STOCKHOLM SCHOOL OF ECONOMICS

MASTER THESIS IN FINANCE

December 2016

The visible hand of the central bank: Evidence from the ECB's Corporate Sector Purchase Program

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Abstract

On March 10, 2016 the ECB surprised financial markets by announcing the latest measure taken under its unconventional asset purchase programs, the CSPP. Through this program the ECB is purchasing corporate bonds and aims to support bond valuations through supply shocks. In this paper we investigate the short-term impact on corporate credit spreads from the CSPP supply shocks and find evidence in favor of local supply effects on the French non-financial corporate bond market. Using Nelson Siegel estimated credit spreads and a difference-in-differences regression methodology, we document an economically and statistically significant credit spread narrowing for CSPP eligible and purchased short-term corporate bonds. Our findings highlight the merit of theories allowing for segmented markets and challenge traditional theories of the yield curve where supply effects are generally ruled out. Furthermore, this paper argues that central bank supply shocks lead to corporate bond prices deviating from fundamentals. As a consequence, these shocks may, at least temporarily, have a negative effect on market functioning.

Keywords: Central bank supply shocks, unconventional monetary policy, asset purchase programs, corporate credit spreads

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Table of contents

1. Introduction

In the aftermath of the financial crisis, policy rates have been reduced to their effective floors around zero. With conventional monetary policy reaching its limit, central banks around the world have turned to unconventional monetary policies, called Asset Purchase Programs (APPs). Under these programs, significant amounts of debt instruments are purchased on primary and secondary markets in order to reduce the real cost of financing and to boost economic activity.

On March 10, 2016, financial markets were caught by complete surprise when the European Central Bank (ECB) announced the latest measure taken under its APP, the Corporate Sector Purchase Program (CSPP). In the press release announcing the CSPP, the ECB informed markets that it would, for the first time in history, purchase euro-denominated, investment graded and non-financial corporate bonds. Expected CSPP purchases constitute 4.3% of the targeted European corporate bond market and is planned to be terminated in March 2017 (ECB, 2016; BIS, 2016) [2].

Under the CSPP, the ECB aims to reduce financing costs on the corporate bond market through a mechanism referred to as the supply effect (Cordemans, 2016). By reducing the bond supply, the supply effect mechanism allows the ECB to support bond valuations, put pressure on bond yields and thereby reduce funding costs. However, the effectiveness of this mechanism in finance theory is ambiguous. While traditional theories generally rule out an effect on bond yields from changes in supply, the opposite is true in more recently developed theories that are based on segmented markets. In these theories, investors have preferences for specific maturities along the yield curve. Bonds with different maturities should therefore be viewed as separate markets that are influenced by local factors such as supply and demand. Building on the concept of segmented markets, several empirical studies have documented a causal link between bond supply and yields (Vayanos & Vila, 2009). Similarly, several macroeconomic studies on the effectiveness of APPs have found a causal link between central bank bond purchases, that reduce the bond supply, and bond yields. However, the relationship between central bank supply shocks and corporate bond spreads are yet to be fully understood (D'Amico & King, 2013; Kettemann & Krogstrup, 2014).

As the CSPP is one of the few APPs in Europe targeting non-financial corporate bonds[3], it presents an opportunity to gain further insight into the relationship between supply shocks and spreads on the corporate bond market. In addition, the program offers an opportunity to investigate potential implications of APPs for market functioning. If a central bank supply shock affect bond valuation, it may act as a disruptive force and drive valuations away from fundamentals, leading to less informative prices. The purpose of this study is thus to empirically evaluate the theoretical supply effect on the non-financial corporate bond market in connection to the CSPP and investigate its potential short-term implications for market participants.

[2] We calculate this number based on realized monthly purchases as of October 31, 2016 and assume continued monthly purchases of 5 billion euro until the expected termination date of the program. The 4.3% is in line with market expectations (Hill, 2016)
[3] The first APP targeting a European corporate bond market was conducted by the Swiss national central bank in 2009-2010 (Kettemann & Krogstrup, 2014)

In line with theories of market segmentation, we find evidence in favor of local supply effects on the corporate bond market following the introduction of the CSPP. Our study is conducted on the French secondary non-financial corporate bond market which is one of the largest markets targeted under the program (BIS, 2016). Using Nelson Siegel estimated credit spreads as measure of interest during the time period September 1, 2015 to July 17, 2016, we document a statistically and economically significant credit spread narrowing for both eligible and purchased non-financial corporate bonds under the CSPP. By applying a Difference-in-Differences regression (DD) method, we first evaluate any anticipated effects on corporate credit spreads following the CSPP announcement. Thereafter, we use the same methodology to evaluate the effect on credit spreads following subsequent purchases under the program.

Our study contributes to the understanding of the relationship between central bank supply shocks and corporate credit spreads and shed light on the importance of theories allowing for market segmentation. In addition, we argue that central bank supply shocks, at least temporarily, have a negative effect on market functioning as prices become less informative signals about fundamentals and harder for market participants to interpret.

The rest of this paper is organized as follows. In section 2, we provide some necessary information related to the CSPP and the ECB's APPs. Section 3 presents the purpose of this study. Section 4 provides the theoretical foundation that underpins our research question and analysis. Section 5 develops our test logic and hypothesizes. Section 6 explains the methodology applied. Section 7 describes the data generation process and section 8 presents our results and analysis. In section 9 we present our main conclusions. In section 10 the limitations of our findings are discussed and suggestions for future research are presented.

2. Background

In this section, we outline information related to the ECB's APP as well as key events and characteristics of the CSPP. The key events are summarized in Table 1. For further information of the guidelines and restrictions for the ECB's asset purchase programs, see Appendix B.

2.1 The ECB's APP and the CSPP

Since 2009, the ECB has implemented several programs of outright asset purchases in the euro area[4]. The goals of these programs are to "Further enhance the transmission of monetary policy, facilitate credit provision to the euro area economy and ease borrowing conditions for households and businesses, and contribute to returning inflation rates to levels below, but close to, 2% over the medium term" (ECB, 2016).

On March 10, 2016, financial markets were caught by complete surprise when the ECB announced its latest expansion of its APP, the CSPP, through which the universe of eligible assets was to be expanded to include private sector corporate bonds (Hill, 2016). For a security to be eligible it had to fulfill the general APP criteria set out by the ECB as well as four additional criteria. An CSPP eligible security had to be: (1) Euro-denominated, (2) Investment graded, (3) Maturing within 6-months to 30-years and (4) Issued by a non-financial corporation established in the euro area[5]. Furthermore, the ECB informed financial markets that purchases would start towards the end of Q2 2016 (ECB, 2016). Given the unexpected announcement of the CSPP, a market reaction can be expected to have affected credit spreads on March 10. In addition, since the ECB generally targets long-term bonds, the market reaction on the announcement day can be expected to have had a stronger reaction for longer maturities (Cordemans, 2016).

On the same day, the ECB also announced three other policy measures. First, the ECB announced cuts in its three policy rates[6]. Second, the ECB announced an increase in monthly purchases under the APP from €60bn to €80bn. Third, an unexpected program offering attractive long-term funding to banks, the TLTRO II, was announced (ECB, 2016).

Market participants then had to wait until April 21, 2016 for further details of the program. Though a second CSPP announcement, markets learned that purchases would start in June, 2016, be carried out by six National Central Banks (NCBs)[7], be conducted in both the primary and secondary market and comprise a maximum of 70% of issue-specific amounts outstanding (ECB, 2016). Based on the information released on April 21, 2016, some adjustment of market expectations related to the CSPP can be expected to have affected credit spreads on this date.

On June 2, 2016, a final round of information was released regarding the program. However, the announcement contained no information that can be expected to have had an effect on credit spreads. Through the announcement, markets learned that purchases would begin on June 8, 2016. It was further

[4] See Table A1 in Appendix A for a full list of the ECB's asset purchase programs
[5] See Appendix B, Exhibit B1 for further details of CSPP eligibility criteria, and Exhibit B2 for general APP eligibility criteria
[6] (1) The interest rate on the main refinancing operations of the Eurosystem was lowered by 5 bps to 0.00%, (2) The interest rate on the marginal lending facility was lowered by 5 bps to 0.25% and (3) The interest rate on the deposit facility was lowered by 10 bps to -0.40%
[7] Including the national central banks in Germany, France, Belgium, Spain, Italy and Finland. Each NCB would purchase corporate bonds in pre-defined parts of the euro area

stated that the ISINs of securities, purchased after June 7, would be published by the six NCBs on July 18, 2016. The published list would then be updated on a weekly basis. Between list releases, ECB counterparties would only be allowed to communicate targeted maturity brackets and sectors to investors but no security-specific information, such as amounts purchased, firm and security names (ECB, 2016).

Table 1

Key events for the Corporate Sector Purchase Program

Date	Description
10 Mar 2016	ECB press release announcing the CSPP
21 Apr 2016	ECB press release announcing details of the program
2 Jun 2016	ECB press release announcing remaining details of the program
3 Jun 2016	CSPP legal act is published
8 Jun 2016	Purchases under the program are initiated
18 Jul 2016	CSPP ISIN list of purchased securities is published
31 Mar 2017*	Estimated end-date for the program

*Or beyond, if deemed necessary

3. Purpose of study

Different theories of the term structure imply different views as to the effectiveness of central bank supply shocks and thereby APPs, where the market segmentation theory is the only one permitting supply shocks to affect yields (Vayanos & Vila, 2009; Joyce et al., 2011). This ambiguity has led to an evolving literature around these types of interventions. Several studies have examined the relationship between central bank supply shocks and bond yields and found evidence of a causal link. However, if this relationship exists on corporate bond markets is yet to be fully understood (Altavilla et al., 2015; D'Amico & King, 2013; Kettemann & Krogstrup, 2014). Therefore, the CSPP presents an opportunity to fill the existing gap in academia on central bank supply shocks targeting the non-financial corporate bond sector.

The purpose with our study is thus to shed light on the relationship between central bank supply shocks and corporate credit spreads. In particular, we aim to empirically evaluate the theoretical supply effect on the French non-financial corporate bond market following the introduction of the CSPP. Our research question reads out:

"Can a supply effect, that narrows credit spreads by reducing the corporate bond supply, be identified following the introduction of the CSPP on the French non-financial corporate bond market?"

Our research question is important for market participants as they need to understand the mechanisms that drive bond prices and these mechanisms' potential implications for market functioning. A well functioning market is one that provides liquidity and in which bond prices reflect information about fundamentals (Barth

III et al., 2002). Therefore, if a central bank supply shock affects bond valuation, it would drive valuations away from fundamentals and lead to less informative prices and worse market functioning.

4. Theory and literature review

This section provides an overview of the theoretical framework that underpins this paper. In order to put our study in context, we evaluate the role of supply shocks in relation to three different but related theoretical research areas. In the first section, we discuss supply shocks in relation to different theories of the yield curve and present related literature. In the next section, we discuss supply shocks in relation to monetary policy transmission channels and present related papers evaluating the effectiveness of APPs. In a third section, since the CSPP targets corporate bonds, we discuss supply shocks in relation to theory and research on corporate credit spread determinants.

4.1 Theories of the yield curve

According to existing theories of the yield curve, the effectiveness of central bank stimulation on debt capital markets through supply shocks is not obvious. The existing theories can be divided into 1) the expectation hypothesis, 2) the liquidity hypothesis and 3) the market segmentation hypothesis. The expectation hypothesis assumes a no-arbitrage relationship between the current and future short-term interest rates and the shape of the yield curve is therefore exclusively determined by the expected future short-term spot rates. The liquidity hypothesis adds a dimension to the expectation hypothesis by including a term premia derived from interest rate risk associated with longer maturities. Under both the expectation and liquidity hypothesis, the possibility of supply shocks to affect the shape of the yield curve is ruled out. In contrast, the market segmentation hypothesis allows for supply shocks to affect yields by introducing market imperfections where different parts of the yield curve are driven by local forces. (Culbertson, 1957; Vayanos & Vila, 2009)

Theories allowing market imperfections to affect the yield curve have existed for decades. Culbertson (1957) and Modigliani and Sutch (1966) formulate a preferred-habitat theory in which there are investor clienteles with preferences for specific maturities along the yield curve. In this theory, the yield for a given maturity is influenced by local supply and demand forces. As a result, bonds with different maturities should, at least partially, be viewed as separate markets, where one debt security group cannot predict another. In line with this reasoning and under the assumption of imperfect asset substitution, Tobin (1969) and Friedman (1978), document that a change in the quantity outstanding for a specific debt security will lead to a local change in its relative yield. These early findings have in recent years gained renewed interest as researchers have attempted to construct more rigorous yield curve frameworks. One of the most influential models, built on the preferred-habitat theory, was introduced by Vayanos & Vila (2009). The authors assume that the term structure of yields is determined through the interaction between investor clienteles and risk-averse arbitrageurs. They conclude that shocks to clienteles' demand for bonds influence the term structure, thus constituting a determinant of bond prices. In another paper, Vayanos & Greenwood (2008) empirically

examine a term structure model allowing for supply effects and document a causal link between bond supply and bond yields, with stronger effect for longer maturities. The authors find that an increase in the supply of US government bonds by one standard deviation raises the long-term yield by around 40 bps.

4.2 Monetary policy transmission channels

The macroeconomic theoretical framework is closely related to the theories of the yield curve but shifts focus to specific transmission channels through which monetary policy may affect the shape of the yield curve. The most conventional monetary policy theory paraphrases the expectation hypothesis and assumes that yields are driven by changes in the expectations of future short-term interest rates. According to this theory, central bank interventions can only affect bond yields through one transmission channel, the signaling channel. This channel refers to anything market participants can learn about the path of future short-term interest rates from policy announcements (Cordemans et al., 2016; Joyce et al., 2011).

Along with the introduction of more modern theories of the yield curve, the monetary policy theory has expanded to include a second transmission channel affined to the market segmentation hypothesis, the portfolio rebalance channel. This channel is the key transmission mechanism through which APPs are expected to affect bond yields. The channel permits the central bank to lower bond yields by decreasing the bond supply which theoretically should result in eased financing conditions (Joyce et al., 2011). Eased financing conditions in turn encourage investments which contributes to economic activity (Cordemans et al., 2016). Furthermore, lower bond yields should also encourage investors to rebalance their portfolios to riskier asset classes in order to obtain sustained returns. However, this paper focuses solely on the underlying supply shock and any succeeding portfolio rebalancing effects following the CSPP is thus outside the scope of this paper.

In addition, there is a third monetary policy transmission channel, the liquidity premia channel. However, this channel is separate from the theories of the yield curve, and allows bond purchases to put pressure on yields through increased liquidity as central banks enter the market (Joyce et al., 2011). The potential effect through this channel following the CSPP is also outside the scope of this paper.

Several recent macroeconomic studies have empirically evaluated the effect of central bank supply shocks on yields in connection to APPs targeting government bonds. For instance, using security-level data on US Treasuries and regressing purchased quantities on bond prices, D'Amico & King (2013) document significantly compressed yields as a response to the Federal Reserve's Large Scale Asset Purchase (LSAP) Program in 2009[8]. The authors estimate a general downward shift in the yield curve of 30 bps over the life of the program and an additional decline of 3.5 bps on average for purchased maturity brackets, except for long maturities. Joyce et al. (2011) provides similar evidence on the UK government bond market following the Bank of England's bond purchases initiated in 2009. Based on market reactions to news about bond

[8] Several other studies have been conducted on the Federal Reserve's LSAP. Among others, Gagnon et al. (2010) find evidence for economically significant and persistent reductions in long-term US Treasury yields following the LSAP. Taking a wider perspective, Neely (2010) finds a substantial compressing effect on international long-term bond yields and the dollar spot value from the LSAP

purchases, the authors document depressed medium and long-term yields of 100 bps and suggest that the effect mainly came through the portfolio rebalance channel. Moreover, in a European and non-financially distressed context, Altavilla et al. (2015) apply an event-study approach and find a significant yield compression of 30-50 bps following the ECB's purchases of government bonds in 2015. Together, these studies highlight the importance of the portfolio rebalancing channel in central bank APP interventions targeting government bonds.

Although many studies have found a causal link between central bank supply shocks and government bond yields, the effect of supply shocks on the non-financial corporate bond market is yet to be fully understood. To the best of our knowledge, Kettemann & Krogstrup (2014) is the only study that evaluates the effectiveness of an APP targeting a non-financial corporate bond market in Europe. This paper is therefore the most closely related to our study. The authors test for local supply effects on the Swiss corporate bond market following the Swiss National Bank's bond purchase program in 2009-2010. They use an event-study approach on security-level data and regress daily changes in corporate credit spreads on time dummies in event windows around the announcement, the actual bond purchases and the subsequent sell-offs but fail to find any spread effects. In our study, we are not able to analyze the credit spread effects from the ECB's sell-offs as the CSPP is yet to be terminated. However, as pointed out by Kettemann & Krogstrup (2014), central bank sell-offs are likely to be reactive rather than active. Hence, they may be subject to reverse causality and as such they are less relevant to study.

