	1.655	1	6
Bond coupon	1,360	1.979	2.385	0	15
Country	1,360	-	-	1	30
Industry	1,360	-	-	1	10
Size (bn)	1,360	13.174	23.987	2.889	230.6
1-timer	1,360	0.0971	0.296	0	1
Market volatility	1,356	14.66	2.312	11.01	22.54
Business cycle	1,360	0.157	0.0216	0.130	0.200
Systemic stress	1,360	0.720	0.226	0.224	1.243
Uncertainty	1,360	0.255	0.0320	0.186	0.308
Corporate risk	1,360	0.791	0.115	0.623	0.973

Source: Bloomberg, Compustat Global, Capital IQ, ECB, Banque de France, EPU.
YTM is the yield to maturity calculated based on previously presented technique. The credit spread is the I-spread. Maturity is counted in days and bond value in billion euros. Rating is a scale from 1-6 where 1 is the lowest risk (equivalent to AAA), and 6 is worst (B or below) or no rating. Size is turnover in bn euros. 1-timer describes if the issuer has only issued one bond in the period 2015-01-01 until 2020-04-01. Market volatility is measured by the daily VSTOXX index. Business cycle is the euro coin index. Systematic stress is the CISS index, the EPU index measures Uncertainty, and Corporate risk is non-financial corporate euro area index.

[2] Euro zone countries: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, The Netherlands, Portugal, Slovakia, Slovenia and Spain

The variables credit spread (and bond value) serve as the dependent variable in the analysis below, while variables maturity, bond value and rating are included to account for bond-specific features. The variable maturity is expected to have a positive impact on the spread since longer time to maturity increases the interest rate risk for the bondholder. Bond value, on the other hand, is a matter of assessment following the analysis. This is because a large amount issued may increase the costs for the issuer, which would have a positive impact on the spread. Though, it also allows for increased liquidity up for trade on the secondary market, which would imply an easing of the issue, in that sense a negative impact on the spread. Furthermore, given the scaling of the rating variable, the variable is expected to be positively correlated with the spread as worse rating and higher risk would imply a higher spread. From the summary of the bond-specific features, it appears that an average bond in the sample has a maturity of about 7 years with an amount of €400 million, a coupon rate at 2%, a yield to maturity of 2.5%, a credit spread of 3% and a rating below IG. In fact, it appears that the majority of the sample consists of non-IG rated bonds. The high degree of standard deviation in the variables reflects a significant variation in the sample, which is expected because of the different risk classes.

Firm-specific variables are included to account for features that influence the spread. Turnover is included as a proxy for firm size. It is expected to be negatively correlated with the spread since, as previously discussed, large firms are often perceived as more stable and resistant in times of financial distress. From the summarizing table, significant variance appears in terms of size and that the variable is considerably biased towards the lower bound. This is because of some outliers in the upper bound. As earlier described, the logarithmic value of size is used to minimize heteroskedasticity of the large and biased variables. The issuer industry group variable initially consists of 60 categories but is arranged into 10 general industry categories as proposed by Bloomberg's framework2. The variable country is a categorical variable referring to the issuer country. The issuer country is included as fixed effect variable, to account for potential market fragmentation in the European financial market. Furthermore, the analysis also includes a variable named 1-timer, since theory proposes that firms which do not often issue bonds pay a premium at issuance, thus the variable is expected to be positively connected to the spread (Zaghini, 2019). Used as a dummy variable, it takes the value of 1 if the firm has only issued one bond during the period from 2015-01-01 until 2020-01-01, and 0 otherwise. From Table 3 it appears that the majority of bonds issued in the sample are not one-timers.

The choice of variables related to market condition is based on Zaghini's (2019) methodology. Like Zaghini, we use various variables tracking the state of the financial market and the economy. Market volatility is measured at a high frequency by the daily VSTOXX index (Euro Stoxx 50), which is the European equivalent to the American VIX index. Business cycle fluctuations are measured by the monthly euro coin index developed by Altissimo et al. (2010). The CISS index (Composite Indicator of Systemic Stress) developed by Hollo et al. (2012) is included to account for systemic stress in the European financial markets and is measured at a weekly level. Uncertainty is tracked at a monthly level by the EPU index, indicating Economic Policy Uncertainty (Baker et al. 2016). The corporate risk in the euro area is included at a daily level and measured by an index developed by Gilchrist & Mojon (2018). The variables tracking market financial market stress and corporate risk are expected to be positively correlated with the spread.

Table 4 presents the same basic statistics for the groups studied: the Treatment group, which are the bonds with characteristics nominating them for purchase under the CSPP, and the Control group, which are euro-denominated bonds issued during the same time period, which do not meet criteria for CSPP eligibility. Underpinned by the effort to obtain a sufficiently large sample size, also bonds issued by firms that are resided outside of the euro area are included in the control group. This might inflict distortion in the sample coherence. To solve for this, we run country-fixed effect regressions. Additionally, the regressions are estimated using both the larger sample, as well as a part of the sample, which include only eurozone firms.

The control group include all rating classes, while the treatment group only consists of IG-rated bonds. However, there are no AAA-rated bonds in the sample. It appears from the summary that the bond ratings in the control group are well below the treatment group (~2.5 compared to ~5). As discussed previously, these groups have been examined and proved to follow a parallel trend typically. The average firm size appears to be larger in the treatment group, as compared to the control group, possibly explained by the overarching majority of higher-rated firms. However, the minimum and maximum sizes are more extreme in the control group. This is primarily because of high-rated low-risk large firms present in the sample, contributing to some bias. The same differences apply to the variable bond value: the treatment group has a

higher mean, but the control group are subject to larger variance. This is also explained by the larger variance of rating categories in the control group, which includes everything from AA to junk bonds. Moreover, in terms of market conditions, it looks like the two groups have experienced similar economic environment.

Table 4. Descriptive statistics per treatment and control group

Treatment group is defined as bonds eligible for CSPP. The control group are all euro-denominated bonds that are not eligible. The relationship of issues in the treatment vs. control group in the sample is approximately1:3.

	(1)	(2)	(3)	(4)	(5)
	Treated	*Treated*	*Treated*	*Treated*	*Treated*
VARIABLES	N	mean	sd	min	max
Bond value (bn)	318	0.542	0.314	0.005	1.750
Coupon	318	0.947	0.887	0	4.496
Maturity	318	8.438	5.603	0.803	30.44
Credit spread	232	0.0150	0.00900	-0.0194	0.0509
Rating	318	2.597	0.596	1	3
Size (bn)	318	17,528	21,563	2.889	82.531
1-timer	318	0.0189	0.136	0	1
Market volatility	318	14.74	2.231	11.01	22.06
Business cycle	318	0.157	0.0206	0.130	0.200
Systemic stress	318	0.749	0.224	0.268	1.243
Uncertainty	318	0.256	0.0324	0.186	0.308
Corporate risk	318	0.790	0.119	0.623	0.973

	(1)	(2)	(3)	(4)	(5)
	Control	*Control*	*Control*	*Control*	*Control*
VARIABLES	N	mean	sd	min	max
Bond value (bn)	1,042	0.308	0.324	0.0835	2.057
Coupon	1,042	2.295	2.601	0	15
Maturity	1,041	6.156	4.897	0.253	30.57
Credit spread	559	0.0367	0.0267	-0.00258	0.186
Rating	1,042	4.970	1.467	1	6
Size (bn)	1,042	11.185	24.778	88.000	230.645
1-timer	1,042	0.121	0.326	0	1
Market volatility	1,042	14.63	2.336	11.01	22.54
Business cycle	1,042	0.158	0.0219	0.130	0.200
Systemic stress	1,042	0.711	0.226	0.224	1.243
Uncertainty	1,042	0.255	0.0320	0.186	0.308
Corporate risk	1,042	0.792	0.114	0.623	0.973

Source: Bloomberg, Compustat Global, Capital IQ, ECB.

5.2 Hypotheses testing

In this section, the empirical results are presented by going through each regression and commenting on the findings. This is concluded with rejecting or accepting the hypothesis. In section (5.2.1) – (5.2.2), we look at the credit spreads as the dependent variable, in section (5.2.2), we look at the bond value as the dependent variable.

5.2.1 Effects on credit spreads

The first part of the analysis investigates the spreads on new issues around the announcement of CSPP. Figure 8 depicts the credit spreads at issuance over the period 2018 Q3- 2020 Q1. From the two graphs presenting (a) CSPP-eligible and (b) non-eligible bond issues, neither shows any sign of a quarterly average decrease following the official announcement in September 2019 (end Q3). Conversely, the following quarter, 2019 Q4 shows a higher average credit spread for the both groups.