4.3 Corporate credit spread determinants

In order to analyze the relationship between central bank supply shocks and corporate credit spreads following the CSPP, a deeper understanding of credit spread determinants is required. The credit spread is a measure of the risk premia for holding a corporate bond instead of a government bond. In traditional models of credit spreads, firm and business climate fundamentals determine this risk premia. The Merton (1974) model has been found to provide the best insight into which fundamentals that drive credit spreads (Collin-Dufresne et al., 2001). The model assumes that default is triggered if total firm value decreases below a critical default barrier, defined as the face value of a firm's outstanding debt. In the event of default, the firm's debt holders will recover only a fraction of the credit's initial face value. The value of debt is thus risky and is determined by the face value together with the probability of default. Given that the debt holder payoff is equivalent to that of a short position in a put option, Merton's model mathematically derives the value of credit spreads by plugging fundamentals into the Black & Scholes (1973) put option pricing formula. In this framework, credit spreads are determined by leverage, expected earnings potential and volatility that govern asset value, as well as the risk-free rate (Van Landschoot, 2004).

As predicted by the Merton model, several empirical studies have found fundamentals to have explanatory power of credit spread changes. Collin-Dufresne et al. (2001), Avramov et al. (2007) and Elton & Gruber (2002) find that firm leverage, long-term and short-term spot rate as well as equity market return and volatility significantly explain variation in credit spreads. However, the studies also point out that these

fundamentals only can explain part of the observed variance. In order to explain the remaining variation, recent studies have turned to alternative factors. Since most corporate bonds trade in relatively thin markets, an additional acknowledged non-fundamental determinant of corporate credit spreads is a security's liquidity. Fleming (2003), Chen et al. (2007) and Bao et al. (2011) all find liquidity to be an important determinant of credit spreads on the US corporate bond market. However, even after including both fundamentals and security liquidity, Collin-Dufresne et al. (2001) conclude that only 30%[9] of the variation in credit spreads can be explained. By performing a principal components analysis, the authors document highly correlated residuals, suggesting the existence of a systematic factor that cannot be explained by previously identified credit spread determinants. They argue that a plausible explanation could be segmented markets in which credit spreads are driven by local supply and demand forces. In a more recent study, Van Landschoot (2004) documents results similar to those of Collin-Dufresne et al. (2001). However, while Collin-Dufresne et al. (2001) focus on security-level US data, Van Landschoot (2004) studies the sensitivity of the term structure using Nelson Siegel estimated credit spreads. Our study draws heavily on the empirical methods used by Van Landschoot (2004).

To conclude, previous research suggests that a large part of the variation in credit spreads remains unexplained. Therefore, the CSPP offers a unique opportunity to further assess whether theories of market segmentation are applicable and if central bank supply shocks affect the term structure of corporate credit spreads.

5. Test logic and hypothesis development

To answer our research question stated in section 3, we use a two-step procedure. In a first step, hereafter referred to as Step 1, we investigate the CSPP announcement effect on French corporate credit spreads. The announcement on March 10, 2016 can be expected to have had an effect on credit spreads since, as described in section 2, market participants had all the necessary information regarding eligibility criteria to price in any anticipated program effects. As a result, if markets anticipated a future supply effect on the corporate bond market on March 10, we would expect a larger credit spread narrowing for eligible bonds compared to non-eligible bonds. Therefore, we formulate our first hypothesis as follows:

$\boldsymbol{H_{A,0}}$**:** *There is not a larger credit spread narrowing for eligible bonds compared to non-eligible bonds following the CSPP announcement*

$\boldsymbol{H_{A,1}}$**:** *There is a larger credit spread narrowing for eligible bonds compared to non-eligible bonds following the CSPP announcement*

A rejection of $H_{A,0}$ does not necessarily imply a supply effect as other credit spread determinants might explain the outcome. Therefore, after testing $H_{A,0}$, we continue our analysis in a second step, hereafter referred to as Step 2. In this step, we aim to isolate a potential supply effect by comparing purchased and non-purchased eligible bonds. As mentioned in section 2, the NCBs started to purchase corporate bonds on June 8, 2016. The first ISIN list of purchased securities in France was then published by the French

[9] Measured by the adjusted R^2

national bank on July 18, 2016. Under the assumption of no market leakage between these two dates, the market was informed in retrospect of purchases made, and the effect of changing the supply outstanding for purchased bonds may be isolated. According to theories of segmented markets, a reduced outstanding supply of purchased bonds should result in a larger credit spread narrowing for purchased compared to non-purchased eligible bonds. Therefore, we formulate our second hypothesis as follows:

$\boldsymbol{H_{B,0}}$*: A supply effect, that narrows credit spreads by reducing the corporate bond supply, cannot be identified through a larger credit spread narrowing for purchased compared to non-purchased eligible bonds following subsequent purchases under the CSPP*

$\boldsymbol{H_{B,1}}$*: A supply effect, that narrows credit spreads by reducing the corporate bond supply, can be identified through a larger credit spread narrowing for purchased compared to non-purchased eligible bonds following subsequent purchases under the CSPP*

We limit our analysis to the first list release as only a few ISINs were added in the updated lists during the preceding weeks after July 18, 2016.

6. Method

In this section we outline the methodology used to answer our research question. We start by describing how we construct corporate credit spreads using a Nelson Siegel estimation procedure based on quoted bond prices. In a second step, we outline the Difference-in-Differences (DD) regression method used to single out the CSPP effect on credit spreads. Finally, we comment on potential shortcomings of the methods applied.

6.1 Modeling the term structure of credit spreads

The credit spread of a corporate bond is defined as the difference in yield between the corporate and the corresponding government bond with the same time to maturity. A common yield measure in the calculation of the credit spread term structure is the internal rate of return, commonly known as the yield to maturity (YTM). However, it is not entirely accurate to use the YTM of coupon-paying bonds to construct the term structure. First, the YTM is an average of zero yields up until maturity of the debt security. Therefore, it does not represent a term-specific yield which is needed in order to construct the credit spread term structure. Second, due to accrued interest, the YTM of a coupon-paying bond partly depends on the coupon rate. As a result, two bonds with the same time to maturity but with different coupon rates can have very different yield to maturity. This phenomenon is referred to as the coupon effect (Stander, 2005). For these two reasons, the YTM is an inappropriate yield measure when constructing the credit spread term structure.

In accordance with Van Landschoot (2004), we overcome the aforementioned shortcomings of the YTM by using zero rates when constructing credit spreads. Zero rates are both term-specific and non-coupon paying. However, they are not directly observable as there are not enough zero coupon bonds in the market. Therefore, they need to be estimated. In general, there are two common methods for estimating zero rate term structures, bootstrapping and curve fitting. Bootstrapping is an iterative procedure to estimate

zero rates based on available coupon bond market data. This method works well when the number of bonds equal the number of maturities. However, if there are several bonds for a certain maturity or gaps between maturities, as is the case for our dataset, bootstrapping is not feasible. The alternative is to use curve fitting. These models specify a parametric functional form to fit the term structure of zero rates (Veronesi, 2011). We use the most commonly applied curve fitting model developed by Nelson & Siegel (1987) to estimate the term structure of credit spreads.

6.1.1 The Nelson Siegel model

The Nelson Siegel model, hereafter referred to as the NS model, was first introduced in 1987 and is today widely applied for modelling the yield curve. It is built on the arbitrage-free notion that the price of a coupon-paying bond can be calculated using zero yield discount factors. Under the assumption of no arbitrage, the price of a coupon-paying bond P_t at time t must be equal to the price of a portfolio of zero coupon bonds with replicated cash flows (Veronesi, 2011):

$$P_t = \sum_{\tau=1}^{T} Z_t(\tau)C + Z_t(T)M \tag{1}$$

Where:

$$Z_t(\tau) = \exp(-r_t(\tau)\tau) \tag{2}$$

C is the annual coupon payment. M is the face value of the bond received at maturity T and $Z_t(\tau)$ is the zero rate discount factor at time t with time to coupon payment τ. $r_t(\tau)$ is the term-specific continuously compounded zero rate at time t with term τ.

The idea of the NS model is to estimate the zero rates, $r_t(\tau)$, along the term structure. The estimated zero rates are then plugged into equation (2) to generate discount factors. The zero rate discount factors are thereafter used to price the coupon-paying bond using equation (1). The NS model estimates $r_t(\tau)$ by fitting the empirical form of the yield curve using a pre-specified functional form:

$$r_t(\tau) = \beta_0 + \beta_1\left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau}\right) + \beta_2\left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau}\right) \tag{3}$$

Where $r_t(\tau)$ is the continuously compounded zero rate at time t and with term τ. β_0, β_1, β_2 and λ are the model parameters that we estimate. β_0, β_1 and β_2 can be interpreted as the level, slope and curvature of the term structure (Diebold & Li, 2006). Alternatively, β_0 can be interpreted as determining the long-term yield level, β_1 as the determinant of the short-term yield, β_2 as the determinant of the medium-term yield and λ as the determinant for the decay rate (Nelson & Siegel, 1987).

Using quoted market prices for coupon-paying bonds, the NS procedure estimates these parameters by minimizing the following objective function:

$$J(\beta_0, \beta_1, \beta_2, \lambda) = \sum_{i=1}^{N_t} \left(P_{i,t}^{NS} - P_{i,t}\right)^2 \quad (4)$$

Where $P_{i,t}^{NS}$ is the NS arbitrage-free model price for bond i at time t using equations (3), (2) and (1) above. $P_{i,t}$ is the quoted market price for bond i at time t. Hence, the minimization procedure generates values for the model parameters in equation (3) so that the difference between the modeled and the quoted price is minimized (Nelson & Siegel, 1987).

The NS approach to estimate credit spreads is applied as it offers a conceptually simple description of the term structure. It generates a smooth curve that allows for monotonically increasing or decreasing yield curves as well as hump shapes (Van Landschoot, 2004). Furthermore, it avoids over-parameterization which is a potential risk in the extended NS model introduced by Svensson (1995). The NS model also avoids the issue in spline-based models of finding the best knot point specification (Stander, 2005).

6.1.2 Nelson Siegel estimation setup

We use the IRFunctionCurve.fitNelsonSiegel in Matlab for the implementation of the NS estimation procedure. To generate representative zero credit spread curves, the bonds used in each estimation should be as homogenous as possible. For this purpose, we take inspiration from Van Landschoot (2004) and divide the eligible and non-eligible bond groups in Step 1 as well as the purchased and non-purchased eligible bond groups in Step 2 into subsets of A- and BBB-rated bonds. Based on these subsets, eight separate NS corporate bond zero rate curves are generated. A sample of AA-rated government bonds are then used to estimate a separate NS government bond zero yield curve. See Figure A1 in Appendix A for the estimated curves. Finally, the term structure of credit spreads for a given subset is calculated as the difference between the zero yield curve for corporate and government bonds:

$$CS_{t,T}^{j} = r_{t,T}^{j,corp} - r_{t,T}^{j,gov} \quad (5)$$

Where $CS_{t,T}^{j}$ is the credit spread on day t with term T for rating category j. $r_{t,T}^{j,corp}$ is the NS estimated corporate bond zero rate on day t with term T for rating category j. $r_{t,T}^{j,gov}$ is the NS estimated government zero rate on day t with term T for rating category j.

Through the NS estimation procedure, we obtain estimated credit spreads on a subset-level and security-specific data is lost. The estimation procedure described above is repeated for every day during the studied time periods for Step 1 and Step 2 respectively.

6.2 Econometric approach

6.2.1 The DD regression method

In order to evaluate the relationship between the CSPP supply shocks and French corporate credit spreads, we use a Difference-in-Differences (DD) regression method. Academia recognizes this method as a

powerful tool to reduce the risk of biased estimations (Wooldridge, 2013). In a DD estimation, the outcome of a variable is observed for two separate groups before and after an external shock. The first group, referred to as the treatment group, is exposed to the shock. The other group, referred to as the control group, is not exposed to the shock but should represent the treatment group in absence of the shock. The shock's true effect on the treatment group, referred to as the DD estimator, can then be calculated using a two-step procedure. First, the average control group variable outcome is subtracted from the average treatment group variable outcome in the pre- and post-shock time periods. Second, the calculated pre-shock difference is subtracted from the post-shock difference. The remaining difference is the DD estimator:

$$\delta_1 = (\bar{y}_{2,T} - \bar{y}_{2,C}) - (\bar{y}_{1,T} - \bar{y}_{1,C}) \tag{6}$$

Where δ_1 is the DD estimator. $\bar{y}_{2,T}$ is the post-shock average variable outcome for the treatment group. $\bar{y}_{2,C}$ is the post-shock average variable outcome for the control group. $\bar{y}_{1,T}$ is the pre-shock average variable outcome for the treatment group and $\bar{y}_{1,C}$ is the pre-shock average variable outcome for the control group.

The DD estimator presented in equation (6) can also be constructed using the following regression specification:

$$y = \beta_0 + \delta_0 P + \beta_1 T + \delta_1 (P * T) + other\ factors \tag{7}$$

Where y is the outcome for the observed variable. β_0 is the intercept. T is a dummy variable taking the value of one if the observed y belongs to the treatment group. P is a dummy variable taking the value of one if y is observed in the post-shock time period. δ_1 is the DD estimator and the variable of interest.

We choose the DD procedure to evaluate the CSPP effects on credit spreads due to its ability to reduce the risk of biased estimations. The method reduces biased estimations derived from systematic differences between the treatment and the control group. It also controls for common time trends for the two groups. As a result, the DD estimator has the ability to isolate the effect from a single external shock, in our case the CSPP, thus supporting the establishment of causality (Woolridge, 2013).

For the DD estimator to be unbiased, two important assumptions need to hold, the no anticipation and the parallel trend assumption. For the no anticipation assumption to hold, the external shock should be an unexpected event. If this assumption is violated and part of the effect is already priced in, the DD estimator will be underestimated. For the parallel trend assumption to hold, the control group should represent a counterfactual to the treatment group before and after the event. This assumption is commonly confirmed using a visual inspection before and after the shock. If parallel trends between the treatment and the control group is observed before the event, the control group can be assumed to be an accurate counterfactual. If this assumption is violated and a pre-event parallel trend is not confirmed, the control group could be misspecified and will result in a biased DD estimator (Woolridge, 2013). As it is vital for the no anticipation and parallel trend assumptions to hold in order to obtain unbiased estimations, we conduct a visual inspection as part of our DD analysis.

6.2.2 DD estimation setup

In this section we outline our regression setup. First, we describe how we generate treatment and control groups in Step 1 and Step 2 of our analysis. Second, we define the time windows used in each step. Third, we present our DD regression specification.

6.2.2.1 Construction of treatment and control groups

In Step 1 of our analysis, we generate a treatment group of eligible bonds by identifying securities that fulfill both the general APP and the specific CSPP criteria. We first identify bonds that fulfill all the general APP criteria by using a Bloomberg dummy variable[10]. Thereafter, we single out bonds that also fulfill the CSPP-specific criteria described in section 2. A control group is then constructed by imposing several filters on the non-eligible bond group in order to make it comparable with the eligible treatment group. We start by identifying all non-eligible bonds that are euro-denominated, investment graded, maturing within 6-months to 30-years and issued by a non-financial corporation established in the euro area. The filtered out bonds thus fulfill all the CSPP specific criteria but are still non-eligible under the general APP criteria. In a next step, we assess whether the remaining differences between the non-eligible and the eligible bonds are material enough to violate the parallel trend assumption. We use the legal ECB document stating the general APP criteria to examine the underlying reasons for why the bonds in the control group are non-eligible. Two explanations are found; the bond is subordinated to other debt securities issued by the same firm or the bond lacks a book-entry form settlement procedure. The relevant legal text can be found in Exhibit B2, Appendix B.

The two identified differences between the treatment and the control group potentially violate the parallel trend assumption. By including subordinated bonds in the control group, it may become less comparable to the treatment group as bondholders require compensation for holding subordinated bonds. However, since rating agencies can be expected to capture subordination in their rating procedure we control for this difference by dividing the treatment and the control group into subgroups based on rating, see section 6.1.2 (John et al., 2005). In addition, the non-standard settlement procedure may lead to lower liquidity for the securities in the control group and thereby reduce its comparability with the treatment group. A potential difference in liquidity between the two groups therefore needs to be controlled for in our DD regressions.

In step 2 of our analysis, we generate a treatment group of eligible bonds that are purchased between June 8 and July 17, 2016. We identify these bonds by using the first ISIN list released by the French NCB on July 18, 2016. The remaining eligible bonds that are not purchased during this period are used as control group. In accordance with the procedure in Step 1, we divide the treatment and control group into subgroups based on rating.

[10] The Bloomberg dummy takes the value "Yes" if the security is eligible and "No" if not

By constructing treatment and control groups, we automatically control for any signaling effects from the other policy announcements described in section 2 as these should have the same effect on the two groups.

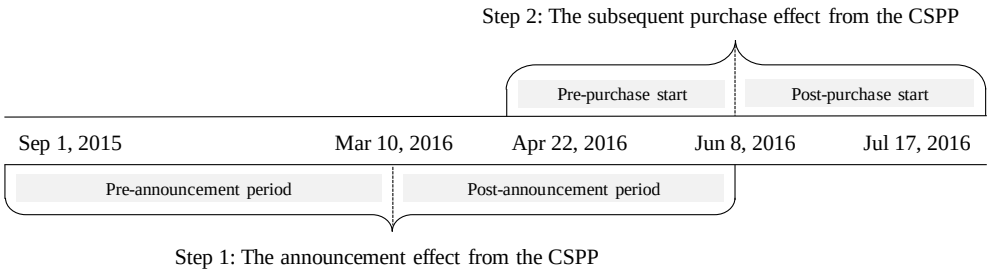
6.2.2.2 Specification of time windows

Figure 1 presents the time windows used in the DD regressions in Step 1 and Step 2 of our analysis. In order to assess the announcement effect of the CSPP in Step 1, we compare the credit spread development for our specified treatment and control group before and after the CSPP announcement. We use a six-month pre-shock period between September 1, 2015 and March 9, 2016. The specified period allows for a robust assessment of the parallel trend assumption without introducing potential disturbance from other ECB APPs[11]. The post-shock period includes the subsequent CSPP press releases on April 21 and June 2, 2016, to capture any additional market reactions on those dates, and ends the day before June 8, 2016 when the CSPP purchases were initiated.

In order to isolate a potential supply effect in Step 2, we compare the credit spread development for our specified treatment and control group before and after June 8, 2016 when purchases under the CSPP were initiated. The pre-event period starts on 22 April, 2016 as to avoid announcement effects on April 21 but includes the third press release on June 2, 2016. However, as described in section 2, the press release on June 2 was a non-event as it contained no significant new information regarding the CSPP. The post-event window is set to end on July 17, 2016 as the first list of purchased ISINs was released on the following day.

Figure 1

Illustration of the pre- and post-time windows used in Step 1 and Step 2 of our analysis



6.2.2.3 Difference-in-Differences regression specification

To accurately measure a causal link between the CSPP and credit spread movements, potential differences in bond characteristics and firm fundamentals between the treatment and control groups need to be controlled for. Therefore, to increase the precision of the DD estimator we include leverage and liquidity, that previously have been found to drive credit spreads, in the regression. In addition, to further control for general market-level factors such as equity market return and volatility and the risk-free rate, we also include day fixed effects.

[11] In January 2015, the ECB announced its Public Sector Purchase Program (PSPP), see Appendix A, Table A1

In the setup of our DD regressions, we extract daily NS estimated credit spreads and use them as the dependent variable. For each rating category j and term T, we run the following panel data regression:

$$CS_{t,T}^{j} = \beta_0 + \beta_1 T + \delta_1 (T * P) + \beta_2 Lev_{t,T}^{j} + \beta_3 Liq_{t,T}^{j} + \sum_{t} \lambda_t d_t + \varepsilon \quad (8)$$

Where $CS_{t,T}^{j}$ is the observed credit spread on day t with term T for rating category j. β_0 is the intercept. T is a treatment dummy taking the value one if the observed $CS_{t,T}^{j}$ belongs to the treatment group. P is a dummy variable taking the value of one if $CS_{t,T}^{j}$ is observed in the post-shock time period. δ_1 is the DD estimator and the variable of interest. $Lev_{t,T}^{j}$ is a weighted average of firm leverage on day t with term T for securities in rating category j. $Liq_{t,T}^{j}$ is the NS estimated liquidity on day t with term T for rating category j. d_t is a dummy for day t and λ_t is the time fixed effects. ε is an error term. For detailed information on the construction of the control variables, see section 7.

The maturities range from four to ten years. P is dropped due to collinearity with day-fixed effects and robust standard errors are used in the DD regressions to control for heteroscedasticity. The estimation procedure described above is performed for Step 1 and Step 2 using their respective time periods defined in section 6.2.2.2.

6.3 Measuring purchased quantities

To find further evidence of a supply effect following CSPP purchases, information regarding purchased volumes on security or firm level would be desirable. Unfortunately, this information is not available. Therefore, to circumvent the lack of data, we assemble the following statistics for different maturity brackets and rating: (1) The number of securities purchased, (2) The number of securities purchased in relation to the total number of eligible bonds, (3) The maximum volume that could have been purchased and (4) The maximum volume that could have been purchased in relation to the total volume of eligible bonds. The maximum volume that could have been purchased is approximated by the 70% of the amount outstanding for purchased securities within each maturity bracket. The 70% limit is used as CSPP purchases cannot exceed this threshold (ECB, 2016).

6.4 Method critique

The methods used throughout our study are subject to potential shortcomings. These shortcomings are discussed below.

The Nelson Siegel model

The Nelson Siegel model described in section 6.1 is built on an estimation procedure and may therefore be subject to estimation errors. For the method to return a well fitted line, model inputs should be as homogenous as possible without compromising the sample size. Due to the limited number of French non-financial corporate bonds, our construction of homogenous bond groups used as NS model inputs has led to one subgroup consisting of only nine securities. However, due to the high degree of bond homogeneity in the group we consider this number to be enough for constructing a representative term structure.

The Difference-in-Differences regression method

Several studies applying a DD regression method have been criticized for their ignorance of underestimated standard errors due to autocorrelation. The severance of the autocorrelation issue increases with longer time-series and higher correlation between dependent variable observations (Bertrand, 2004). Bierens et al. (2005) argue that corporate credit spreads may be correlated over time which introduces a risk of autocorrelation for our dependent variable. We partly control for this risk by running DD regressions by maturity and during a relatively short time period. However, serial correlation for a term-specific credit spread may still exist, leading to underestimations of our standard errors[12]. This must be considered in the interpretation of our results.

A potential issue common to all studies evaluating the effect from monetary policy interventions is the risk of reversed causality. In the evaluation of CSPP effects, causality could go the other way around, where the ECB and the French NCB react to market movements rather than acting independently. This source of endogeneity may result in a true credit spread narrowing that is left unidentified as the central banks intervene in upward trending corporate bond markets.

In addition, if information leaked about which securities that had been bought before the first ISIN list release by the French NCB on July 18, 2016, the assumption of no market leakage would be violated. If this is the case, credit spread movements between June 8 and July 17, 2016 could have been subject to market reactions related to the leaked information and may thus hinder the establishment of a causal link between the CSPP supply shocks and corporate credit spreads. Finally, credit spread movements during our studied time period could also be driven by changes in demand. This must also be considered in the interpretation of our results.

[12] Bertrand (2004) proposes clustering and block-bootstrapping as two methods that can be used to avoid understatements of standard errors due to autocorrelation. However, both methods require a large number of groups to cluster on. Since the estimated credit spreads used in our DD regressions are on subgroup level, we have too few bond groups for clustering to be feasible.

Control variables

If constructed incorrectly, control variables may lead to decreased instead of increased precision of the DD estimates (Woolridge, 2013). Our chosen measure of leverage, the leverage ratio, is well recognized in academia and should therefore serve its purpose (Collin-Dufresne et al., 2001). However, the choice of liquidity measure is not as straightforward. While Fleming (2007) argues for the usefulness of the bid-ask spread to capture liquidity effects, others have rejected it as a suitable proxy (Bao et al., 2011; Chen et al., 2007). Nevertheless, as no other measure stands out as a better proxy we use the bid-ask spread to control for liquidity effects in our DD regressions.

Another possible bias related to the choice of control variables, is the CSPP's potential impact on liquidity through the liquidity channel described in section 4. If the program has an effect on the securities' liquidity and liquidity in turn is an important credit spread determinant, the variable becomes a "bad control". A bad control would in our case cannibalize on the true effect from the CSPP intervention and result in less precision of the DD estimator.

7. Data

A dataset consisting of corporate and government securities incorporated in France has been downloaded from Bloomberg. For each security, static bond characteristics including issue date, maturity date, coupon rate, coupon paying frequency, amount outstanding, currency and face value have been downloaded. For corporate bonds, a Bloomberg ECB eligibility variable has been extracted together with issuer name and industry[13]. Daily price observations and security ratings for all bonds have also been downloaded for the studied time period September 1, 2015 to July 17, 2016[14]. Prices are expressed in percentage of par value and quoted as clean on an actual/actual basis.

Several filters have been imposed in order to obtain a final dataset compatible with the Nelson Siegel method. We keep straight, fixed rated and annual coupon paying securities and drop all bonds without a credit rating from the three largest credit rating firms S&P, Fitch and Moody's. In addition, we sort for extreme values and obvious mispricing. Finally, to minimize the liquidity risk, we omit too illiquid securities. The filtering procedure results in a balanced panel dataset of 271 corporate bonds and 42 government bonds incorporated in France. In the final dataset, all days on which banks and stock exchanges are closed have been excluded.

For the construction of the leverage control variable in our DD regressions, we assemble a list of issuer names for the corporate bonds included in our dataset. Based on this list, firm-level daily market values of equity and semi-annual book values of debt are downloaded from Factset. Due to the lack of quarterly data for the firms in our dataset, semi-annual debt values are used and kept constant between

[13] The Bloomberg ECB eligibility variable is a dummy that takes the value "Yes" if the security fulfills the general APP critera stated by the ECB. See Exhibit B2, Appendix B for details on the criteria

[14] Ratings are constant during our studied time period

reporting dates. In accordance with both Van Landschoot (2004) and Collin-Dufresne et al. (2001), we then define the leverage variable for each firm i as:

$$\frac{Book\ Value\ of\ Debt_i}{Market\ Value\ of\ Equity_i + Book\ Value\ of\ Debt_i} \tag{9}$$

The leverage ratio for a specific firm i is matched with securities in our dataset issued by that firm. In a next step, we generate daily weighted averages of the leverage ratios in each subset and maturity bracket based on firm value. This is done in order to aggregate the leverage ratios to a subset- and maturity-level that match the data structure obtained from the NS estimation described in section 6.1. Within each subset, we use 4-5 years, 6-7 years and 8-10 years as maturity brackets. Depending on which credit spread along the term structure that is used as dependent variable in the DD regression, the weighted leverage ratio from the matching maturity bracket and rating is included as control variable.

For the construction of the liquidity control variable, bid and ask prices for each security have been obtained from Bloomberg. To make the bid-ask spread measure conformable with the credit spreads used as dependent variable in the DD regressions, we use the same NS estimation procedure as described in section 6.1 and generate bid and ask zero yield curves. For each of our subsets, the bid-ask yield spread on day t with term T for rating category j is defined as:

$$Liq_{t,T}^{j} = Bid_{t,T}^{j} - Ask_{t,T}^{j} \tag{10}$$

Where $Liq_{t,T}^{j}$ is the bid-ask yield spread on day t with term T for rating category j. $Bid_{t,T}^{j}$ is the NS estimated bid zero yield on day t with term T for rating category j. $Ask_{t,T}^{j}$ is the NS estimated ask zero yield on day t with term T for rating category j.

Akin to the aforementioned potential shortcomings in our chosen methodology, our generated dataset may also include potential biases. Corporate bond markets are in general thinly traded. As a result, daily quotes might not reflect the true value for a specific bond. It is therefore possible that temporary or more persistent mispricing of securities exist in our dataset. In addition, due to our data filtering process a selection bias might exist as the final dataset does not represent the entire eligible universe of corporate bonds in France. For ease of analysis, a balanced panel dataset is used in the NS estimation procedure. As a result, bonds issued or maturing during the studied time period are not included in the dataset. Excluding maturing bonds is desirable as bonds tend to be priced differently close to maturity (Van Landschoot, 2004). On the other hand, it could be argued that excluding new issues leads to selection bias. However, since a limited number of securities are excluded in our generation of a balanced panel dataset, the significance of a potential selection bias ought to be small.

8. Empirical findings and analysis

In this section, we present and analyze our results in accordance with the two-step procedure described in section 5. First, the empirical findings related to the announcement of the CSPP are presented. Second, the findings related to subsequent purchases are outlined. In each of the two steps, results and analysis are presented in the following order: (1) Summary statistics for the treatment and the control group are discussed in order to assess their comparability, (2) A visual inspection of the credit spread development for the treatment and the control group is performed in order to evaluate the no anticipation and parallel trend assumption and (3) Results for the DD regressions are presented and analyzed.

8.1 The announcement effect

Recall that in Step 1 of our analysis, the treatment group includes eligible French corporate bonds and the control group includes non-eligible French corporate bonds. Table 2 summarizes key characteristics of the treatment and the control group. The two groups should have as homogenous characteristics as possible to generate unbiased DD regression results. Although the two groups differ in size, Table 2 confirms an otherwise high resemblance on key bond characteristics. Mean and median time to maturity (TTM) for the two groups are well matched within the same rating category and range from 3.2 to 6.5 years with similar standard deviations. This is also the case for the coupon rates that range from 3.5% to 4.4%. The similarities in TTM and coupon rate suggest that the identified control group is suitable as counterfactual in our DD regression setup. On the other hand, some variation can be observed when comparing the security-specific liquidity and firm-specific leverage ratios between the two groups. Despite the similarities in mean and median, the standard deviation differs to some extent. These results may be due to the different settlement procedure and seniority between the securities in the treatment and the control group. These differences further highlight the importance of controlling for leverage and liquidity in our DD regressions.

8.1.1 Visual inspection

The results from the conducted visual inspections are summarized in Figure 2. The figure presents the credit spread development for the 5-year, 7-year and 10-year maturities in the treatment and the control group around the announcement of the CSPP. In the pre-announcement period, the treatment and the control group show overall parallel trends in their credit spread development and the parallel trend assumption thus seems to hold. In addition, no clear pre-event CSPP effect is visible. In the days before the announcement on March 10, 2016, there seems to be a uniform increase in credit spreads. These movements could be due to anticipated monetary policy decisions or related to changes in the general business climate. However, if markets would have anticipated the CSPP announcement, we would instead expect to see a drop in credit spreads. Therefore, the no anticipation assumption also seems to hold. Since both the parallel trend and the no anticipation assumption seem to hold, the identified control group stands as a suitable counterfactual.

Although the treatment and the control group seem to follow parallel trends prior to the announcement, the two groups show different spread levels. This suggests that the two groups have

different characteristics. As indicated in Table 2, this could be explained by differences in leverage and liquidity between the two groups. Table A2 in Appendix A reports evidence that the two variables significantly explain the different levels in credit spreads over the studied time period. This further highlights the necessity to include control variables for leverage and liquidity in our DD regressions.

A last important observation from the visual inspection is that the common trends observed in the pre-event window seem to change following the announcement of the CSPP. The next section further analyzes the magnitude these changes.

8.1.2 Regression results

Table 3 and Figure 3 present the DD regression results from the announcement effect. According to theories of segmented markets, an anticipated supply effect can be expected to result in narrowing credit spreads. Our results generally confirm the expected outcome. In contrast to the findings by Kettemann & Krogstrup (2014), we find significant credit spread effects following the announcement of the CSPP as a majority of our DD estimators indicate a larger drop for the treatment group than for the control group. In addition, all DD estimators are statistically significant at the 1% level after controlling for day-fixed effects, leverage and liquidity.

The outcome for A- and BBB-rated bonds generally show similar results, which can be expected since the rating categories are close to each other. For BBB-rated bonds, the estimated drops become larger along the term structure and range from 5.86 bps for the 4-year maturity to 19.66 bps for the 10-year maturity. The stronger effect for longer maturities is not surprising as the ECB has informed market participants that they generally target longer term securities under their APPs. This result is also in line with the previously documented effects on government yields by Vayanos and Greenwood (2013). The DD estimators for A-rated bonds, show similar results but with some inconsistency. While there is a drop ranging from 2.76 bps up to 25.30 bps for maturities between six to ten years, the shorter maturities show statistically significant increases in credit spreads. The positive DD estimators for shorter maturities may be a result of less precise NS estimations. Less precision is expected for A-rated bonds as the control group has a small sample size, see Table 2 and Figure A2 in Appendix A.

In light of market responses to previous APP announcements, a credit spread narrowing of up to 25 bps for eligible French corporate bonds can be regarded as economically significant. Kettemann & Krogstrup (2014), D'Amico & King (2013) and Altavilla et al. (2015) all find results in the same range when examining programs targeting government and corporate bonds.