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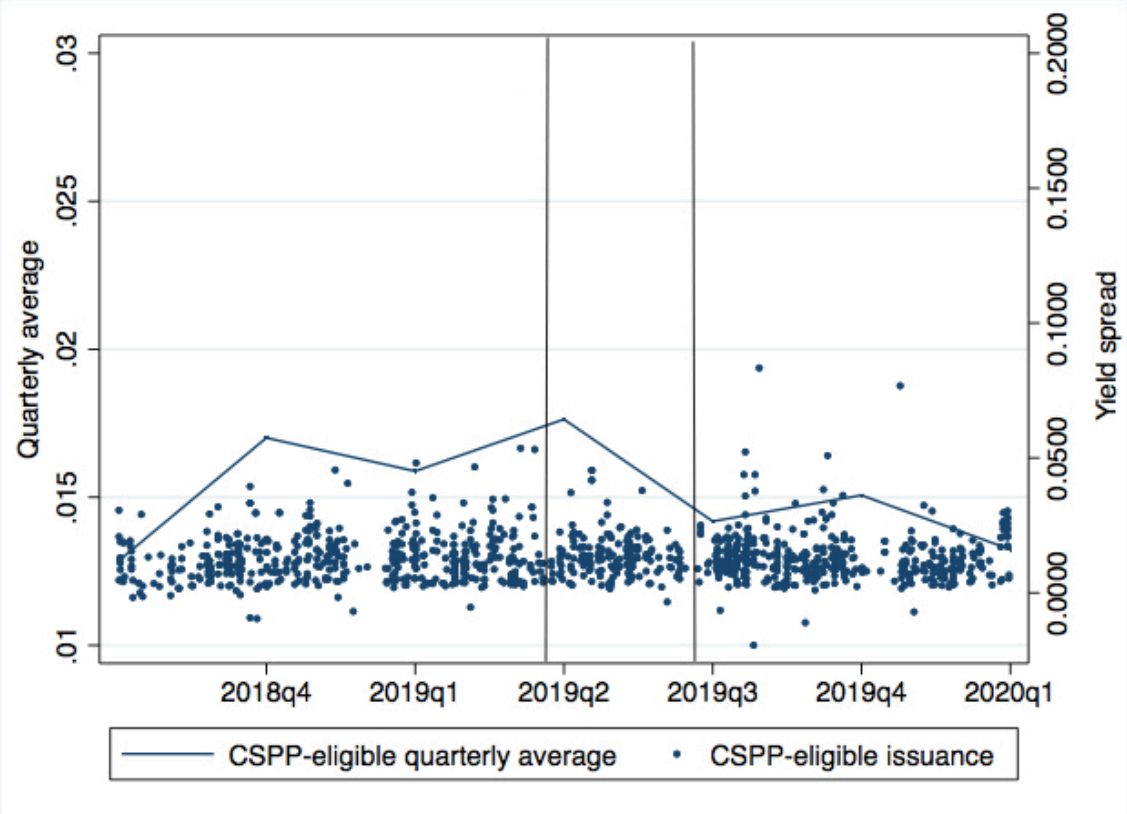
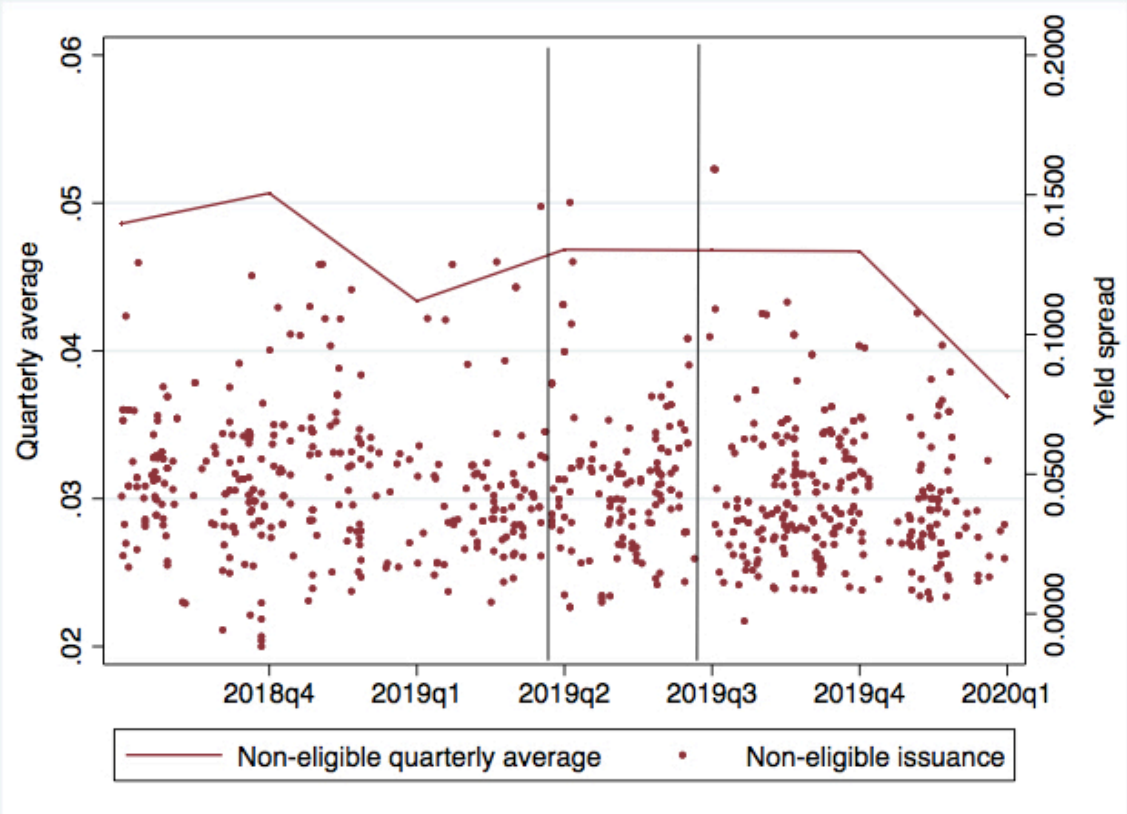
The graphs are also valuable in providing an overview of the sample. As we can see in graph (b), there is large variance in the sample. This is because the non-eligible group also includes IG-rated non-euro zone bonds. While the group of bonds studied in graph (a) only includes IG rated euro zone bonds, this contributes to the coherence in the sample.

Figure 8. Credit spread a issuance

(a) Graph showing CSPP eligible bonds development over 2018 Q3- 2020 Q1



(b) Graph showing non-eligible bonds development over 2018 Q3- 2020 Q1



An important part of the analysis is to check consistent estimation of our model. In Table 5, the basic regression is presented in the first column, including only the time and treatment dummies and the interaction terms *Treated* × *Inter* and *Treated* × *Post*. The model is subsequently complemented with control variables and fixed effects in column 2-5. In column 6, the fixed effect regression is estimated on a subset of the sample, including only euro zone firms, to test the reliability of the coefficient of the interaction terms *Treated* × *Inter* and *Treated* × *Post,* and the control variables, on a more coherent sample.

Looking at the control variables in column 2, it appears that most of the bond-level control variables have the expected sign. The coefficient of *Rating* has a positive effect on the spread, confirming the trade-off between risk and return. The coefficient for *Bond value* is neither economically nor statistically significant. This might imply that there is improved liquidity on the market. Conversely, from the coefficient representing time to maturity, it appears that the signs is opposite of the expected. Following bond pricing theory, a longer time to maturity increases the risk for the holder, thus the spread should be larger compared to shorter term bonds. However, the coefficient is not significantly different from zero across the different fixed-effects models. Thus, the regression estimates fail to prove a relationship between time to maturity and spread.

Furthermore, from the firm-level control variables, it can be seen that both the variables describing the size of issuer and whether the firm is a one-timer have the expected signs and are significantly different from zero. Consistent with theory, it appears that firms which have only issued one bond during the period of the previous five years, pays a costly premium of around 59 basis points across the euro bond market. The variable for issuer size tells us that the larger the firm, the lower the spread, confirming the anticipations that larger firms are rewarded for their size in the determination of credit spread. As far as the market condition variables are concerned, only *Corporate risk* is significant across all specifications. Yet, in column 6, showing the regression on only euro zone firms, it appears that the *Business cycle* index is significant. The reason for it not being significant when including the full sample, may be that each one but the business cycle index are significantly different from zero. *Corporate risk* and *Uncertainty* has, as expected, a positive impact on the spread while a positive business cycle has a negative impact on the spread. The same holds for *Systemic stress* and *Market volatility*.