Since these results generally indicate a significantly larger credit spread narrowing in the treatment group compared to the control group, we reject $H_{A,0}$ stated in section 5. The rejection of the first null hypothesis provides a first indication of the existence of a supply effect on the French corporate bond market following the introduction of the CSPP. However, since the actual purchases started first several months after the announcement of the program, the announcement effect is unable to explain how the actual changes in the

outstanding supply affect French corporate bond valuations. To find more robust evidence, we continue with Step 2 of our analysis.

Table 2

Key characteristics of treatment and control group

The table shows sample characteristics by rating for the treatment and the control group as of September 1, 2015. Treatment group refers to eligible corporate bonds under the CSPP. The control group refers to non-eligible but otherwise conformable with treatment corporate bonds. TTM denotes time to maturity. Coupon refers to the coupon rate of the bonds. Leverage is defined as Book value of Debt divided by Book value of Debt plus Market value of Equity. Liquidity is defined as the bid-ask yield spread, calculated by subtracting the NS estimated Bid-yield from the NS estimated Ask-yield. Volume outstanding refers the outstanding debt value denominated in millions of euro.

	No. Of	TTM (years)			Coupon (%)			Leverage (%)			Liquidity (bps)			Volume outst.
	securities	Mean	Median	σ	Mean	Median	σ	Mean	Median	σ	Mean	Median	σ	Millions of €
Treatment														
All ratings	211	5.8	4.9	3.8	3.6	3.6	1.3	30.2	28.8	14.7	6.9	6.8	2.7	130,034
A	120	6.5	5.7	4.0	3.6	3.5	1.3	28.8	33.8	14.3	8.0	7.3	1.5	77,584
BBB	91	4.8	4.1	3.2	3.7	3.8	1.3	31.0	27.8	14.4	5.8	5.0	3.1	52,450
Control														
All ratings	60	5.2	3.5	4.8	4.3	4.1	1.5	26.1	27.3	10.4	9.4	8.7	4.3	28,436
A	9	5.5	6.2	3.0	3.6	4.0	1.0	28.0	28.0	5.7	8.3	6.3	5.0	3,872
BBB	51	5.1	3.2	5.0	4.4	4.2	1.5	25.5	27.3	11.4	10.6	9.1	3.1	24,564
Total	271													158,470

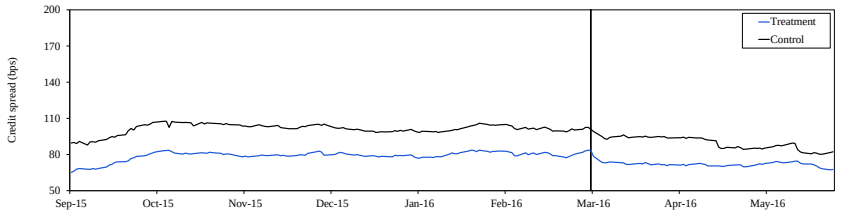
Figure 2

Credit spread development by rating for corporate bonds in treatment and control group around the announcement of the CSPP

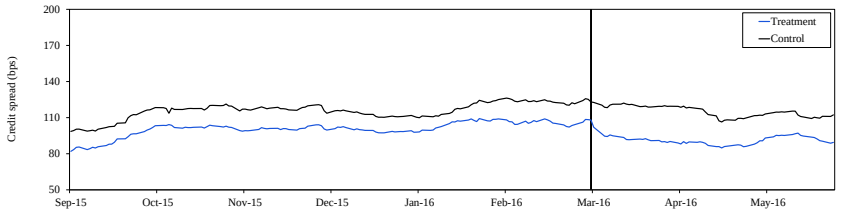
The figure shows daily credit spread time series by rating for corporate bonds in the treatment and control group. (a) plots the 5-year credit spread development, (b) plots the 7-year credit spread development and (c) plots the 10-year credit spread development. To generate credit spreads for a specific maturity, the corporate and government yield for that maturity are extracted from the daily estimated NS curves. For each date, the credit spread is then calculated by subtracting the government yield from the corporate yield. The studied period is September 1, 2015 to June 7, 2016. The event day is defined as March 10, 2016 when the ECB announced the CSPP, illustrated by a black vertical line in the graphs below. A pre-event period is defined as September 1, 2015 to March 9, 2016 and a post-event period is defined as March 10, 2016 to June 7, 2016.

A-rated bonds

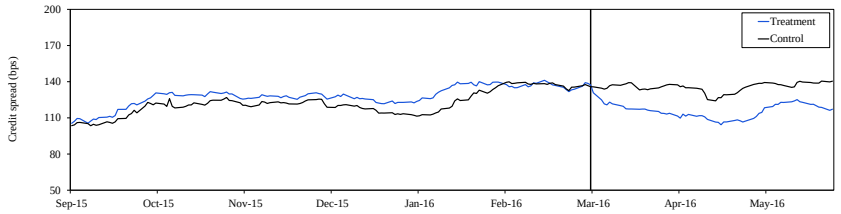
(a) 5-year



(b) 7-year

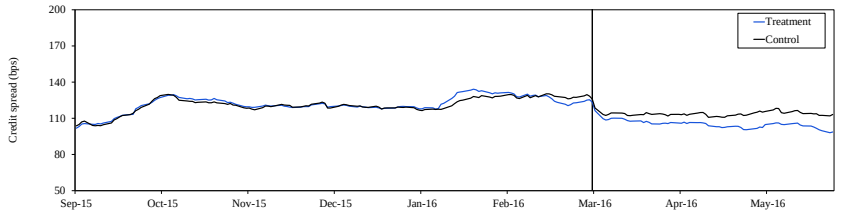


(c) 10-year

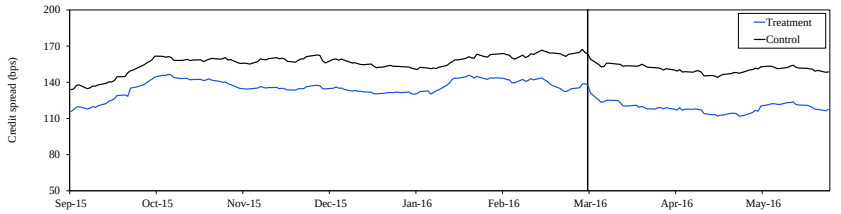


BBB-rated bonds

(d) 5-year



(e) 7-year



(f) 10-year

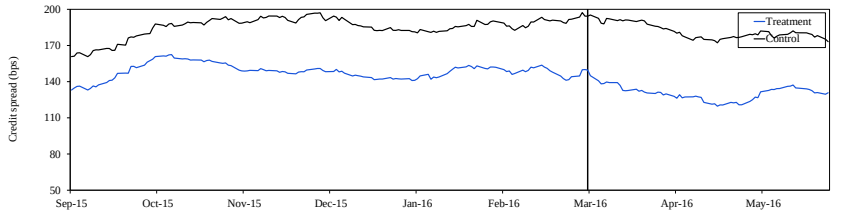


Table 3

Difference-in-Differences regression results by rating and for maturities 4-10 years

The table below shows DD regression coefficients (in basis points) for maturities 4-10 years comparing eligible and non-eligible securities following the CSPP announcement. T-values are in brackets. Over the studied time period September 1, 2015 to June 7, 2016, we run the following regression: $CS_{t,T}^{j} = \beta_0 + \beta_1 T + \delta_1 (T * P) + \beta_2 Lev_{t,T}^{j} + \beta_3 Liq_{t,T}^{j} + \sum_t \lambda_t d_t + \varepsilon$. $CS_{t,T}^{j}$ is the observed credit spread on day t with term T for rating category j. β_0 is the intercept. T is a treatment dummy taking the value one if the observed $CS_{t,T}^{j}$ belongs to the treatment group. P is a dummy variable taking the value of one if $CS_{t,T}^{j}$ is observed in the post-shock time period. δ_1 is the DD estimator and the variable of interest. $Lev_{t,T}^{j}$ denotes a weighted average of firm leverage on day t with term T for securities in rating category j. $Liq_{t,T}^{j}$ denotes the NS estimated liquidity on day t with term T for rating category j. d_t is a dummy for day t and λ_t is the time fixed effects. ε is an error term.

Panel A: A rated bonds

	4Y	5Y	6Y	7Y	8Y	9Y	10Y
δ_1	8.75	3.32	-2.76	-8.31	-13.33	-19.98	-25.30
	[13.65]	[5.33]	[-4.11]	[-12.00]	[-18.82]	[-20.33]	[-20.28]
$Liq_{t,T}^{j}$	0.00	-0.02	0.04	0.51	1.04	0.71	0.41
	[-0.01]	[-0.62]	[0.66]	[4.06]	[7.61]	[5.35]	[2.95]
$Lev_{t,T}^{j}$	0.41	0.35	0.15	-0.22	0.15	0.40	0.31
	[6.90]	[5.93]	[1.84]	[-1.49]	[1.05]	[2.58]	[1.43]
Adjusted R^2	0.97	0.97	0.97	0.96	0.95	0.92	0.89

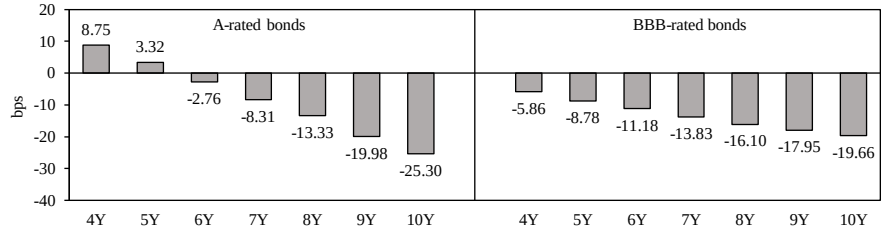
Panel B: BBB rated bonds

	4Y	5Y	6Y	7Y	8Y	9Y	10Y
δ_1	-5.86	-8.78	-11.18	-13.83	-16.10	-17.95	-19.66
	[-10.32]	[-17.47]	[-21.68]	[-23.96]	[-23.33]	[-20.08]	[-18.32]
$Liq_{t,T}^{j}$	-0.23	-0.08	-0.05	-0.09	-0.32	-0.50	-0.45
	[-2.59]	[-0.82]	[-0.43]	[-0.64]	[-2.31]	[-3.08]	[-2.60]
$Lev_{t,T}^{j}$	-1.25	-0.46	0.54	1.52	2.32	2.41	2.97
	[-6.03]	[-2.71]	[3.11]	[9.80]	[11.87]	[8.48]	[8.49]
Adjusted R^2	0.95	0.95	0.97	0.98	0.98	0.97	0.97

Figure 3

Difference-in-Differences estimators by rating and for maturities 4-10 years

The figure below illustrates the Difference-in-Differences estimators (in basis points) by rating and for maturities 4-10 years



8.2 The subsequent purchase effect

Recall that in Step 2 of our analysis, the treatment group includes purchased French corporate bonds and the control group includes non-purchased French corporate bonds. Table 4 summarizes key characteristics for the treatment and the control group. Similar to the findings in Step 1, within each rating category the key bond characteristics TTM and coupon rate are highly comparable between the two groups. Furthermore, leverage and liquidity report some variation between the two groups, similar to the results in Step 1.

8.2.1 Visual inspection

The results from the conducted visual inspections are summarized in Figure 4. The figure presents the credit spread development for the 5-year, 7-year and 10-year maturities in the treatment and the control group around the start of CSPP purchases. In accordance with the results from the visual inspection in Step 1, the parallel trend and the no anticipation assumption seem to hold. In addition, there seems to be a change in trend between the treatment and the control group following the start of purchases under the CSPP. More precise estimates of these changes are presented in section 8.2.2.

8.2.2 Regression results

As pointed out in section 2, the purchased securities were published in retrospect on July 18, 2016. While market participants may have been aware of which maturity brackets and sectors the French NCB were purchasing, they were unaware of issuer and security name as well as of the specific amounts bought. Therefore, the only obvious difference between the treatment and the control group after June 8, 2016 until the list was released on July 18, 2016, is the change in supply for the treatment group as a result of the CSPP purchases. This allows for the identification of a potential supply effect.

Table 5 and Figure 5 present the DD regression results from the subsequent purchases analysis. In contrast to the lack of findings on subsequent purchases by Kettemann & Krogstrup (2014), a majority of the DD estimators are statistically significant at the 1% level after controlling for day-fixed effects, leverage and liquidity. As can be seen in Table 5, shorter maturities experience a credit spread narrowing while longer maturities experience a widening. These findings are similar to those of D'Amico & King (2013) on US Treasuries. The outcome for A and BBB-rated bonds generally show similar results, which can be expected since the rating categories are close to each other. For A-rated bonds, the DD estimators range from -3.76 bps for the 4-year maturity to 3.40 bps for the 10-year maturity. For BBB-rated bonds, the DD estimators range from -4.88 bps for the 4-year maturity to 3.17 bps for the 10-year maturity. These results are economically significant and the magnitude of the spread effects is in accordance with the findings by D'Amico & King (2013) on US Treasuries.

According to the supply effect mechanism, the lower quantities outstanding for purchased bonds should result in narrowing credit spreads and higher valuations. In addition, given the ECB's communicated objective to primarily purchase long-term securities, the credit spread narrowing should be observed for

longer and not for shorter maturities. However, our results show the opposite. A possible explanation for this puzzling finding is that the actual purchases were not tilted towards longer maturities.

To evaluate which maturities that were actually purchased, we analyze the assembled statistics related to purchased quantities described in section 6.3. The statistics are reported in Figure 6. In general, the results show no clear tilt towards longer maturities. As can be seen in Figure 6, 23 (19) A-rated (BBB-rated) securities with maturities between one and four years have been purchased, comprising 61% (70%) of the total number of A-rated (BBB-rated) securities bought. A larger number of short-term maturities bought does not necessarily imply larger volumes bought. However, the maximum volume that could have been bought of the purchased securities, given the ECB's purchase restrictions[15], are also higher for short-term maturities. The observed narrowing of French corporate credit spreads for shorter maturities following actual CSPP purchases can therefore be interpreted to be supply driven.

To conclude, the observed narrowing of credit spreads for short-term maturities provide evidence in favor of a local supply effect and we thus reject $H_{B,0}$ stated in section 5. In line with the findings of D'Amico & King (2013) on US Treasuries, we do not find credit spread narrowing for long-term maturities. Given the strong announcement effect for longer maturities, it is reasonable to assume that the few purchases made are not sufficient to drive a supply shock and further compress long-term credit spreads. In addition, as mentioned in section 6.4, the French NCB might be purchasing in an upward trending corporate credit spread market, which would further explain the outcome for longer term maturities.

[15] Maximum holding of 70% of the volume outstanding for a specific security. See Appendix B for further details on purchase restrictions

Table 4

Key characteristics of treatment and control group

The table shows sample characteristics by rating for the treatment and the control group as of April 22, 2016. Treatment group refers to purchased eligible corporate bonds under the CSPP. The control group refers to non-purchased but otherwise conformable with treatment corporate bonds. TTM denotes time to maturity. Coupon refers to the coupon rate of the bonds. Leverage is defined as Book value of Debt divided by Book value of Debt plus Market value of Equity. Liquidity is defined as the bid-ask yield spread, calculated by subtracting the NS estimated Bid-yield from the NS estimated Ask-yield. Volume outstanding refers to the total debt value denominated in millions of euro.