Table 5. Effects on credit spreads on CSPP-eligible bonds in the interim period

Column 1 estimates the difference in difference regression (1) without fixed effects or control variables. Column 2 estimates the same regression but with bond-, firm and market level controls. Column 3-6 estimates the fixed effect model regression (2), where 3 includes only quarter fixed effects, column 4 includes also industry fixed effect, column 5 includes also country fixed effects. Column 6 estimates the regression from column 5 on a subsample consisting of bonds issued by euro-zone firms.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Credit spread	Credit spread	Credit spread	Credit spread	Credit spread	Credit spread
Treated × Inter	-0.00607**	-0.00599**	-0.00604**	-0.00701**	-0.00648**	-0.00460*
	(0.00280)	(0.00256)	(0.00265)	(0.00274)	(0.00288)	(0.00324)
Treated× Post	-0.00404	-0.00556**	-0.00614*	-0.00658**	-0.00616*	-0.00898***
	(0.00278)	(0.00264)	(0.00323)	(0.00321)	(0.00328)	(0.00337)
Treated	-0.00251	-0.00129				
	(0.00206)	(0.00186)				
Inter	0.000673	0.00870**				
	(0.00248)	(0.00354)				
Post	0.00195	0.0147***				
	(0.00231)	(0.00402)				
Rating		0.00775***	0.00796***	0.00787***	0.00796***	0.00723***
		(0.000736)	(0.000637)	(0.000640)	(0.000656)	(0.000849)
Maturity		-0.000152	-0.000147	-0.000109	-0.000114	0.000238
		(0.000145)	(0.000161)	(0.000162)	(0.000162)	(0.000183)
Size		-0.00107**	-0.001075**	-0.001081**	-0.001085**	-0.00169**
		(0.000498)	(0.000456)	(0.000464)	(0.000499)	(0.000399)
Bond value		0.000074	0.000062	0.000074	0.000086	0.00121*
		(0.000782)	(0.000567)	(0.000601)	(0.000602)	(0.000617)
1-timer		0.00544*	0.00578**	0.00580**	0.00586**	0.00561**
		(0.00289)	(0.00246)	(0.00244)	(0.00245)	(0.00275)
Market volatility		-0.00109**	-0.000889**	-0.000729*	-0.000714*	-0.000544
		(0.000451)	(0.000422)	(0.000418)	(0.000419)	(0.000479)
Business cycle		-0.0187	-0.0753	-0.0840	-0.0817	-0.129**
		(0.0513)	(0.0535)	(0.0530)	(0.0532)	(0.0582)
Systemic stress		-0.00186	-0.00296	-0.00535	-0.00551	-0.0119**
		(0.00444)	(0.00484)	(0.00479)	(0.00480)	(0.00537)
Uncertainty		0.0644**	0.0277	0.0148	0.0160	0.0151
		(0.0310)	(0.0332)	(0.0331)	(0.0332)	(0.0363)
Corporate risk		0.0494***	0.0281**	0.0302**	0.0310**	0.0309**
		(0.0138)	(0.0131)	(0.0131)	(0.0131)	(0.0154)
Constant	-0.00172	-0.0385***	-0.0365*	-0.0431**	-0.0438**	-0.0407*
	(0.00278)	(0.0146)	(0.0193)	(0.0213)	(0.0213)	(0.0243)
Observations	790	790	790	790	790	519
R-squared (adj.)	0.255	0.329	0.327	0.419	0.488	0.505
Quarter FE	NO	NO	YES	YES	YES	YES
Industry FE	NO	NO	NO	YES	YES	YES
Country FE	NO	NO	NO	NO	YES	YES
Firm Controls	NO	YES	YES	YES	YES	YES
Market Controls	NO	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The variables of interest in Table 5 are the variables simulating the interaction of periods and treatment group. The interaction variables focus on two periods of interest: the interim period, which reaches over the approximate three months between the ECB's speech June 18 and the official announcement September 12, and the three months following the official announcement, and represent the CSPP-eligible bonds issued. The coefficients for variables *Treated* ×*Inter* and *Treated* ×*Post* are significantly different from zero across all specification, and have negative signs. This indicates that the spreads on CSPP eligible bonds decreased, both following the initial signals about a potential restart of the ECB's quantitative easing, as well as in the period after the official announcement. The dummy variables signifying the *Inter* and *Post* periods are both significantly different from zero and have positive coefficients in the second column. This is interesting, as it strengthens our hypothesis and evidence that the spread decline was an effect isolated for the eligible bond segment only. In other words, the results suggest that CSPP-eligible bonds were issued at 65 basis points less during the interim period, and 62 during the post period.

When quarter fixed effects are introduced in column 3, there is a small change in all of the covariate's coefficients. By including quarter fixed effect, the time dummies are automatically omitted because of collinearity. Omitting the *Treated* dummy variable is with strong probability the reason to why the coefficient of *Rating* proves a stronger effect. However, the variables for uncertainty is no longer significant. In column 4, the previous model is complemented with industry fixed effects, which results in a small change in the coefficients of the control variables. In column 5, country fixed effects are included.

Furthermore, column 6 in table 5 estimates the fixed effects regression, limited to a sample consisting of only euro zone firms. From this column it appears that while there are some small deviations, the coefficients are basically in the same spectrum as in the regressions in columns 2-5. Yet, there are some divergence. Whereas the coefficients for *Market volatility* is no longer significantly different from zero, the coefficient for *Bond value*, *Business cycle* and *Systemic stress* suddenly is. With regards to the market condition, this is with possibly explained by the fact that the CISS and Euro coin indices are specifically tracking the European business environment. In fact, according to column 6 in Table 5, it appears that the effect is significant, although larger in the coefficient of the interaction variable *Treated* ×*Post*. This would imply

that the effect was more significant in the post period, when only evaluating bonds by Euro zone firms.

Table 6. Effects on credit spread on all IG rated bonds

The table presents the estimates of regression (2) on all IG-rated euro denominated bonds. Column 1 includes the full sample whereas column 2 estimates the regression from column 1 on a subsample consisting of bonds issued by euro-zone firms.

VARIABLES	(1) Credit spread	(2) Credit spread
IG×Inter	-0.00634**	-0.00651*
	(0.00278)	(0.00348)
IG×Post	-0.0108***	-0.00871**
	(0.00289)	(0.00364)
Rating	0.00614***	0.00612***
	(0.000689)	(0.000889)
Maturity	0.000105	0.000098
	(0.000152)	(0.000207)
Size	-0.000755**	-0.000301
	(0.000371)	(0.000444)
Bond value	0.00184***	0.00136*
	(0.000633)	(0.000724)
1-timer	0.00491*	0.00596*
	(0.00262)	(0.00336)
Market volatility	-0.000535	-0.00107**
	(0.000427)	(0.000542)
Business cycle	-0.0705	-0.136**
	(0.0530)	(0.0671)
Systemic risk	-0.00731	-0.0114*
	(0.00480)	(0.00594)
Uncertainty	0.0133	0.00722
	(0.0321)	(0.0400)
Corporate risk	0.0163	0.0224
	(0.0137)	(0.0169)
Constant	-0.0129	-0.0417
	(0.0217)	(0.0271)
Observations	790	519
R-squared (adj.)	0.3917	0.522
Quarter FE	YES	YES
Industry FE	YES	YES
Country FE	YES	YES
Firm Controls	YES	YES
Market Controls	YES	YES

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

Table 6 present the estimates of regression 2 in a scenario where the group under estimation includes all IG-rated bonds, in other words, also bonds of issuers resided outside of the eurozone. From the interaction variables *IG*×*Inter* and *IG*×*Post*, it appears that the spreads on IG-rated euro denominated bonds tightened in both the *Post* and the *Interim* period. It is important to note, that this specific results does not measure the impact of the CSPP, but give us some hints on the IG-rated euro bonds segment, during the respective periods. Yet, certain interesting deductions could be made from these results. The fact that the effect in the coefficient for *IG*×*Post* is larger than that of *Treated*×*Post,* with around 46 basis points (108 compared to 62), implies that the effect transmitted from eligible bonds, to bonds in the same rating segments that were not eligible for purchase under the CSPP. Moreover, column 2 shows that the effects on the groups are significant, and coefficients for the independent variables are in the same range. The small variation in coefficients, in comparison with column 6 of table 5, arise from the inclusion of the bonds which do not meet certain eligibility criteria in the simulated treatment group i.e. maturity less than 6 months or more than 30 years.

To conclude the findings in this session: given the results arrived at in the above regressions, specifically table 5, there is evidence that credit spread on CSPP-eligible bonds declined both in the interim and the post announcement period. Therefore, we can reject the first of the null hypotheses that $\delta s_{TP} \geq 0$ and $\delta s_{TI} \geq 0$, and accept the alternative hypothesis, $\delta s_{TP} < 0$ or $\delta s_{TI} < 0$.

5.2.2 Effects on credit spreads across ratings and maturities

This section analyses the heterogenous effects of quantitative easing, estimating the distribution of the effect on spreads across bonds with different risk. According to the theoretical understanding that QE reduces risk premium, it would be expected that the effect would be larger in higher risk assets. Therefore, the effect is isolated within two different rating segments AA-A and BBB. Table 7 depicts the regressions run on the different ratings segments only in the treatment group and table 8 show the regressions run on the different ratings across the full sample. In fact, table 7 present evidence in favour of a larger decline in the lower rating segment BBB. Thus, the evidence support the proposition that this was a direct effect of the CSPP.

Table 7. Effects on credit spreads across ratings eligible bonds

The table show estimates of regression (2), presenting the distribution of effect across two different rating segments within the treatment group.

	(1)	(2)
VARIABLES	Credit spread	Credit spread
AA-A× Treat ×Inter	-0.00648**	
	(0.00288)	
BBB× Treat ×Inter		-0.00703**
		(0.00286)
AA-A× Treat ×Post	-0.00616*	
	(0.00328)	
BBB× Treat ×Post		-0.00685*
		(0.00359)
Constant	-0.0438**	-0.0456**
	(0.0213)	(0.0212)
Observations	790	790
R-squared (adj.)	0.416	0.417
Quarter FE	YES	YES
Industry FE	YES	YES
Country FE	YES	YES
Firm Controls	YES	YES
Market Controls	YES	YES

Table 8. Effects on credit spreads across ratings

The table show estimates of regression (2), presenting the distribution of effect across two different rating segments.

	(1)	(2)
VARIABLES	Credit spread	Credit spread
AA-A×Inter	-0.00855***	
	(0.00288)	
BBB×Inter		-0.00603**
		(0.00249)
AA-A×Post	-0.00980***	
	(0.00305)	
BBB×Post		-0.00854***
		(0.00300)
Constant	-0.0346	-0.0423**
	(0.0216)	(0.0212)
Observations	790	790
R-squared (adj.)	0.422	0.420
Industry FE	YES	YES
Quarter FE	YES	YES
Country FE	YES	YES
Firm Controls	YES	YES
Market Controls	YES	YES

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

Table 9. Effects on credit spread on CSPP eligible bonds across maturities

The table presents estimates of regression (2) on different maturities. The interaction term is the CSPP eligible bonds during the respective time periods Inter and Post. The dependent variable is the credit spread, distinguished according to the length of maturity. ST = 0-5 years, MT = 5-10 years and LT = > 10 years.

	(1)	(2)	(3)
VARIABLES	Credit spread ST	Credit spread MT	Credit spread LT
Treated × Inter	-0.0146*	0.00121	-0.00458**
	(0.00793)	(0.00265)	(0.00222)
Treated × Post	-0.0125	-0.00525*	-0.00326
	(0.00899)	(0.00318)	(0.00231)
Constant	-0.0439	0.0260	0.0236
	(0.0442)	(0.0254)	(0.0157)
Observations	316	328	146
R-squared (adj.)	0.406	0.468	0.599
Industry FE	YES	YES	YES
Quarter FE	YES	YES	YES
Country FE	YES	YES	YES
Firm Controls	YES	YES	YES
Market Controls	YES	YES	YES

Table 10. Effects on credit spread on all IG rated bonds across maturities

The table presents estimates of regression (2) on different maturities. The interaction term is all IG rated denominated bonds during the respective time periods Inter and Post. The dependent variable is the credit spread, separated according to the length of maturity.

	(1)	(2)	(3)
VARIABLES	Credit spread ST	Credit spread MT	Credit spread LT
IG×Inter	-0.0166**	-0.00151	-0.00510*
	(0.00783)	(0.00280)	(0.00282)
IG ×Post	-0.0103	-0.0146***	-0.00668**
	(0.00841)	(0.00306)	(0.00307)
Constant	-0.0276	0.0377	0.0267*
	(0.0458)	(0.0248)	(0.0159)
Observations	316	328	146
R-squared (adj.)	0.407	0.501	0.600
Industry FE	YES	YES	YES
Quarter FE	YES	YES	YES
Country FE	YES	YES	YES
Firm Controls	YES	YES	YES
Market Controls	YES	YES	YES

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

Table 9 and 10 presents the effect on spreads across different maturities. The sample is split into different maturity buckets. ST stands for short-term and is defined as bonds with maturity of 0 - 5 years, MT stands for medium-term and is defined as bonds with maturity of 5 - 10 years and LT stands for long-term and is defined as bonds with maturity over 10 years. According to theory about the duration risk channel of quantitative easing, it is expected that the effect on spreads is largest on longer term assets. However, the results in table 9 do not provide any evidence against the null hypothesis. None of the sets of regressions evaluating short, medium and long terms maturities show the effect expected from the duration risk channel, which practically would imply that the coefficients referring to short term bonds would be inferior to that of medium term bonds, and the coefficients referring to long-term bonds would be larger that of medium term bond. Yet, the coefficients in table 10, column 1-2, imply that spreads on medium-term IG-rated bonds decreased more than short-term IG-rated bonds in the period post the official announcement. Though, as the coefficient in the ST regression for the Post period not is significant, it is difficult to compare and make any sort of deductions. Additionally, very few of the coefficients are significantly different from zero.

To summarize, this section set out to evaluate the difference in credit spread across rating and particularly maturity segments. We do not find any evidence in support of the second alternative hypothesis which states that the decrease in credit spreads was larger for assets with longer maturities compared to shorter maturities, $\Delta\delta sST_{TP} < \Delta\delta sLT_{TP}$ or $\Delta\delta sST_{TI} < \Delta\delta sLT_{TI}$, and therefore, we have to accept the null hypothesis that $\Delta\delta sST_{TP} \geq \Delta\delta sLT_{TP}$ and $\Delta\delta sST_{TI} \geq \Delta\delta sLT_{TI}$.

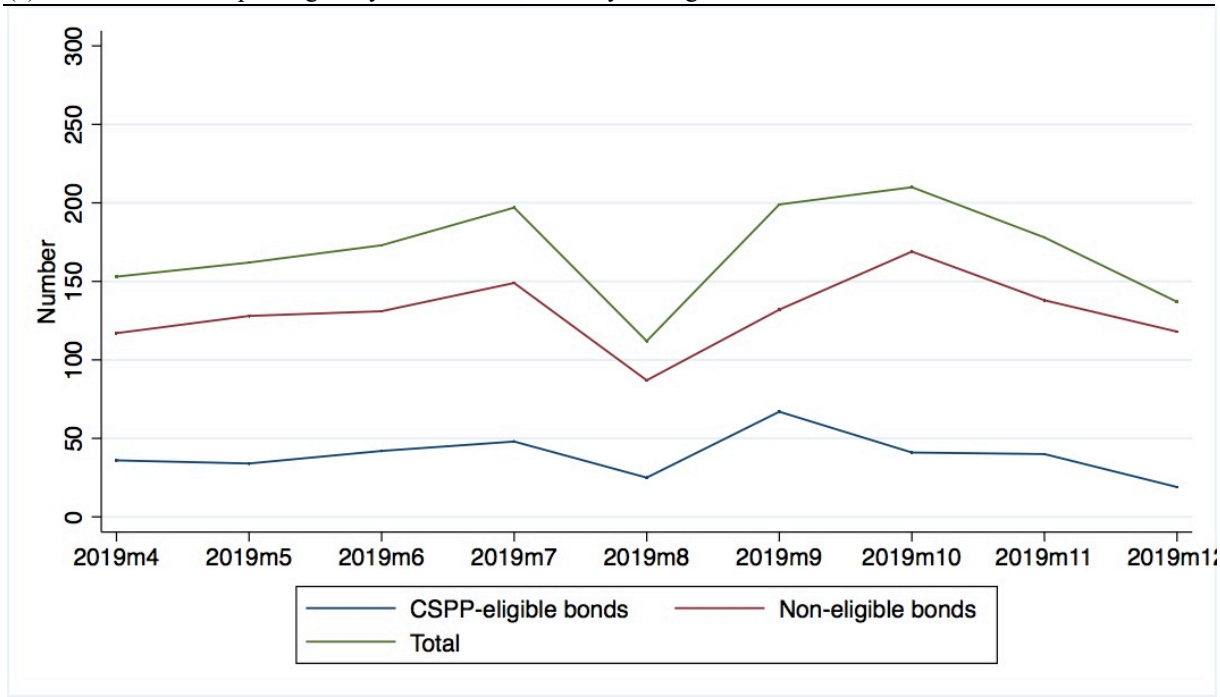
5.2.3 Effects on bond issuance in volumes

So far, the focus of attention has been the pricing mechanisms of bonds, using the credit spread as the dependent variable. This section deals with the effect on the quantity: the value, volume and number of bonds issued. Figure 9 presents two graphs showing the monthly average number of new issues per (a) CSPP eligibility and (b) rating category. Initially, it is important to note that the slump in month 8, August 2019, is with probably a consequence of the fact that August is generally a very uneventful period for bond issuance. We will disregard this temporary sharp decline, as we can find no other reasonable explanation for a sudden slump, and thus deem it independent of the anticipated CSPP activity. Looking at graph (a) in figure

9, we can distinguish two peaks in the sample studied. The first appears in July while the second appears in October. The initial surge in number of issues is most represented in the junk bond segment. The following rise starts in September, where issues of BBB rated bonds exceeds the number of junk bonds issued. The second peak for the non-eligible bond segment comes later and emerges in October.