	No. Of	TTM (years)			Coupon (%)			Leverage (%)			Liquidity (bps)			Volume outst.
	securities	Mean	Median	σ	Mean	Median	σ	Mean	Median	σ	Mean	Median	σ	Millions of €
Treatment														
All ratings	72	5.1	4.2	3.8	3.5	3.1	1.6	28.4	27.4	15.5	11.1	10.6	3.8	58,455
A	40	5.5	4.8	3.6	3.3	2.8	1.7	26.2	25.2	14.7	11.3	11.1	4.8	32,125
BBB	32	4.7	3.8	4.0	3.8	3.9	1.6	30.5	30.5	15.9	10.8	10.1	2.3	26,330
Control														
All ratings	139	5.1	4.5	3.8	3.7	3.8	1.2	29.6	26.5	15.5	9.9	8.6	7.9	73,079
A	80	6.1	5.3	4.2	3.8	3.9	1.1	28.3	29.4	15.2	9.5	8.8	1.3	45,458
BBB	59	3.8	3.4	2.6	3.7	3.6	1.2	30.3	26.5	15.2	10.4	6.0	11.0	27,620
Total	211													131,534

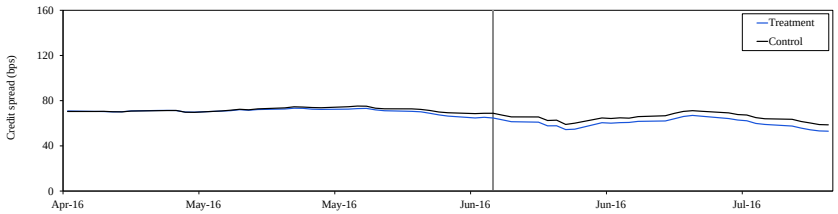
Figure 4

Credit spread development by rating for corporate bonds in treatment and control group around the purchasing start date under the CSPP

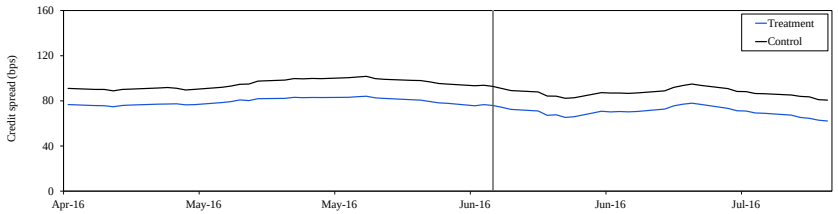
The figure shows daily credit spread time series by rating for corporate bonds in the treatment and the control group. (a) plots the 5-year credit spread development, (b) plots the 7-year credit spread development and (c) plots the 10-year credit spread development. To generate credit spreads for a specific maturity, the corporate and government yield for that maturity are extracted from the daily estimated NS curves. For each date, the credit spread is then calculated by subtracting the government yield from the corporate yield. The studied period is April 22, 2016 to July 17, 2016. The event day is defined as June 8, 2016 when the ECB starts purchasing corporate bonds under the CSPP, illustrated by a black vertical line in the graphs below. A pre-event period is defined as April 22, 2016 to June 7, 2016 and a post-event period is defined as June 8, 2016 to July 17, 2016.

A-rated bonds

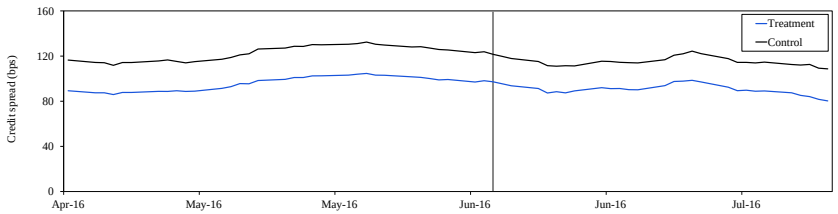
(a) 5-year



(b) 7-year

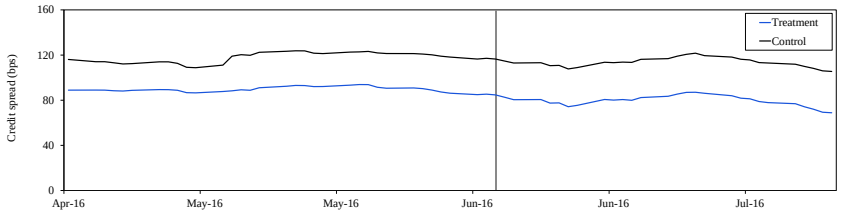


(c) 10-year

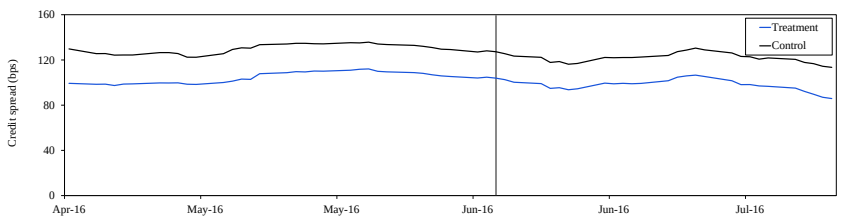


BBB-rated bonds

(d) 5-year



(e) 7-year



(f) 10-year

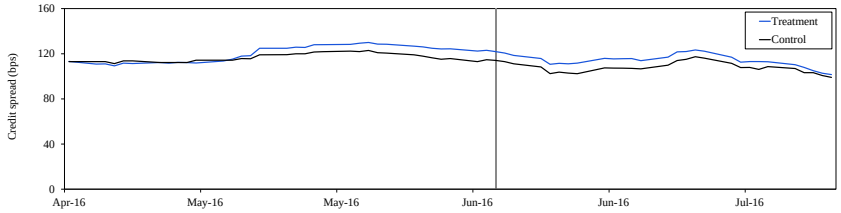


Table 5

Difference-in-Differences regression results by rating and for maturities 4-10 years

The table below shows DD regression coefficients (in basis points) for maturities 4-10 years comparing purchased and non-purchased securities following the CSPP purchases. T-values are in brackets. Over the studied time period April 22, 2016 to July 17, 2016, we run the following regression: $CS_{t,T}^{j} = \beta_0 + \beta_1 T + \delta_1 (T * P) + \beta_2 Lev_{t,T}^{j} + \beta_3 Liq_{t,T}^{j} + \sum_t \lambda_t d_t + \varepsilon$. $CS_{t,T}^{j}$ is the observed credit spread on day t with term T for rating category j. β_0 is the intercept. T is a treatment dummy taking the value one if the observed $CS_{t,T}^{j}$ belongs to the treatment group. P is a dummy variable taking the value of one if $CS_{t,T}^{j}$ is observed in the post-shock time period. δ_1 is the DD estimator and the variable of interest. $Lev_{t,T}^{j}$ denotes a weighted average of firm leverage on day t with term T for securities in rating category j. $Liq_{t,T}^{j}$ denotes the NS estimated liquidity on day t with term T for rating category j. d_t is a dummy for day t and λ_t is the time fixed effects. ε is an error term.

Panel A: A rated bonds

	4Y	5Y	6Y	7Y	8Y	9Y	10Y
δ_1	-3.76	-3.43	-2.50	-1.93	-0.26	2.14	3.40
	[-19.99]	[-14.61]	[-8.96]	[-3.76]	[-0.53]	[8.71]	[14.42]
$Liq_{t,T}^{j}$	0.05	0.15	0.00	0.14	-0.35	-0.28	-0.05
	[1.64]	[3.57]	[-3.52]	[1.02]	[-2.05]	[-3.90]	[-0.85]
$Lev_{t,T}^{j}$	0.22	0.37	0.89	-1.00	-0.13	-0.34	-0.42
	[1.14]	[1.57]	[3.17]	[-1.47]	[-0.20]	[-5.37]	[-5.71]
Adjusted R^2	0.99	0.99	0.99	0.99	0.99	0.99	0.99

Panel B: BBB rated bonds

	4Y	5Y	6Y	7Y	8Y	9Y	10Y
δ_1	-4.88	-3.39	-0.75	1.95	4.42	6.61	3.17
	[-8.70]	[-6.30]	[-2.06]	[5.03]	[5.09]	[7.11]	[6.48]
$Liq_{t,T}^{j}$	0.12	0.23	0.04	-0.18	-0.30	0.46	0.22
	[1.35]	[2.66]	[0.67]	[-3.15]	[-1.38]	[3.16]	[4.41]
$Lev_{t,T}^{j}$	3.79	2.88	1.85	1.02	0.79	4.23	2.90
	[6.94]	[4.00]	[2.62]	[2.95]	[1.14]	[6.44]	[8.18]
Adjusted R^2	0.99	0.99	0.99	0.99	0.96	0.92	0.97

Figure 5

Difference-in-Differences estimators by rating and for maturities 4-10 years

The figure below illustrates the Difference-in-Differences estimators (in basis points) by rating and for maturities 4-10 years

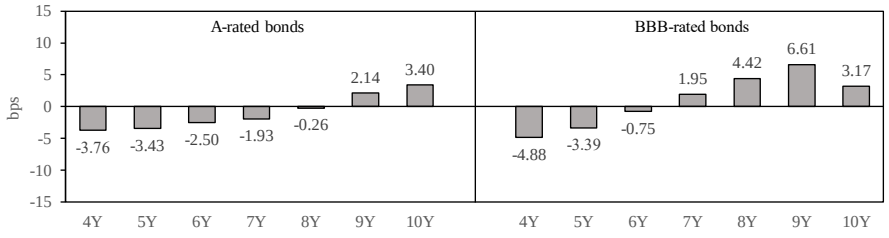
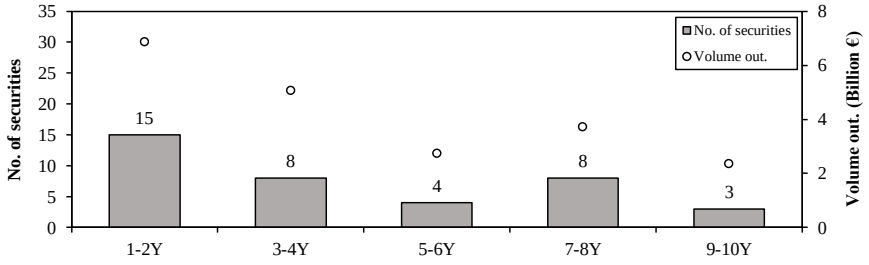


Figure 6

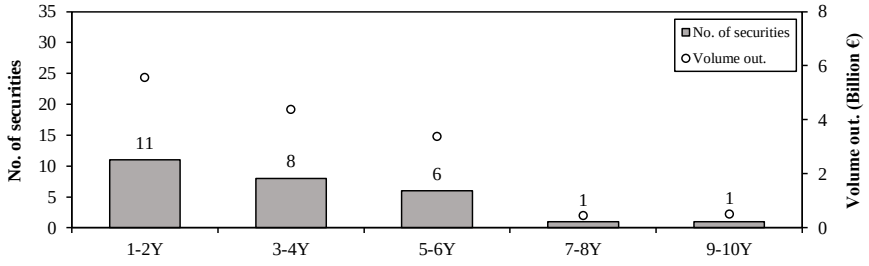
Maturity distributions by rating for purchased securities

The figures below show statistics on which maturity brackets that were purchased by the French NCB from the start of CSPP purchases on June 8, 2016 until the first ISIN list release on July 18, 2016. (a) and (b) shows the number of A-rated and BBB-rated securities that were bought in the maturity brackets 1-2 years, 3-4 years, 5-6 years, 7-8 years and 9-10 years together with the maximum amount the central bank could have bought in each maturity bracket given the restriction stating that maximum 70% of each eligible security's value outstanding can be bought under the CSPP. (c) and (d) show the number of purchased bonds in relation to the total number of CSPP eligible bonds in each maturity bracket together with the maximum amount that could have been bought in each maturity bracket in relation to the total amount outstanding of eligible bonds on the French market within in each maturity bracket.

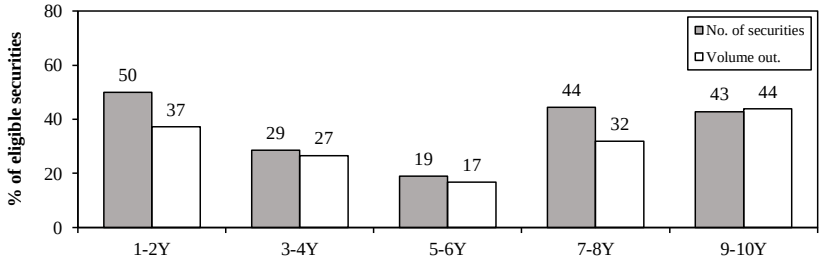
(a) No. of securities and volume outstanding (A-rated bonds)



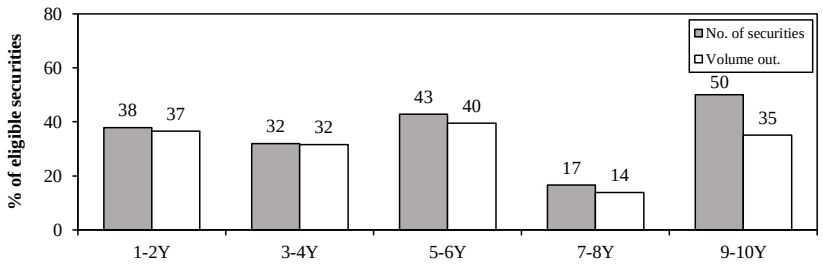
(b) No. of securities and volume outstanding (BBB-rated bonds)



(c) Purchased securities as a % of eligible bonds (A-rated)



(d) Purchased securities as a % of eligible bonds (BBB-rated)



8.3 Robustness

Our results are conditional upon an accurate construction of control and treatment groups. As mentioned in section 6.4, there is a trade-off between the number of observations and the homogeneity of bonds when generating groups for the NS estimation and subsequent DD regressions. A larger number of observations increase the precision in the NS estimation. On the other hand, more homogenous bonds decrease the risk of an inaccurate control group. To further validate the robustness of our results and the rejection of $H_{B,0}$ in step 2 of our analysis, we therefore create more consistent but smaller treatment and control groups. The new groups are constructed by matching firms across the old treatment and control group. All securities with unmatched firms are then dropped. This results in a treatment and a control group consisting of securities issued by the same firms. This matching procedure removes any firm-differences between the treatment and the control group, thus making the groups even more homogenous. The outcome from this robustness test is presented in Figure 6 and 7 together with Table 6. As the results are consistent with the findings in section 8.2 and we can still reject $H_{B,0}$.

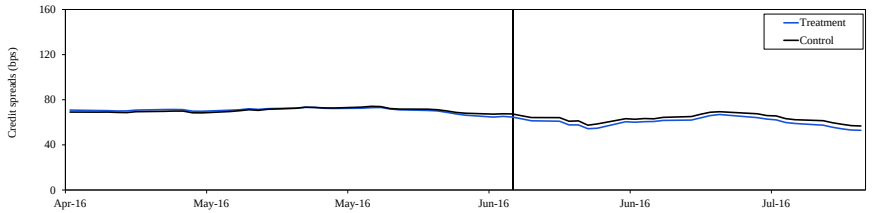
Figure 6

Credit spread development by rating for corporate bonds in treatment and control group around purchasing start under the CSPP

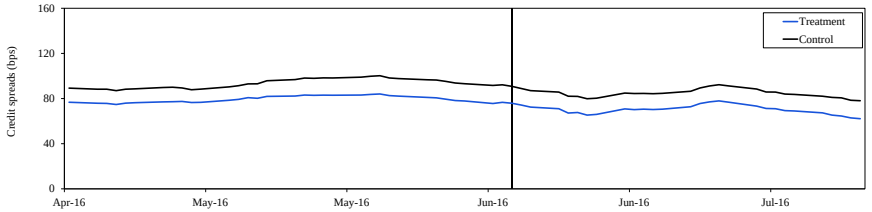
The figure shows daily credit spread time series by rating for corporate bonds in the treatment and the control group. (a) plots the 5-year credit spread development, (b) plots the 7-year credit spread development and (c) plots the 10-year credit spread development. To generate credit spreads for a specific maturity, the corporate and government yield for that maturity are extracted from the daily estimated NS curves. For each date, the credit spread is then calculated by subtracting the government yield from the corporate yield. The studied period is April 22, 2016 to July 17, 2016. The event day is defined as June 8, 2016 when the ECB starts purchasing corporate bonds under the CSPP, illustrated by a black vertical line in the graphs below. A pre-event period is defined as April 22, 2016 to June 7, 2016 and a post-event period is defined as June 8, 2016 to July 17, 2016.