Figure 9. Effects on number of bonds issued

(a) Number of issues per eligibility under CSPP, monthly average



(b) Number of issues per rating class, monthly average

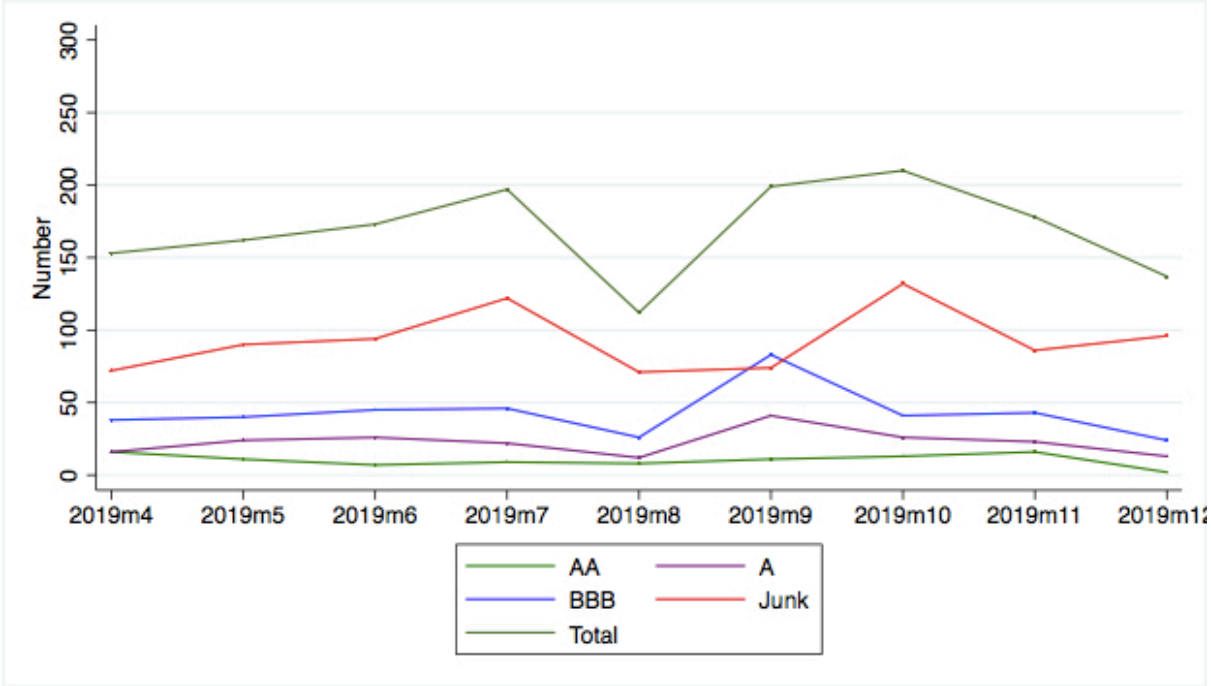
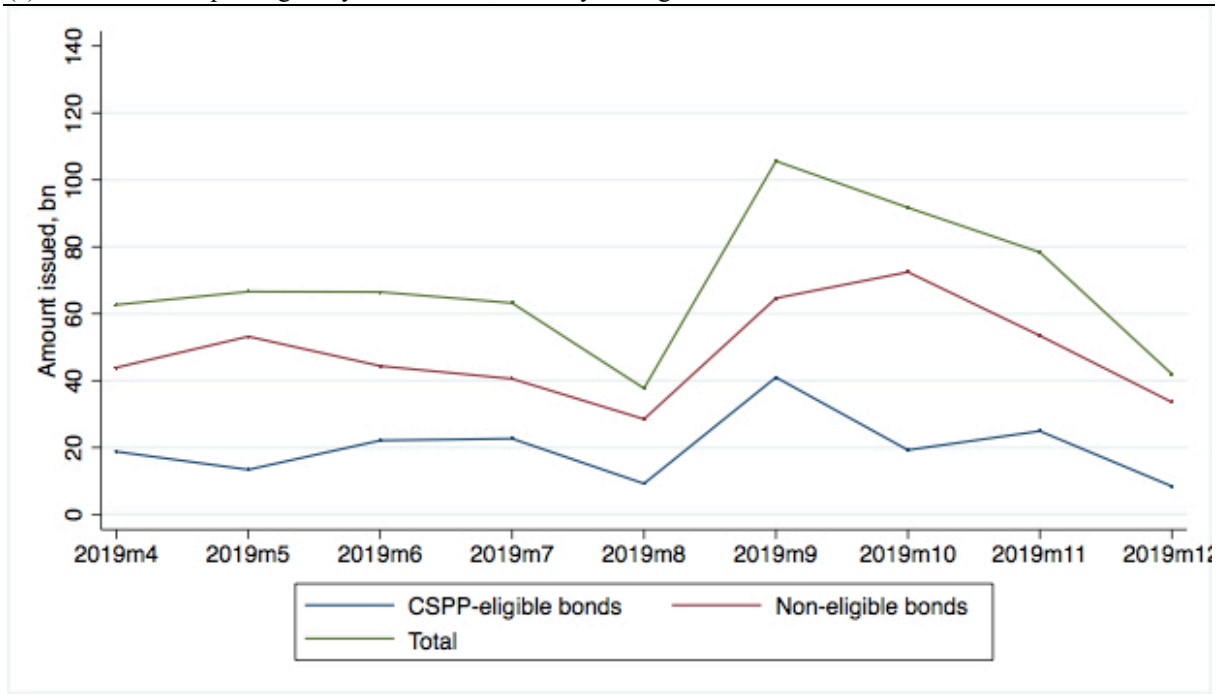


Figure 10. Effects on total amount of bonds issued

(a) Amount issued per eligibility under CSPP, monthly average



(b) Amount issued per rating class, monthly average

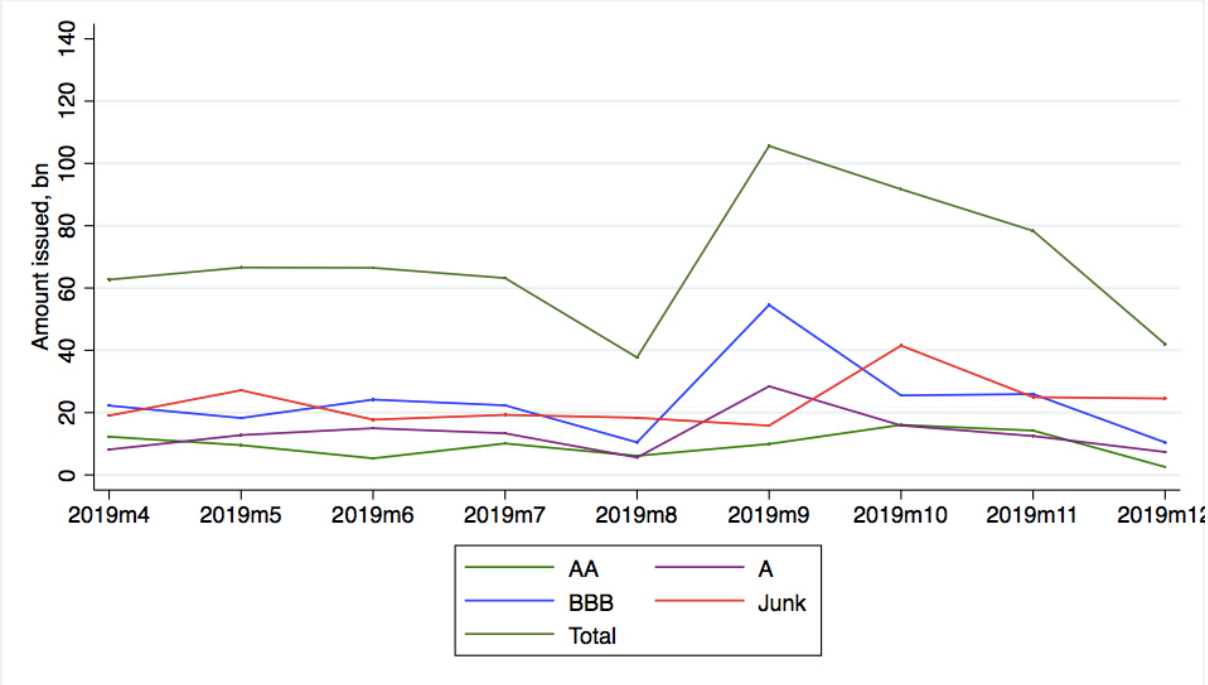


Figure 10 depicts the effect on total amount issued in the sampled period. It pretty much follows a similar pattern as in figure 9. However, there are two striking differences. The sample shows two peaks in the evolvement of number of issues, which both reaches approximately the same

level, close to 200 as a total in July and October. However, looking at amount issued, it appears that there is only one significant peak, taking place in September. Furthermore, the total amount issued is almost the double what it was in July. This might be a sign of more liquidity in the market. Furthermore, the graph (b) in figure 10 also shows that the amount issued of BBB-rated increased the most, consistent with the expectations derived from table 7, that bonds with the highest risk are affected the most. Another noteworthy indication in the graphs shows that ineligible bonds, significantly junk bonds, peaked in October. This could be indications that spill-over effect took place, initiating more credit-constrained firms to issue bonds following a surge in demand.

Table 11. Changes in bond values per month

The table show regression (2), however with month fixed effects. Column 1 show the quarter fixed effect for the whole sample, while column 2 show the effects only for eligible bonds.

	(1)	(2)
	All	*Treated*
VARIABLES	Bond Value	Bond Value
April	Omitted	0.173
		(0.301)
May	0.278	-0.313
	(0.198)	(0.291)
June	0.00754	0.0342
	(0.191)	(0.270)
July	-0.0224	0.372
	(0.226)	(0.259)
August	-0.170	0.175
	(0.315)	(0.345)
September	0.313	0.403*
	(0.423)	(0.241)
October	-0.0316	0.414
	(0.424)	(0.279)
November	-0.0186	0.204
	(0.421)	(0.278)
December	-0.209	0.317
	(0.422)	(0.338)
Constant	1.401	
	(1.278)	
Observations	1,360	
R-squared (adj.)	0.455	
Month FE	YES	
Industry FE	YES	
Country FE	YES	
Firm Controls	YES	
Market Controls	YES	

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

Table 11, estimating the amount issued over monthly period in the studied time interval. The findings are consistent with the interpretations of the visual results in figure 9 and 10. None but the coefficient for the treatment group in September are significantly different from zero, implying that the only provable increase in bond value happened for eligible bonds in September.

The result in this section provide proof of both and increase in total value on new bond issues, and an increase in number of new issues in the period following the announcement. Therefore, we can reject the third null hypothesis, $\delta V_{Tp} \leq 0$, and the fourth null hypothesis, $\delta Number_{Tp} \leq 0$, and accept the alternative hypotheses H_3: $\delta V_{Tp} > 0$ and H_4: $\delta Number_{Tp} > 0$.

5.3 Summary of Findings

In the analysis, we have come to certain conclusions. First of all, credit spread in the treatment group dropped by approximately 65 basis points in the interim period and 62 basis points in the post period. There is also evidence pointing towards a possible spill-over effect towards non-eligible IG-rated bonds in the post period.

Credit spread	Coef.	Std. Err	t	P-value
Treated × Inter	-0.00648**	(0.00288)	-2.25	0.025
Treated × Post	-0.00616*	(0.00328)	-1.88	0.061
Credit spread	Coef.	Std. Err	t	P-value
IG × Inter	-0.00634**	(0. 00278)	-2.28	0.023
IG × Post	-0.01084***	(0. 00289)	-3.75	0.000

Additionally, the analysis show that the spread decline was larger for BBB-rated eligible bonds, compared to AA-A-rated. It was not possible to make and sort of deductions about the distribution of effect among different maturity bonds.

	Treated		*Control*	
Credit spread	AA-A	BBB	AA-A	BBB
Inter	-0.00648**	-0.00703**	-0.00855***	-0.00603**
Post	-0.00616*	-0.00685*	-0.00980***	-0.00854***

Furthermore, the data also shows some interesting findings with regards to the control variables. The estimates confirm the expectations of a bias in favour of larger firms, as well as firms that more frequently issue bonds. In fact, one-timers, as they are called in this paper, pay a premium of approximately 59 basis points in the sample studied. Also, in the regression where the coefficient for bond value is significant, it appears that a larger amount issued results in a higher spread, indicating that it is more expensive for firms to issue larger volumes.

Finally, there is evidence of a rise in total volume of bond issuance in the period post the formal announcement, evidence suggesting that the formal announcement initiated a larger demand for bond debt. Specifically, this rise was significant in September, when the bond value on CSPP-eligible bonds increased with 40%, compared to the rest of the period.

Bond value	Coef.	Std. Err	t	P-value
Treated × September	0.403*	(0.241)	1.67	0.095

Ultimately, the findings and implications from the empirical analysis will be further discussed in the next chapter.

6. Discussions, Conclusions and Recommendations

The purpose of this chapter is to deliberate on the findings generated from the empirical analysis, building on theoretical grounds and findings generated by previous researchers. First, the chapter begins with a short discussion of the findings. Next, there is a summarising conclusion on the aims and questions that this paper set out to answer, and finally, the authors of this paper give some implications and suggestions for further research.

6.1 Discussions

By analysing price dynamics and volumes of bond issuance during periods of forward guidance, the empirical analysis sheds light on the effect of the ECB's announcements related to a restart of the CSPP. Related literature on the subject has found evidence in support of a signalling channel and a local supply channel, having direct effect on the overall bond market, but the targeted assets in particular; a liquidity channel, contributing with increased demand resulting in a rise in bond supply; a duration and default risk channel, causing a larger effect on longer-term and higher-risk assets; as well as a portfolio rebalance channel, producing spill-over effects from the targeted to non-targeted assets. This paper hypothesised that there would be evidence supporting these theories in the data studied.

In the first section, (5.2.1) *Effects on credit spreads*, the empirical results show that spreads on bonds eligible for purchase under the CSPP decreased with approximately 65 and 62 basis points as a consequence of announcements. This is in line with previous findings, as for instance, Zaghini (2019), who found that eligible bonds were issued at 70 basis points less than non-eligible. The findings of the empirical study in this paper supports what is theoretically referred to as the signalling channel and the local supply channel, indicating that the announcements had an effect most pronounced amongst bonds targeted by CSPP. However, there is also proof of portfolio rebalancing effects, by the indication of non-eligible IG-rated bonds from non-EMU issuers have profited from the new policy announcements. This indication is presumably in line with the theoretical understanding that portfolio rebalancing effects are the strongest on the assets which are the most similar to those targeted by the programme (Abidi and Miquel-Flores, 2018; Albertazzi et al., 2016).

In contrast to previous research (Vayanos and Vila, 2009; Altavilla et al., 2015; Andrade et al., 2016; Todorov, 2018), the results exhibited in the section (5.2.2) *Effects on credit spreads across ratings and maturities*, does not find evidence supporting the hypothesis that the effect would be more substantial in longer maturities. Various reasons might be behind this papers rejection of the null hypothesis. One explanation could be the prevailing low-interest environment and the state of financial markets in 2019. It is true that during the year 2019, financial markets were reaching their ten-year peak and policy interest rates in Europe were close to zero or even negative and the credit curve for corporate bonds flattened. Additionally, given the exponential shape of the credit curve, and the fact that a large part of the sample consists of longer duration assets, it might be so that there is a very small, insignificant difference that arise as a consequence of duration, among the bonds studied. In other words, the difference between short- and long-term assets was, at the time, not as significant as it had been during the previous announcements of the CSPP, as for instance in 2016. This, together with the fact that the relatively small sample studied in this paper is subject to a large within-variation, may cause disturbance to the variable explaining for the relationship between the credit spread and the maturity, which shows a negative, instead of a positive, association between the asset duration and the spread. Based on this, the analysis applied in this paper may be inadequate in proving an effectual duration risk channel.