A-rated bonds

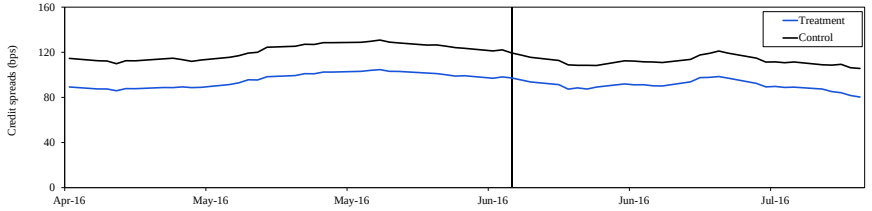
(a) 5-year



(b) 7-year

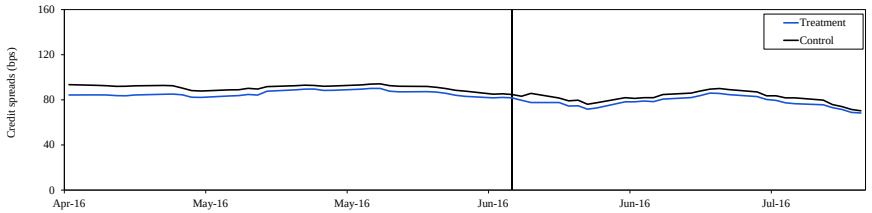


(c) 10-year

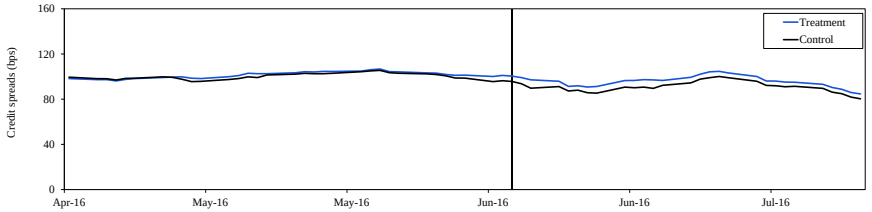


BBB-rated bonds

(d) 5-year



(e) 7-year



(f) 10-year

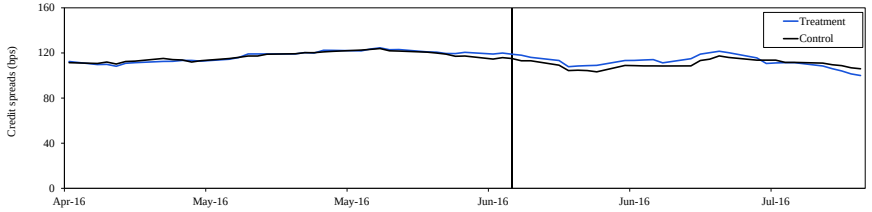


Table 6

Difference-in-Differences robustness regression results by rating and for maturities 4-10 years

The table below shows DD regression coefficients (in basis points) for maturities 4-10 years comparing purchased and non-purchased securities following the CSPP purchases. T-values are in brackets. Over the studied time period April 22, 2016 to July 17, 2016, we run the following regression: $CS_{t,T}^{j} = \beta_0 + \beta_1 T + \delta_1 (T * P) + \beta_2 Lev_{t,T}^{j} + \beta_3 Liq_{t,T}^{j} + \sum_t \lambda_t d_t + \varepsilon$. $CS_{t,T}^{j}$ is the observed credit spread on day t with term T for rating category j. β_0 is the intercept. T is a treatment dummy taking the value one if the observed $CS_{t,T}^{j}$ belongs to the treatment group. P is a dummy variable taking the value of one if $CS_{t,T}^{j}$ is observed in the post-shock time period. δ_1 is the DD estimator and the variable of interest. $Lev_{t,T}^{j}$ denotes a weighted average of firm leverage on day t with term T for securities in rating category j. $Liq_{t,T}^{j}$ denotes the NS estimated liquidity on day t with term T for rating category j. d_t is a dummy for day t and λ_t is the time fixed effects. ε is an error term.

Panel A: A rated bonds

	4Y	5Y	6Y	7Y	8Y	9Y	10Y
δ_1	-3.57	-3.06	-1.85	-1.35	0.47	3.05	4.37
	[-19.29]	[-13.00]	[-6.82]	[-2.56]	[0.93]	[10.36]	[15.46]
$Liq_{t,T}^{j}$	0.06	0.17	0.22	0.16	-0.33	-0.28	-0.05
	[2.06]	[3.82]	[3.60]	[1.13]	[-1.79]	[-3.60]	[-0.77]
$Lev_{t,T}^{j}$	0.15	0.29	0.66	-1.40	-0.57	-0.27	-0.35
	[0.90]	[1.32]	[2.52]	[-2.02]	[-0.82]	[-4.03]	[-4.47]
Adjusted R^2	0.99	0.99	0.99	0.99	0.99	0.99	0.99

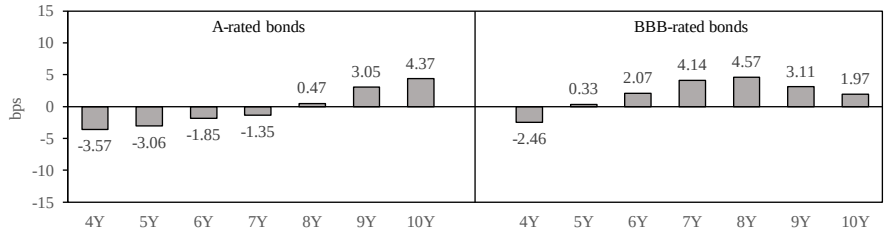
Panel B: BBB rated bonds

	4Y	5Y	6Y	7Y	8Y	9Y	10Y
δ_1	-2.46	0.33	2.07	4.14	4.57	3.11	1.97
	[-4.50]	[0.69]	[4.64]	[10.25]	[9.85]	[6.41]	[2.83]
$Liq_{t,T}^{j}$	-0.07	-0.19	-0.12	-0.18	-0.04	0.25	0.10
	[-1.56]	[-4.73]	[-3.13]	[-4.01]	[-0.33]	[3.53]	[2.22]
$Lev_{t,T}^{j}$	-0.04	-1.23	0.98	1.14	0.89	0.84	1.72
	[-0.06]	[-2.45]	[1.38]	[3.61]	[2.18]	[2.45]	[3.77]
Adjusted R^2	0.98	0.98	0.97	0.98	0.96	0.96	0.90

Figure 7

Difference-in-Differences estimators by rating and for maturities 4-10 years

The figure below illustrates the Difference-in-Differences estimators (in basis points) by rating and for maturities 4-10 years



9. Conclusion

The significant size and experimental nature of the CSPP makes it an interesting phenomenon to study. The purpose of this study has been to investigate the existence of local supply effects on the French non-financial corporate bond market following the implementation of the CSPP. Through a DD regression method, evidence in favor of local supply effects for short-term maturities have been found. In contrast to previous research, we document an economically and statistically significant credit spread narrowing for both eligible and purchased short-term corporate bonds in conjunction with the CSPP (Kettemann & Krogstrup, 2014). These results underpin theories of market segmentation and indicate that supply driven forces may affect the shape of the credit spread term structure. Our findings therefore shed light on the importance of more sophisticated yield curve theories than those presented by the expectation and liquidity hypothesizes.

According to the expectation and liquidity hypothesizes, prices are exclusively determined by future cash flows and the riskiness of these cash flows. Our findings challenge these theories as central bank supply shocks are unrelated to both firm and business climate fundamentals. Given that these supply shocks affect corporate credit spreads, they force bond prices to deviate from their fundamental values. A first implication of CSPP supply shocks is therefore that corporate bond price movements may become more challenging for market participants to interpret. In addition, corporate bond markets are in general less liquid and much smaller in size compared to the government bond markets previously targeted under central bank APPs. The thin French non-financial corporate bond market in combination with CSPP supply shocks may therefore, at least in the short run, disrupt the functioning of the market.

Even though we find evidence in favor of local supply effects as a result of the CSPP, the general long-term effects and implications from asset purchase programs targeting corporate bonds are yet to be fully understood.

10. Limitations and suggestions for future research

To our knowledge, this is the first study to evaluate short-term market implications of the CSPP on the French corporate bond market and the second in Europe to evaluate an APP targeting corporate bonds (Kettemann & Krogstrup, 2014). The study fulfils its purpose of investigating short-term effects and implications of the CSPP. However, we are not able to evaluate the long-term effects of the program as it is yet to be terminated. In addition, our findings are specific to the French non-financial corporate bond market and one asset purchase program. Our results may thus only be applicable to the specific time period, market and asset purchase program studied. Therefore, additional studies conducted on other European markets targeted by the same program would contribute to the understanding of the CSPP effects on the corporate bond market. Moreover, investigating potential portfolio rebalancing as well as other potential spill-over effects on non-targeted markets would constitute interesting research topics.

As the program is yet to be terminated, a natural next step would be to evaluate its long-term effects. That is, whether or not the central bank achieves its objectives from the asset purchase programs or not. For instance, it would be highly interesting to examine issuer behavior as a result of the CSPP since it is ambiguous whether or not eased financing conditions will lead to higher firm investment as projected by the ECB.

Finally, any behavioral aspects affecting credit spreads as a result of the program are outside the scope of this paper. Therefore, it would be interesting to study investor behavior as a result of the program.

11. References

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Appendix A: Complementary tables and figures

Table A1

ECB Asset Purchase Programs

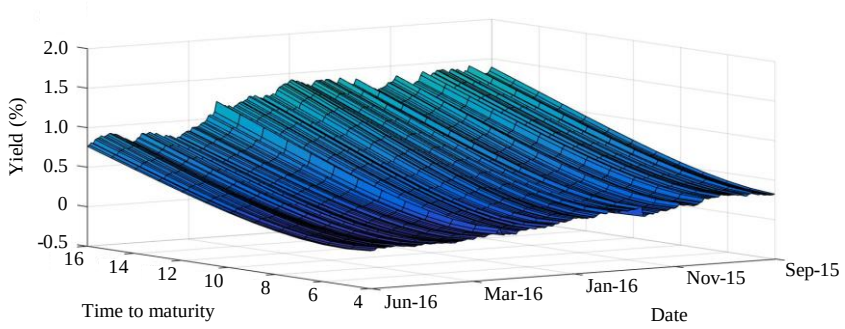
Name	Status
Securities Markets Program (SMP)	Terminated
Covered Bond Purchase Program (CBPP1)	Terminated
Covered Bond Purchase Program 2 (CBPP2)	Terminated
Covered Bond Purchase Program 3 (CBPP3)	Ongoing
Asset-Backed Securities Purchase Program (ABSPP)	Ongoing
Public Sector Purchase Program (PSPP)	Ongoing
Corporate Sector Purchase Program (CSPP)	Ongoing

Figure A1

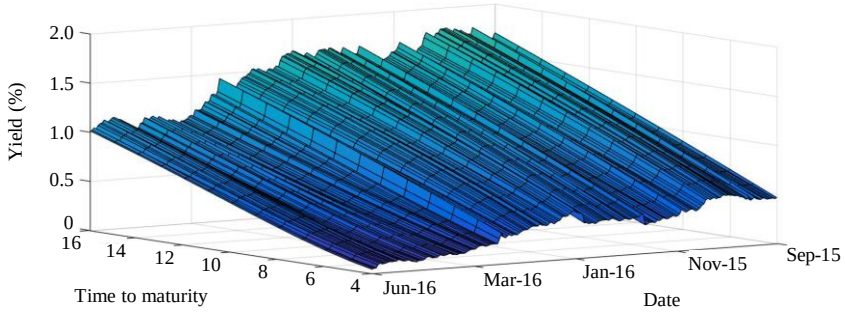
Nelson Siegel estimated zero-rate curves for eligible and non-eligible bonds

The graphs below show the zero-rate curve surfaces for the time period around the announcement date of the CSPP, from September 1, 2015 until June 7, 2016. (a) shows the zero-rate development for A-rated French eligible bonds. (b) shows the zero-rate development for BBB-rated French eligible bonds. (c) shows the zero-rate development or A-rated French non-eligible bonds and (d) shows the zero-rate development for BBB-rated French non-eligible bonds. Dates are shown on the x-axis. The time to maturity is shown on the y-axis. The yield is shown on the z-axis.

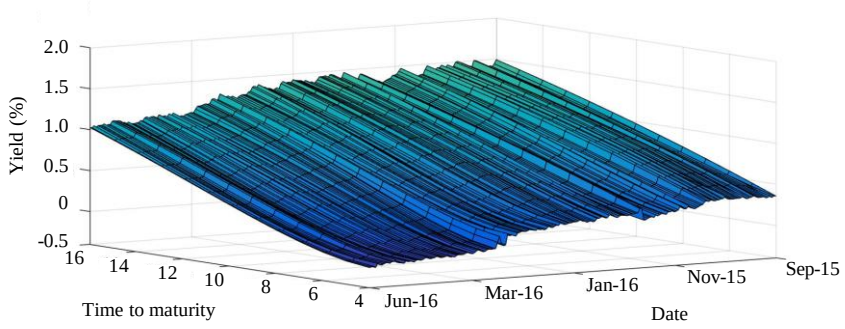
(a) A-rated eligible bonds



(b) BBB-rated eligible bonds



(c) A-rated non-eligible bonds



(d) BBB-rated non-eligible bonds

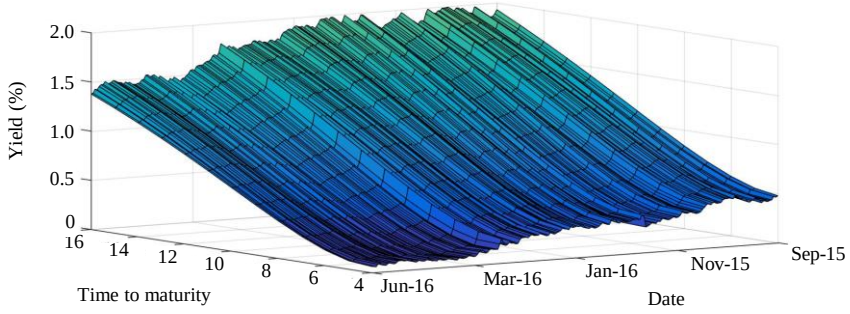
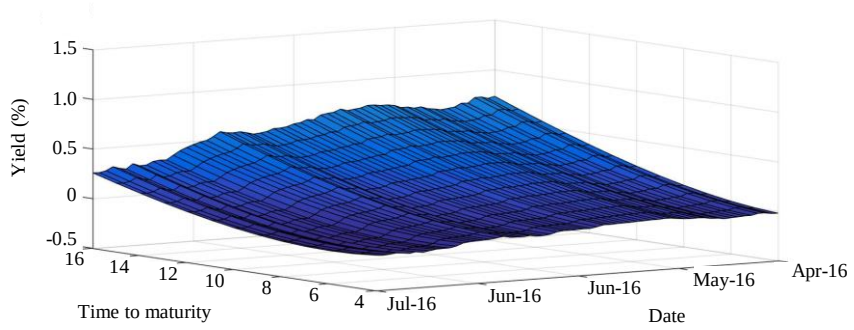


Figure A1 Cont'd

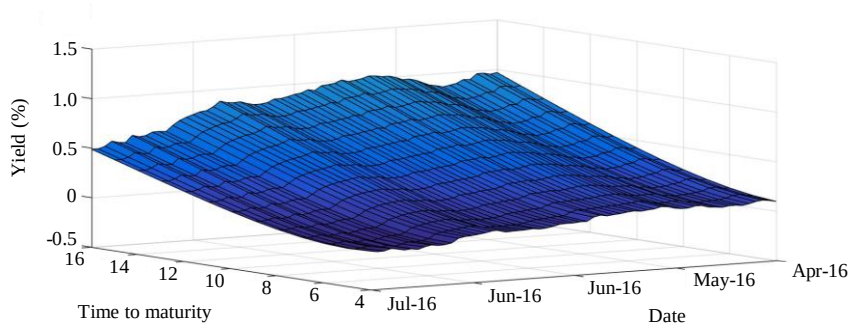
Nelson Siegel estimated zero-rate curves for purchased and non-purchased bonds

The graphs below show the zero-rate curve surfaces for the time period around the start of subsequent purchases under the CSPP, from April 22, 2015 until July 17, 2016. (a) shows the zero-rate development for A-rated French purchased bonds. (b) shows the zero-rate development for BBB-rated French purchased bonds. (c) shows the zero-rate development or A-rated French non-purchased bonds and (d) shows the zero-rate development for BBB-rated French non-purchased bonds. Dates are shown on the x-axis. The time to maturity is shown on the y-axis. The yield is shown on the z-axis.