What is perhaps most apparent, is that the ECB's QE programmes contribute to large upsurges in bond issuance. After the official announcement in September, there is evidence of a substantial rise in the total volume of bonds (measured in the quantities and bond value). Judging by the empirical results arrived at in the analysis, this also holds true for the period studied, as the third section, (5.2.3) *Effect on bond issuance in volume*, provide empirical evidence for a substantial increase in bond issuance volume, both in numbers of issues and in bond value. Additionally, the descriptive statistical analysis show while both the number of bonds issued and the total value increased, so did the average bond value, significantly in September, for the CSPP-eligible bonds. These results are reliable proof of the efficiency of the liquidity channel, as have also been proven by other authors for similar or previous implemented purchase programmes (Zaghini,2019; Todorov, 2018; Beirne et al., 2011). Also, the analysis shows that while the total volume of CSPP-eligible bond issues peaked in September, non-eligible bond issues peaked during the next month. The increased demand for

bond placement that emerges from the data showing not only a rise in volumes of eligible bond issuance but also non-eligible bond issuance is a sign in support of the portfolio rebalancing channel. This is because we know for a fact that the ECB is not directly increasing the demand in this segment since they only buy assets that satisfy the CSPP criteria. It could only be explained by the fact that investors in the eligible bond segment are pushed out, now seek out investment opportunities in the non-eligible segment, which has similar structures but higher return (Zaghini, 2019; Vayanos and Vila, 2009).

6.2 Conclusion

This paper analysed the impact of unconventional monetary policy on asset pricing mechanisms and quantities in the euro bond market. The study aimed to estimate the impact of the ECB's announcements to restart the CSPP. Compared to previous research, this paper evaluates the primary bond market and is therefore successful in proving very direct effects of ECB's forward guidance policy on the borrowing costs for firms. The results show that the CSPP (once again) resulted in (1) firms issuing eligible bonds at around 65 basis points less, following indications in June, and around 62 basis points less, after the announcement in September, and (2) contributed to an increase in liquidity in both the eligible and non-eligible bond segment. In other words, this paper shows that the CSPP, primarily through the signalling channel, has had desired effects on the corporate bond market from an ECB point of view. Important to note is that the paper did not aim to estimate the real success of the CSPP on the real economy, which can only be done further into the future, using more extensive methods, which is outside the scope of this paper. The paper did, however, succeed in quantifying short-term effects. Finally, from a practical and theoretical point of view, announcements of monetary policy tend to have a large impact on financial markets. Thus, it is of great importance to isolate events when indications have been made.

Furthermore, our study provides insight into the field of quantitative easing and its impact on the primary bond market. Previous research has assessed former announcements of past programmes, however, as far as the authors of this paper are concerned, no one has yet evaluated ECB's announcements happening in June to September 2019, and especially the impact it had on bond issuance. The study provides insight into the field of quantitative easing

and its impact on the primary bond market, and more specifically an assessment of the effectiveness of ECB's corporate quantitative easing.

6.3 Implications

This paper provides evidence in support of the proposed mechanisms of QE, and thus verifies the efficiency of forward guidance policies. The study of unconventional monetary policy is of importance for future economic policy implementation. This is especially true, in light of various new initiatives that have been initiated by central banks across the world as a response to the COVID-19 crisis. For instance, the ECB has launched the Pandemic Emergency Purchase Programme, carrying a worth of €750 billion.

Presumably, large scale asset purchases of corporate bonds conducted by central banks make it easier for firms to raise capital. In other words, firms that were not previously able to raise financing because of capital-constrained conditions or low quality, can now get access to debt capital markets through either becoming eligible for purchase under the CSPP, profiting from the increase in bond demand due to spill-over effects initiated through investors' portfolio rebalancing, or benefitting from banks reallocation of loans. Thus, the study raises important questions. While institutional financial support may be a great importance for economic stimulus during times like these, it is imperative to also consider the possible side-effects and risks to financial stability, as well as the reliability of the financial establishment, as well as the optimal level of risk in financial intuitions.

6.4 Suggestions for further studies

This study is executed on quite recent data. It would be interesting to study the evolvement of eligible versus non-eligible bonds following reimplementation of the CSPP. The outbreak of the COVID-19 virus during the spring of 2020 restricted the assessment of the first three months in 2020, as an assessment would have required further measures to isolate the effect, independent of market dynamics driven by forces connected to the COVID-19. In fact, with regards to the virus-driven crisis, it would be interesting to assess the new purchase programmes that have been started. Research around QE tapering will also be of great interest to both banks, economists and investors.

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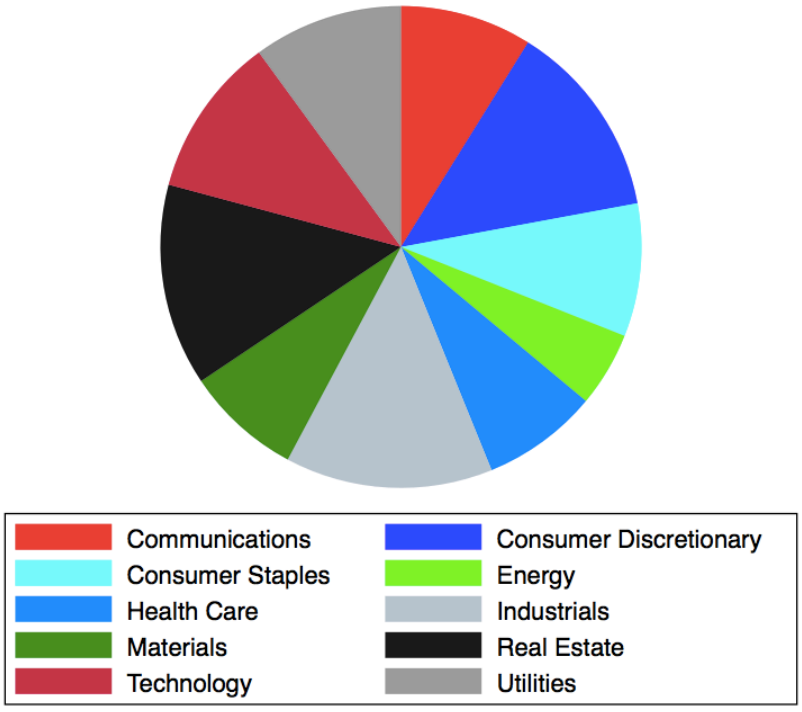
Appendices

Appendix 1. Sample information

Categorical variables: Industry

The table shows the distribution of sampled bonds across euro zone industries.

Industry	Frequency	Percent	Cumulative
Communications	134	9.85	9.85
Consumer Discretionary	200	14.71	24.56
Consumer Staples	135	9.93	34.49
Energy	57	4.19	38.68
Health Care	118	8.68	47.35
Industrials	211	15.51	62.87
Materials	118	8.68	71.54
Real Estate	205	15.07	86.62
Technology	163	11.99	98.60
Utilities	19	1.40	100.00
Total	1,360	100.00	



Source: (Bloomberg, 2020)

Categorical variables: Country

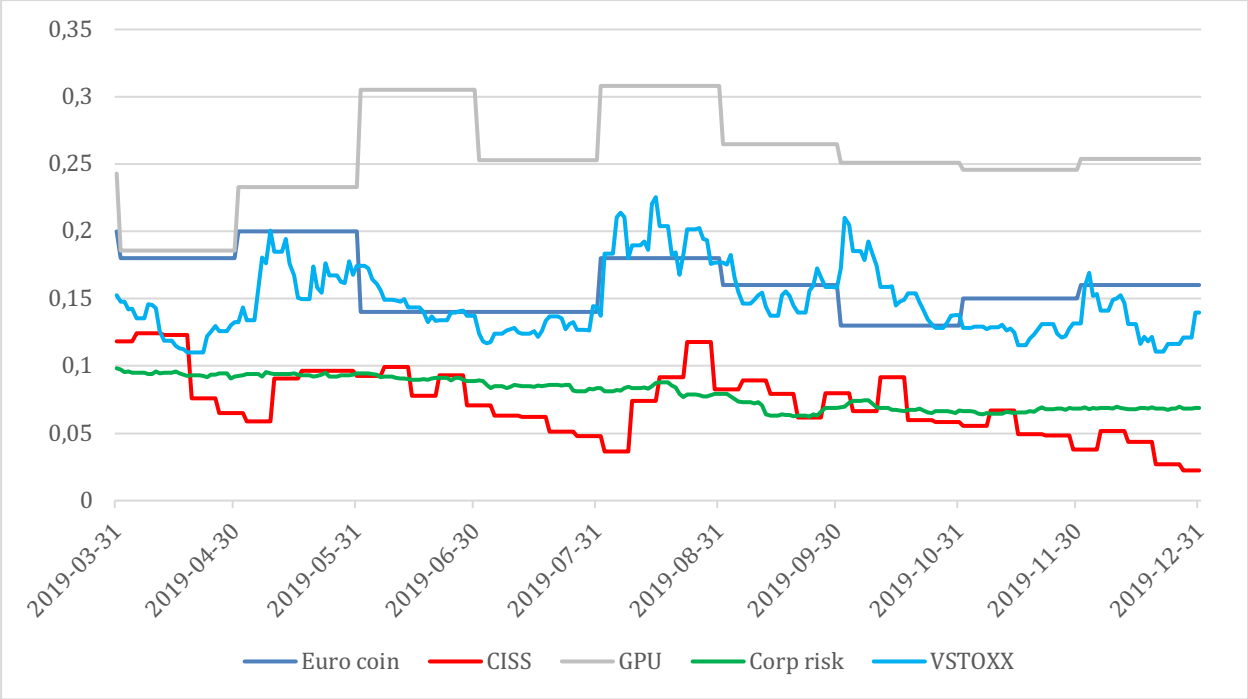
The table shows the distribution of sampled bonds across euro zone countries. The number within the parenthesis is the percentage out of the whole sample.