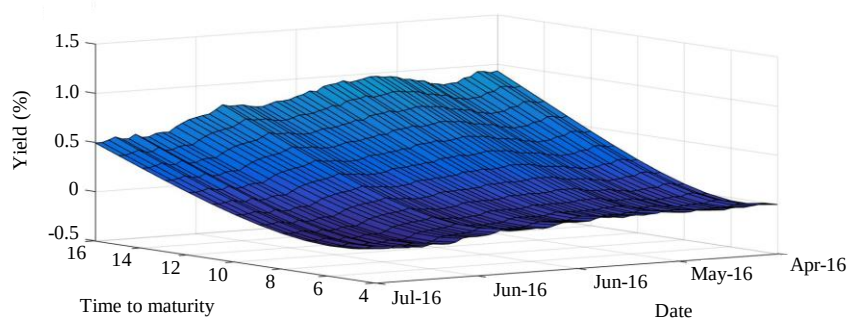
(e) A-rated purchased bonds



(f) BBB-rated purchased bonds



(g) A-rated non-purchased bonds



(h) BBB-rated non-purchased bonds

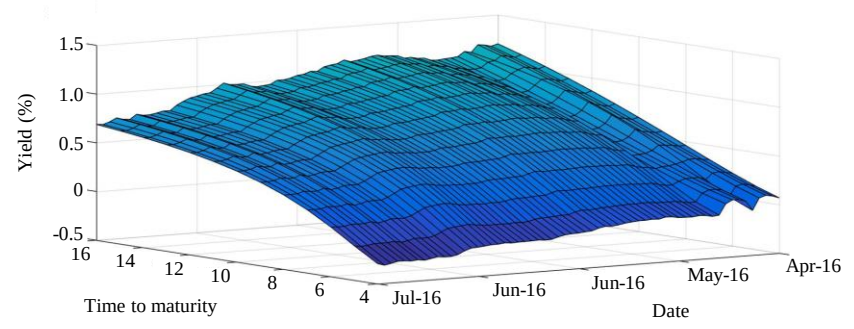


Figure A1 Cont'd

Nelson Siegel estimated spot-rate curves for French government bonds

The graph below shows the zero-rate curve surface for the time period around the announcement and the start of subsequent purchases under the CSPP, from Sep 1, 2015 until July 17, 2016. (g) shows the zero-rate development for AA-rated French government bonds. The spot rate curve is used as benchmark in the calculation of credit spreads described in section 6.1.2. Dates are shown on the x-axis. The time to maturity is shown on the y-axis. The yield is shown on the z-axis

(g) AA-rated French government bonds

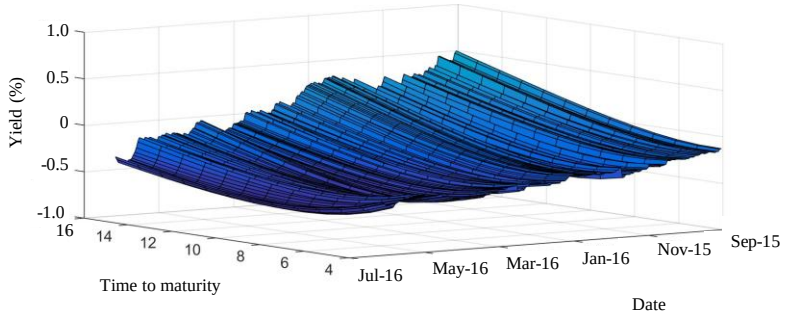


Table A2

Regression results for different rating groups with maturities from 4 to 10 years

To assess whether the variables leverage and liquidity, which both previously have been identified as important credit spread determinants, may be explaining part of the observed difference in credit spreads between our control and treatment groups, we run the following regression: $(CS_{t,T}^{j,Ctrl} - CS_{t,T}^{j,Tr}) = (Lev_{t,T}^{j,Ctrl} - Lev_{t,T}^{j,Tr}) + (Liq_{t,T}^{j,Ctrl} - Liq_{t,T}^{j,Tr})$ where $(CS_{t,T}^{j,Ctrl} - CS_{t,T}^{j,Tr})$ is the observed credit spread difference between the control and the treatment group in time *t* with time to maturity *T* for rating category *j*. $(Lev_{t,T}^{j,Ctrl} - Lev_{t,T}^{j,Tr})$ is the difference between the leverage ratio between the control group and the treatment group in time *t* with time to maturity *T* for a rating category *j*. $(Liq_{t,T}^{j,Ctrl} - Liq_{t,T}^{j,Tr})$ is the difference between the liquidity variable between the control group and the treatment group in time *t* with time to maturity *T* for a rating category *j*.

Step 1

Leverage & Liquidity effect on A-rated and BBB-rated bonds

	A-rated bonds			BBB-rated bonds		
	5Y	7Y	10Y	5Y	7Y	10Y
Intercept	20.05	15.72	-2.03	0.56	21.73	46.64
	[69.92]	[53.65]	[-1.97]	[1.13]	[41.38]	[36.19]
$Lev_{t,T}^{j,Ctrl} - Lev_{t,T}^{j,Tr}$	0.29	0.19	0.74	0.10	1.74	3.21
	[5.51]	[1.39]	[3.34]	[0.68]	[11.41]	[10.87]
$Liq_{t,T}^{j,Ctrl} - Liq_{t,T}^{j,Tr}$	0.05	0.11	0.75	-0.22	-0.28	-1.78
	[1.68]	[0.91]	[4.77]	[-2.20]	[-2.04]	[-6.95]
Adjusted R^2	0.37	0.04	0.18	0.03	0.31	0.45

Step 2

Leverage & Liquidity effect on A-rated and BBB-rated bonds

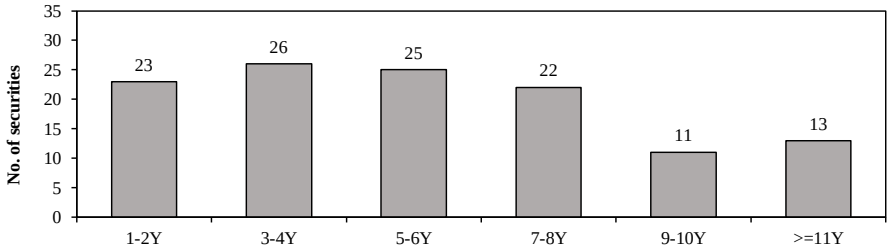
	A-rated bonds			BBB-rated bonds		
	5Y	7Y	10Y	5Y	7Y	10Y
Intercept	26.74	-27.67	13.46	49.83	27.26	1.67
	[2.41]	[-2.57]	[2.03]	[4.15]	[4.17]	[1.47]
$Lev_{t,T}^{j,Ctrl} - Lev_{t,T}^{j,Tr}$	2.00	-4.49	0.79	4.32	-0.31	3.02
	[2.23]	[-4.11]	[2.03]	[1.65]	[-0.33]	[8.38]
$Liq_{t,T}^{j,Ctrl} - Liq_{t,T}^{j,Tr}$	0.16	0.20	-0.07	0.25	-0.18	0.28
	[2.81]	[1.57]	[-1.56]	[1.65]	[-2.75]	[5.48]
Adjusted R^2	0.28	0.25	0.09	0.48	0.19	0.84

Figure A2

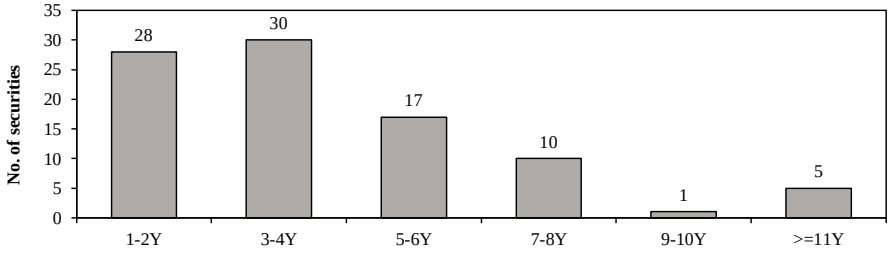
Maturity distributions by rating for treatment and control group

The figures below show the maturity distribution for the treatment and the control group on September 1, 2015

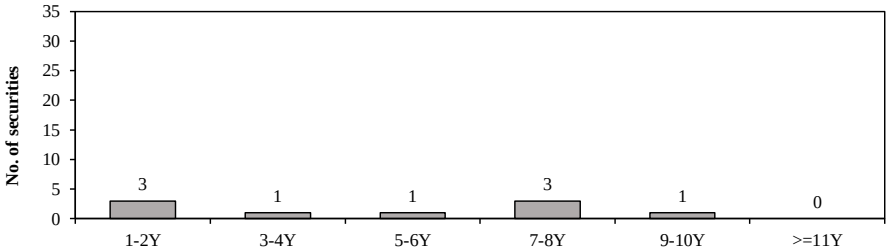
(a) Treatment group (A-rated bonds)



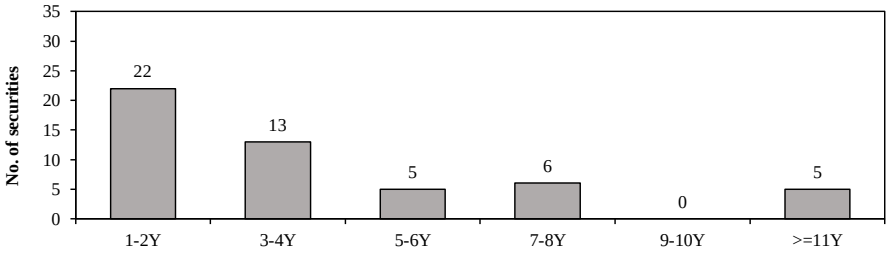
(b) Treatment group (BBB-rated bonds)



(c) Control group (A-rated bonds)



(d) Control group (BBB-rated bonds)



Appendix B: ECB legal documents

Exhibit B1

ECB Decision on the implementation of the CSPP

DECISION (EU) 2016/948 OF THE EUROPEAN CENTRAL BANK

of 1 June 2016

on the implementation of the corporate sector purchase programme (ECB/2016/16)

THE GOVERNING COUNCIL OF THE EUROPEAN CENTRAL BANK,

Having regard to the Treaty on the Functioning of the European Union, and in particular the first indent of Article 127(2) thereof,

Having regard to the Statute of the European System of Central Banks and of the European Central Bank, and in particular the second subparagraph of Article 12.1 in conjunction with the first indent of Article 3.1, and Article 18.1 thereof,

Whereas:

(1) The European Central Bank (ECB), together with national central banks of Member States whose currency is the euro may operate in the financial markets by buying and selling marketable instruments outright.

(2) Decision ECB/2014/40 [1], which established a third covered bond purchase programme, was adopted on 15 October 2014. Decision (EU) 2015/5 of the European Central Bank (ECB/2014/45) [2], which established an asset-backed securities purchase programme, was adopted on 19 November 2014. Decision (EU) 2015/774 of the European Central Bank (ECB/2015/10) [3], which established a secondary markets public sector asset purchase programme (hereinafter the 'PSPP'), was adopted on 4 March 2015 and expanded the existing asset purchase programmes. Alongside the targeted longer-term refinancing operations pursuant to Decision ECB/2014/34 of the European Central Bank [4] and Decision (EU) 2016/810 of the European Central Bank (ECB/2016/10) [5], these asset purchase programmes are aimed at further enhancing the transmission of monetary policy, facilitating credit provision to the euro area economy, easing borrowing conditions for households and businesses and contributing to returning inflation rates to levels below, but close to, 2 % over the medium term, consistent with the ECB's primary objective of maintaining price stability.

(3) On 10 March 2016 the Governing Council decided to further expand the abovementioned asset purchase programmes and initiate a corporate sector purchase programme (CSPP), as part of the single monetary policy and in pursuit of its price stability objective. This decision was taken in order to further strengthen the pass-through of the Eurosystem's asset purchases to the financing conditions of the real economy, and in order to provide, in conjunction with the other non-standard monetary policy measures in place, further monetary policy accommodation and contribute to a return of inflation rates to levels below, but close to, 2 % over the medium term.

(4) The CSPP will be part of the asset purchase programme (APP), under which purchases are intended to run until the end of March 2017, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its aim of achieving inflation rates below, but close to, 2 % over the medium term.

(5) The CSPP should contain a number of safeguards to ensure that the envisaged purchases will be proportionate to its aims. These safeguards should also ensure that related financial risks are taken into account in the CSPP's design and should reflect risk management perspectives. In addition, eligible marketable debt instruments issued by public undertakings should be subject to limits, consistent with those applied to purchases under the PSPP.

[1] Decision ECB/2014/40 of the European Central Bank of 15 October 2014 on the implementation of the third covered bond purchase programme (OJ L 335, 22.11.2014, p. 22).
[2] Decision (EU) 2015/5 of the European Central Bank of 19 November 2014 on the implementation of the asset-backed securities purchase programme (ECB/2014/45) (OJ L 1, 6.1.2015, p. 4).
[3] Decision (EU) 2015/774 of the European Central Bank of 4 March 2015 on a secondary markets public sector asset purchase programme (ECB/2015/10) (OJ L 121, 14.5.2015, p. 20).
[4] Decision ECB/2014/34 of the European Central Bank of 29 July 2014 on measures relating to targeted longer-term refinancing operations (OJ L 258, 29.8.2014, p. 11).
[5] Decision (EU) 2016/810 of the European Central Bank of 28 April 2016 on a second series of targeted longer-term refinancing operations (ECB/2016/10) (OJ L 132, 21.5.2016, p. 107).

(6) The CSPP should fully comply with the obligations of the Eurosystem central banks under the Treaty, including the monetary financing prohibition in relation to the purchase of eligible marketable debt instruments issued by public undertakings.

(7) The CSPP should respect the principle of an open market economy with free competition, while giving due regard to the formation of market prices and the functioning of markets.

(8) In line with the other components of the APP, the principal payments of the eligible marketable debt instruments purchased under the CSPP should be reinvested as the underlying debt instruments mature, for as long as necessary, thus contributing to favourable liquidity conditions and to an appropriate monetary policy stance.

(9) The outright purchases of eligible marketable debt instruments by the Eurosystem under the CSPP should be implemented in a decentralised manner in accordance with this Decision, and should be coordinated by the ECB, thereby safeguarding the singleness of the Eurosystem's monetary policy,

HAS ADOPTED THIS DECISION:

Article 1

Establishment and scope of the outright purchase of corporate bonds

The CSPP is hereby established. Under the CSPP specified Eurosystem central banks may purchase eligible corporate bonds from eligible counterparties in the primary and secondary markets, while public sector corporate bonds, as defined in Article 3(1), may only be purchased in the secondary markets, under specific conditions.

Article 2

Eligibility criteria for corporate bonds

In order to be eligible for outright purchase under the CSPP, marketable debt instruments issued by corporations shall comply with the eligibility criteria for marketable assets for Eurosystem credit operations pursuant to Part 4 of Guideline (EU) 2015/510 of the European Central Bank (ECB/2014/60) ([1]) and the following additional requirements.

1. The issuer of the marketable debt instrument:

   (a) is incorporated in a Member State whose currency is the euro;

   (b) is not a credit institution as defined in point (14) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

   (c) does not have a parent undertaking as defined in point (15) of Article 4(1) of Regulation (EU) No 575/2013 of the European Parliament and of the Council ([2]) that is also a credit institution as defined in point (14) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

   (d) does not have a parent company which is subject to banking supervision outside the euro area;

   (e) is not a supervised entity as defined in point (20) of Article 2 of Regulation (EU) No 468/2014 of the European Central Bank (ECB/2014/17) ([3]) or a member of a supervised group as defined in subpoint (b) of point (21) of Article 2 of Regulation (EU) No 468/2014 (ECB/2014/17), in each case, as contained in the list published by the ECB on its website in accordance with Article 49(1) of Regulation (EU) No 468/2014 (ECB/2014/17), and is not a subsidiary, as defined in point (16) of Article 4(1) of the Regulation (EU) No 575/2013, of any of those supervised entities or supervised groups;

([1]) Guideline (EU) 2015/510 of the European Central Bank of 19 December 2014 on the implementation of the Eurosystem monetary policy framework (ECB/2014/60) (OJ L 91, 2.4.2015, p. 3).
([2]) Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012 (OJ L 176, 27.6.2013, p. 1).
([3]) Regulation (EU) No 468/2014 of the European Central Bank of 16 April 2014 establishing the framework for cooperation within the Single Supervisory Mechanism between the European Central Bank and national competent authorities and with national designated authorities (SSM Framework Regulation) (ECB/2014/17) (OJ L 141, 14.5.2014, p. 1).

(f) is not an investment firm as defined in point (1) of Article 4(1) of Directive 2014/65/EU of the European Parliament and of the Council [1];

(g) has not issued an asset-backed security within the meaning of point (3) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

(h) has not issued a *multi cédula* within the meaning of point (62) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

(i) has not issued a structured covered bond within the meaning of point (88) of Article 2 of Guideline (EU) 2015/510 (ECB/2014/60);

(j) is not an asset management vehicle resulting from the application of an asset separation tool in a resolution action pursuant to Article 26 of Regulation (EU) No 806/2014 of the European Parliament and of the Council [2] or national legislation implementing Article 42 of Directive 2014/59/EU of the European Parliament and of the Council [3];

(k) is not a national asset management and divestment fund established to support financial sector restructuring and/or resolution [4]; and

(l) is not an eligible issuer for the PSPP.

2. The marketable debt instrument has a minimum remaining maturity of 6 months and a maximum remaining maturity of 30 years and 364 days at the time of its purchase by the relevant Eurosystem central bank.

3. In deviation from Article 59(5) of Guideline (EU) 2015/510 (ECB/2014/60), only credit assessment information that is provided by an external credit assessment institution accepted within the Eurosystem credit assessment framework will be taken into account for the assessment of the credit quality requirements of the marketable debt instrument.

4. The marketable debt instrument is denominated in euro.

5. Purchases of nominal marketable debt instruments at a negative yield to maturity (or yield to worst) above the deposit facility rate are permissible.

Article 3

Limitations on the execution of purchases of public sector corporate bonds

1. For the purposes of this Decision, a 'public sector corporate bond' means a corporate bond that fulfils the requirements of Article 2 and is issued by a public undertaking within the meaning of Article 8 of Council Regulation (EC) No 3603/93 [5].