Country	Frequency	Percent	Cumulative
AT	54	5.33 (3.97)	5.19
BE	28	2.76 (2.06)	7.78
CY	1	0.10 (0.07)	7.87
DE	345	34.06 (25.37)	45.37
EE	1	0.10 (0.07)	45.46
ES	69	6.81 (5.07)	51.94
FI	22	2.17 (1.62)	53.98
FR	231	22.80 (16.99)	75.37
GR	9	0.89 (0.66)	76.20
IE	10	0.99 (0.74)	77.13
IT	82	8.09 (6.03)	84.72
LT	1	0.10 (0.07)	84.81
LU	73	7.21 (5.37)	91.57
LV	2	0.20 (0.15)	91.76
MT	6	0.59 (0.44)	92.31
NL	50	4.94 (3.68)	97.13
PT	22	2.13 (1.62)	99.26
SI	1	0.10 (0.07)	99.44
SK	6	0.59 (0.44)	100.00
Total, euro zone	1,013	100.00 (0.74)	
Non-euro zone	347	(0.26)	
Total	1,360	100.00	

Source: (Bloomberg, 2020)

Control variables: Market condition

The graph below demonstrates the movement of indices used in the regression over the time interval. The values should be disregarded, since the graph is only intended to show the development over time.



Euro coin = Business cycle index

CISS = Systemic stress

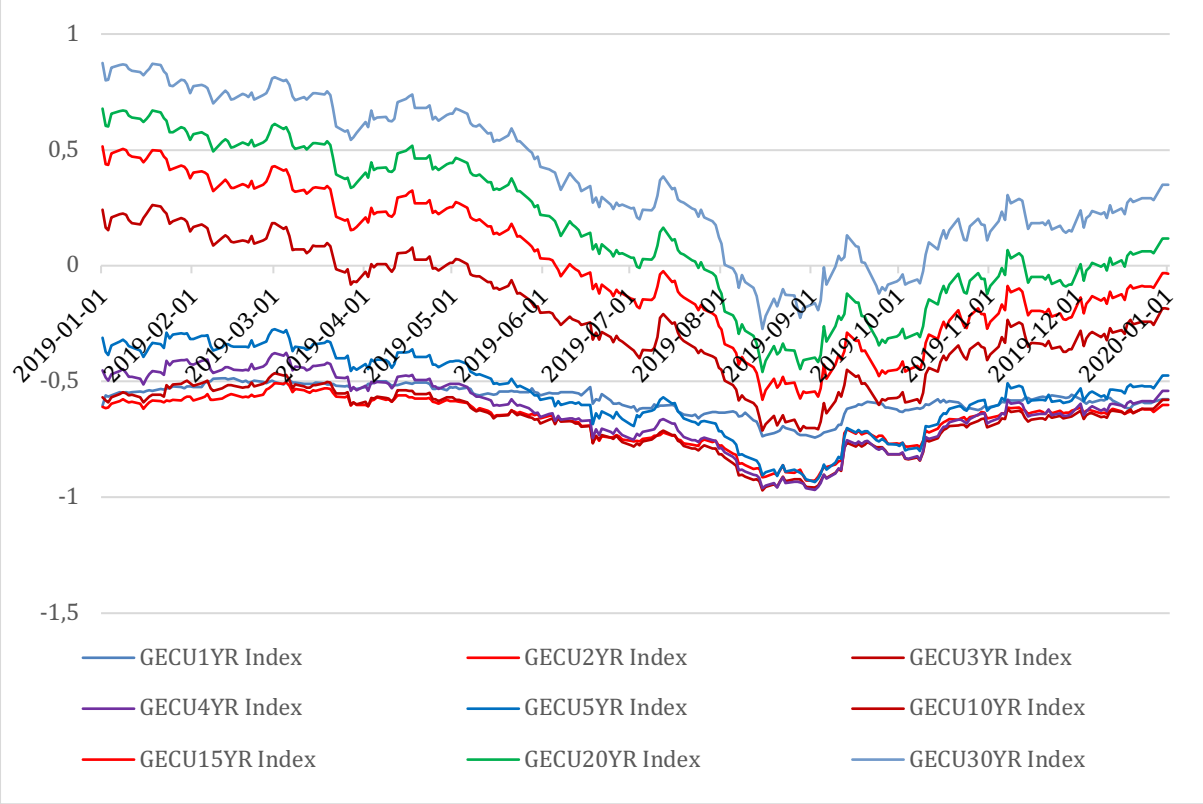
GPU = Global Policy Uncertainty

Corp risk = Corporate risk in Europe

VSTOXX = Euro Stoxx 50, European stock volatility index

Generic government rates

The graph depicts German government bond generic rates (indices) with maturities 1-5, 10, 15, 20 and 30 years, sourced from Bloomberg.

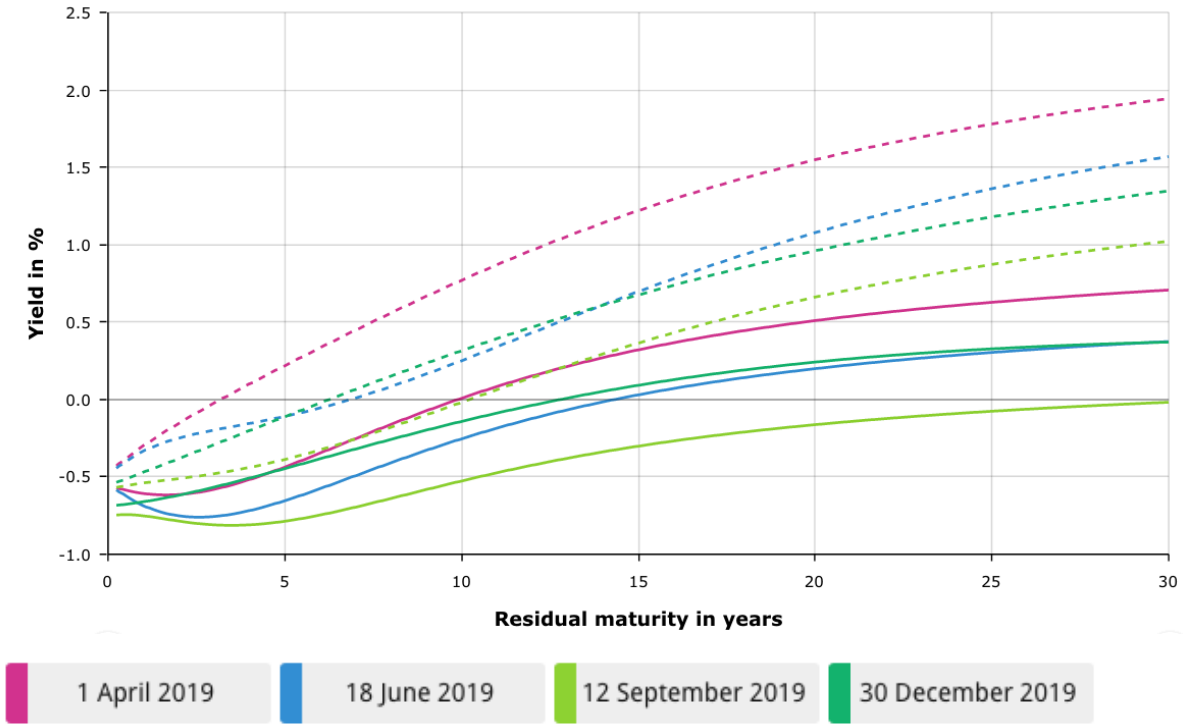


Source: (Bloomberg, 2020)

Appendix 2. Yield curves

Euro area yield curves

The below yield curve shows AAA-rated EMU central government bonds (solid line) and all EMU central government bonds across ratings (including AAA) at specific dates.



Source: (European Central Bank, 2020)