2. To permit the formation of a market price for eligible public sector corporate bonds, no purchases shall be permitted of a newly issued or tapped public sector corporate bond, or of public sector corporate bonds issued by the same entity or by the entities within the issuer's group with maturities that expire close in time to, either just before or after, the maturity of the marketable debt instruments to be issued or tapped, over a period to be determined by the Governing Council.

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[1] Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU (OJ L 173, 12.6.2014, p. 349).
[2] Regulation (EU) No 806/2014 of the European Parliament and of the Council of 15 July 2014 establishing uniform rules and a uniform procedure for the resolution of credit institutions and certain investment firms in the framework of a Single Resolution Mechanism and a Single Resolution Fund and amending Regulation (EU) No 1093/2010 (OJ L 225, 30.7.2014, p. 1).
[3] Directive 2014/59/EU of the European Parliament and of the Council of 15 May 2014 establishing a framework for the recovery and resolution of credit institutions and investment firms and amending Council Directive 82/891/EEC, and Directives 2001/24/EC, 2002/47/EC, 2004/25/EC, 2005/56/EC, 2007/36/EC, 2011/35/EU, 2012/30/EU and 2013/36/EU, and Regulations (EU) No 1093/2010 and (EU) No 648/2012, of the European Parliament and of the Council (OJ L 173, 12.6.2014, p. 190).
[4] A list of such entities is published on the ECB's website at www.ecb.europa.eu
[5] Council Regulation (EC) No 3603/93 of 13 December 1993 specifying definitions for the application of the prohibitions referred to in Articles 104 and 104b(1) of the Treaty (OJ L 332, 31.12.1993, p. 1).

Article 4

Purchase limits

1. An issue share limit per international securities identification number (ISIN) shall apply under the CSPP, after consolidating holdings in all of the portfolios of the Eurosystem central banks. The issue share limit shall be 70 % per ISIN for all corporate bonds other than public sector corporate bonds.

A lower issue share limit may apply in specific cases, including for public sector corporate bonds or for risk management reasons. Public sector corporate bonds shall be dealt with in a manner consistent with their treatment under the PSPP.

2. The Eurosystem shall conduct appropriate credit risk and due diligence procedures on eligible corporate bonds on an ongoing basis.

3. The Eurosystem shall define additional purchase limits for issuer groups based on a benchmark allocation related to an issuer group's market capitalisation to ensure a diversified allocation of purchases across issuers and issuer groups.

Article 5

Purchasing Eurosystem central banks

The Eurosystem central banks purchasing corporate bonds under the CSPP shall be specified in a list published on the ECB's website. The Eurosystem shall apply a specialisation scheme for the allocation of corporate bonds to be purchased under the CSPP based on the issuer's country of incorporation. The Governing Council shall allow ad hoc deviations from the specialisation scheme if there are objective considerations obstructing the scheme's implementation or if such deviations are advisable in order to achieve the CSPP's overall monetary policy objectives. In particular, each specified Eurosystem central bank shall only purchase eligible corporate bonds issued by issuers incorporated in specified Member States within the euro area. The geographical allocation of eligible corporate bond issuers' countries of incorporation in relation to the specified Eurosystem central banks shall be set out in a list published on the ECB's website.

Article 6

Eligible counterparties

The following shall be eligible counterparties for the CSPP, both for outright transactions and for securities lending transactions involving corporate bonds held in the CSPP Eurosystem portfolios:

(a) entities that fulfil the eligibility criteria to participate in Eurosystem monetary policy operations pursuant to Article 55 of Guideline (EU) 2015/510 (ECB/2014/60); and

(b) any other counterparties that are used by Eurosystem central banks for the investment of their euro-denominated investment portfolios.

Article 7

Securities lending transactions

The Eurosystem central banks purchasing corporate bonds under the CSPP shall make securities purchased under CSPP available for lending, including repos, with a view to ensuring the effectiveness of the CSPP.

Article 8

Final provisions

This Decision shall enter into force on 6 June 2016.

Done at Vienna, 1 June 2016.

The President of the ECB
Mario DRAGHI

Exhibit B2

ECB general eligibility criterias under its APPs

PART FOUR

ELIGIBLE ASSETS

TITLE I

GENERAL PRINCIPLES

Article 58

Eligible assets and accepted collateralisation techniques to be used for Eurosystem credit operations

1. The Eurosystem shall apply a single framework for eligible assets common to all Eurosystem credit operations as laid down in this Guideline.

2. In order to participate in Eurosystem credit operations, counterparties shall provide the Eurosystem with assets that are eligible as collateral for such operations. Given that Eurosystem credit operations include intraday credit, collateral provided by counterparties in respect of intraday credit shall also comply with the eligibility criteria laid down in this Guideline, as outlined in Guideline ECB/2012/27.

3. Counterparties shall provide eligible assets by:

(a) the transfer of ownership, which takes the legal form of a repurchase agreement; or

(b) the creation of a security interest, i.e. a pledge, assignment or a charge granted over the relevant assets, which takes the legal form of a collateralised loan,

in either case pursuant to the national contractual or regulatory arrangements established and documented by the home NCB.

4. Where counterparties provide eligible assets as collateral, the home NCB may require either earmarking or pooling of eligible assets, depending on which type of collateral management system it uses.

5. No distinction shall be made between marketable and non-marketable assets with regard to the quality of the assets and their eligibility for the various types of Eurosystem credit operations.

6. Without prejudice to the obligation in paragraph 2 that counterparties provide the Eurosystem with assets that are eligible as collateral, the Eurosystem may, upon request, provide counterparties with advice regarding the eligibility of marketable assets if they have already been issued or regarding the eligibility of non-marketable assets when they have already been requested for submission. The Eurosystem shall not provide any advice in advance of these events.

Article 59

General aspects of the Eurosystem credit assessment framework for eligible assets

1. As one of the criteria for eligibility, assets shall meet the high credit standards specified in the Eurosystem credit assessment framework (ECAF).

2. The ECAF shall lay down the procedures, rules and techniques to ensure that the Eurosystem's requirement for high credit standards for eligible assets is maintained and that eligible assets comply with the credit quality requirements defined by the Eurosystem.

3. For the purposes of the ECAF, the Eurosystem shall define credit quality requirements in the form of credit quality steps by establishing threshold values for the probability of default (PD) over a one-year horizon, as follows.

(a) The Eurosystem considers, subject to regular review, a maximum probability of default over a one-year horizon of 0,10 % as equivalent to the credit quality requirement of credit quality step 2 and a maximum probability of default over a one-year horizon of 0,40 % as equivalent to the credit quality requirement of credit quality step 3.

(b) All eligible assets for Eurosystem credit operations shall comply, as a minimum, with a credit quality requirement corresponding to credit quality step 3. Additional credit quality requirements for specific assets shall be applied by the Eurosystem in accordance with Titles II and III of Part Four.

4. The Eurosystem shall publish information on credit quality steps on the ECB website in the form of the Eurosystem's harmonised rating scale, including the mapping of credit assessments, provided by the accepted external credit assessment institutions (ECAIs) and third-party rating tools (RTs) providers, to credit quality steps.

5. In the assessment of the credit quality requirements, the Eurosystem takes into account credit assessment information from credit assessment systems belonging to one of four sources in accordance with Title V of Part Four.

6. As part of its assessment of the credit standard of a specific asset, the Eurosystem may take into account institutional criteria and features ensuring similar protection for the asset holder, such as guarantees. The Eurosystem reserves the right to determine whether an issue, issuer, debtor or guarantor fulfils the Eurosystem's credit quality requirements on the basis of any information that the Eurosystem may consider relevant for ensuring adequate risk protection of the Eurosystem.

7. The ECAF follows the definition of 'default' laid down in Directive 2013/36/EU and Regulation (EU) No 575/2013.

TITLE II

ELIGIBILITY CRITERIA AND CREDIT QUALITY REQUIREMENTS FOR MARKETABLE ASSETS

CHAPTER 1

Eligibility criteria for marketable assets

Article 60

Eligibility criteria relating to all types of marketable assets

In order to be eligible as collateral for Eurosystem credit operations, marketable assets shall be debt instruments fulfilling the eligibility criteria laid down in Section 1, except in the case of certain specific types of marketable assets, as laid down in Section 2.

Article 61

List of eligible marketable assets and reporting rules

1. The ECB shall publish an updated list of eligible marketable assets on its website, in accordance with the methodologies indicated on its website and shall update it every weekday. Assets assessed in accordance with Article 87(3) shall not be published on this list of eligible marketable assets.

2. As a rule, the NCB reporting a specific marketable asset to the ECB is the NCB of the country in which the marketable asset is admitted to trading.

Section 1

General eligibility criteria for marketable assets

Article 62

Principal amount of marketable assets

1. In order to be eligible, until their final redemption, debt instruments shall have:

(a) a fixed and unconditional principal amount; or

(b) an unconditional principal amount that is linked, on a flat basis, to only one euro area inflation index at a single point in time, containing no other complex structures.

2. Debt instruments with a principal amount linked to only one euro area inflation index at a single point in time shall also be permissible, given that the coupon structure is as defined in Article 63(1)(b)(i) fourth indent and linked to the same euro area inflation index.

3. Assets with warrants or similar rights attached shall not be eligible.

Article 63

Acceptable coupon structures for marketable assets

1. In order to be eligible, debt instruments shall have either of the following coupon structures until final redemption:

(a) fixed, zero or multi-step coupons with a pre-defined coupon schedule and pre-defined coupon values that may not result in a negative cash flow; or

(b) floating coupons that may not result in a negative cash flow and that have the following structure: coupon rate = (reference rate * l) ± x, with f ≤ coupon rate ≤ c, where:

(i) the reference rate is only one of the following at a single point in time:

— a euro money market rate, e.g. EURIBOR, LIBOR or similar indices;

— a constant maturity swap rate e.g. CMS, EIISDA, EUSA;

— the yield of one or an index of several euro area government bonds that have a maturity of one year or less;

— a euro area inflation index; and

(ii) f (floor), c (ceiling), l (leveraging/deleveraging factor) and x (margin) are, if present, numbers that are either pre-defined at issuance, or may change over time only according to a path pre-defined at issuance, where f and c are greater than or equal to zero and l is greater than zero throughout the entire lifetime of the asset. For floating coupons with an inflation index reference rate, l shall be equal to one.

2. Debt instruments with a floating coupon, as referred to in paragraph 1(b), shall be considered ineligible if at any time following the application of the coupon rate formula, the coupon rate results in a negative value.

3. Any coupon structure that does not comply with paragraphs 1 and 2 shall not be eligible, including instances where only part of the remuneration structure, such as a premium, is non-compliant.

4. For the purpose of this Article, if the coupon is either of a fixed multi-step type or of a floating multi-step type, the assessment of the relevant coupon structure shall be based on the entire lifetime of the asset with both a forward- and backward-looking perspective.

5. Acceptable coupon structures shall have no issuer optionalities, i.e. during the entire lifetime of the asset, based on a forward- and backward-looking perspective, changes in the coupon structure that are contingent on an issuer's decision shall not be acceptable.

Article 64

Non-subordination with respect to marketable assets

Eligible debt instruments shall not give rise to rights to the principal and/or the interest that are subordinated to the rights of holders of other debt instruments of the same issuer.

Article 65

Currency of denomination of marketable assets

In order to be eligible, debt instruments shall be denominated in euro or in one of the former currencies of the Member States whose currency is the euro.

Article 66

Place of issue of marketable assets

1. Subject to paragraph 2, in order to be eligible, debt instruments shall be issued in the EEA with a central bank or with an SSS that has been positively assessed pursuant to the Eurosystem User Assessment Framework.

2. In respect of debt instruments issued or guaranteed by a non-financial corporation for which no credit assessment has been provided by an accepted ECAI system for the issue, issuer or guarantor, the place of issue must be within the euro area.

3. International debt instruments issued through the ICSDs Euroclear Bank and Clearstream Banking Luxembourg shall comply with the following criteria, as applicable.

(a) International debt instruments issued in global bearer form shall be issued in the form of new global notes (NGNs) and shall be deposited with a common safekeeper which is an ICSD or a CSD that has been positively assessed pursuant to the Eurosystem User Assessment Framework. By way of derogation, this shall not apply to international debt instruments issued in global bearer form issued in the form of classical global notes prior to 1 January 2007 and fungible tap issuances of such notes issued under the same ISIN irrespective of the date of the tap-issuance.

(b) International debt instruments issued in global registered form shall be issued under the new safekeeping structure for international debt instruments. By way of derogation, this shall not apply to international debt instruments issued in global registered form prior to 1 October 2010.

(c) International debt instruments in individual note form shall not be eligible unless they were issued in individual note form prior to 1 October 2010.

Article 67

Settlement procedures for marketable assets

1. In order to be eligible, debt instruments shall be transferable in book-entry form and shall be held and settled in Member States whose currency is the euro through an account with an NCB or with an SSS that has been positively assessed pursuant to the Eurosystem User Assessment Framework, so that perfection and realisation of collateral are subject to the law of a Member State whose currency is the euro.

2. If the CSD/SSS where the asset is issued and the CSD/SSS where the asset is held, are not identical, for the purposes of eligibility, the two must be connected by an eligible link positively assessed pursuant to the Eurosystem User Assessment Framework in accordance with Article 150.

Article 68

Acceptable markets for marketable assets

1. In order to be eligible, debt instruments shall be those which are admitted to trading on a regulated market as defined in Directive 2014/65/EU of the European Parliament and of the Council [1], or admitted to trading on certain acceptable non-regulated markets.

2. The ECB shall publish the list of acceptable non-regulated markets on its website and shall update it at least once a year.

3. The assessment of non-regulated markets by the Eurosystem shall be based on the following principles of safety, transparency and accessibility.

(a) Safety refers to certainty with regard to transactions, in particular certainty in relation to the validity and enforceability of transactions.

(b) Transparency refers to unimpeded access to information on the market's rules of procedure and operation, the financial features of the assets, the price formation mechanism, and the relevant prices and quantities, e.g. quotes, interest rates, trading volumes, outstanding amounts.

(c) Accessibility refers to the ability of the Eurosystem to take part in and access the market. A market is considered accessible if its rules of procedure and operation allow the Eurosystem to obtain information and conduct transactions when needed for collateral management purposes.

4. The selection process for non-regulated markets shall be defined exclusively in terms of the performance of the Eurosystem collateral management function and should not be regarded as an assessment by the Eurosystem of the intrinsic quality of any market.

Article 69

Type of issuer or guarantor for marketable assets

1. In order to be eligible, debt instruments shall be issued or guaranteed by central banks of Member States, public sector entities, agencies, credit institutions, financial corporations other than credit institutions, non-financial corporations, multilateral development banks or international organisations.

2. In addition to those banks and organisations identified in Article 117(2) and Article 118 of Regulation (EU) No 575/2013, the Eurosystem may recognise any entity as a multilateral development bank or international organisation for the purposes of this Guideline based upon an assessment relating to all of the following criteria:

(a) it is an organisation with a global or regional mandate, transcending national boundaries;

[1] Directive 2014/65/EU of the European Parliament and of the Council of 15 May 2014 on markets in financial instruments and amending Directive 2002/92/EC and Directive 2011/61/EU (OJ L 173, 12.6.2014, p. 349).

(b) it is funded predominantly by contributions from national governments, or organisations or entities linked with national governments;

(c) the mission of the entity is in line with the Union's policies.

Article 70

Place of establishment of the issuer or guarantor

1. In order to be eligible, debt instruments shall be issued by an issuer established in the EEA or in a non-EEA G10 country, subject to the exceptions in paragraphs 3 to 6.

2. In order to be eligible, guarantors of debt instruments shall be established in the EEA, unless a guarantee is not needed to establish the credit quality requirements for specific debt instruments, subject to the exceptions laid down in paragraphs 3 and 4. The possibility to use an ECAI guarantor rating to establish the relevant credit quality requirements for specific debt instruments is laid down in Article 84.

3. For debt instruments issued or guaranteed by non-financial corporations for which no credit assessment from an accepted ECAI system exists for the issue, the issuer or the guarantor, the issuer or guarantor shall be established in a Member State whose currency is the euro.

4. For debt instruments issued or guaranteed by multilateral development banks or international organisations, the criterion in respect of place of establishment shall not apply and they shall be eligible irrespective of their place of establishment.

5. For asset-backed securities, the issuer must be established in the EEA in accordance with Article 74.

6. Debt instruments issued by issuers established in non-EEA G10 countries shall only be considered eligible if the Eurosystem has ascertained to its satisfaction that its rights would be protected in an appropriate manner under the laws of the relevant non-EEA G10 country. For this purpose, a legal assessment shall be submitted to the relevant NCB, in a form and substance acceptable to the Eurosystem, before the relevant debt instruments may be considered eligible.