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Who benefits from the corporate QE? A regression discontinuity design approach

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ABSTRACT

On March 10, 2016, the European Central Bank (ECB) announced the Corporate Sector Purchase Programme (CSPP) – commonly known as corporate quantitative easing (QE) – to improve the financing conditions of the Eurozone's real economy and strengthen the pass-through of unconventional monetary interventions. Using a regression discontinuity design framework that exploits the *rating wedge* between the ECB and market participants, we show that: (i) bond yield spreads decline by around 15 basis points at the announcement of the programme, (ii) the impact is mostly noticeable in the sample of CSPP-eligible bonds that are perceived as high yield from the viewpoint of market participants and, (iii) the CSPP seems to have stimulated new issuance of corporate bonds. Overall, our results are consistent with the explanation that highlights the portfolio rebalancing mechanism and the liquidity channel.

JEL classification: E50, E52, G11, G30, G32

Keywords: Unconventional Monetary Policy, Corporate Quantitative Easing (QE), Cost of Financing, Liquidity, Bond Issuance, Regression Discontinuity Design.

Non-Technical Summary

Since the outbreak of the worldwide financial crisis of 2008 and the European Sovereign Debt Crisis 2009-12, the European Central Bank (ECB) has mainly responded by reducing its policy rate almost to the zero lower bound and enacting a series of non-standard measures such as the full allotment of liquidity, the Security Market Purchase (SMP) and the Long-Term-Refinancing-Operations (LTROs). The turning point, especially important to restore trust and confidence in the Eurozone was July 26, 2012 when the ECB's president Mario Draghi announced to do "whatever it takes" to preserve the euro and subsequently launched the Outright Monetary Transactions (OMT) programme. In effect, the Governing Council of the ECB was able to calm financial markets by announcing conditional support for all eurozone countries involved in a sovereign state bailout programme from the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM).

Yet, few years later and despite the plethora of non-conventional monetary interventions, downside risks in the euro area tilted towards inflation rates remaining "too low for too long". To address this issue, an important change of policy occurred on January 22, 2015 when the ECB's Governing Council announced a large-scale public sector purchase programme (PSPP). The PSPP comprised bonds issued by euro area central governments, government related agencies and European institutions. Together with purchases of private-sector assets (asset backed securities and covered bonds), which had been ongoing since September 2014, the PSPP constituted the ECB's so-called Expanded Asset Purchase Programme (APP). Purchases started in March 2015, and initially amounted to EUR 60 billion per month.[1] Complementing a series of policy rate cuts and other non-standard monetary policy measures, the APP was intended to help bring euro area inflation back to the ECB's desired level of below, but close to, 2%.

On March 10, 2016, the ECB decided to increase its monthly bond purchases by EUR 20 billion per month (EUR 80 billion in total), announced new accommodative four-year loans to banks (TLTRO II) and started to include corporate bonds under the corporate sector purchase programme (CSPP).[2] The aim of this paper is to examine the causal effects of the CSPP – commonly known as corporate quantitative easing (QE) – and evaluate its efficacy.

Studying the impact of the CSPP empirically requires solving an identification problem which relates to the endogeneity of eligible securities to be purchased by the ECB. Indeed, bonds that are accepted in the ECB's portfolio (i.e. eligible to the CSPP) differ on several dimensions from bonds that are not. For example, eligible corporate bonds tend to be safer (i.e. better rating) and more liquid (i.e. lower bid-ask spread) as compared to bonds that are not. Therefore, comparing bonds between eligible and those that are not is likely to capture the effect of these (observable and unobservable) differences rather than capturing the causal effect of the CSPP. We overcome this obstacle by using a research design that increases the likelihood of a CSPP-eligible bond (i.e.

[1] Public-sector securities accounted for more than 75% and thus constitute the largest part of the APP.
[2] https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310.en.html

"Investment-Grade" from the viewpoint of the ECB) to be classified as "High Yield" by market participants (e.g. investment banks, mutual funds, pension funds). Put it differently, our analysis exploits the existence of a specific *rating wedge* between the ECB and investors in the corporate bond market to highlight the transmission channels through which the corporate QE may affect asset prices and subsequent firm decisions.

In order to illustrate this *wedge*, note that according to the CSPP eligibility criteria, debt instruments must: (i) be issued by a non-bank corporation established in the euro area and denominated in euro; (ii) have a minimum remaining maturity of six months and a maximum remaining maturity of 30 years at the time of purchase, and, (iii) have a minimum first best credit assessment of at least credit quality step 3 (rating of BBB- or equivalent) obtained from an external credit assessment institution (rating agency; henceforth). Keeping this as a backdrop, we use the credit rating vector of a bond and the pivotal roles of some rating agencies (with regard to bond's eligibility to the corporate QE) as the most important pieces of information to evaluate the CSPP.

We argue that steadfast adherence to stricter credit rating standards (i.e average/minimum rating rule) by investors to separate bonds from "Investment Grade" to "High Yield" creates a sharp "market BBB-" cut-off around which there is a discontinuity in the probability of bond assignment to investment grade investors' portfolio from 0 to 1. We are then able to examine a subsample of corporate bonds that are below, but close to, the "market BBB-" threshold (i.e. perceived as "High Yield" by the market), and still eligible to the CSPP (i.e. perceived as "Investment Grade" by the ECB). This *rating wedge* generates an exogenous source of variation that we use to estimate the impact of the CSPP on the cost of borrowing and the availability of market-based funding of eurozone non-financial corporations.

Our conjecture is that, at the announcement of the CSPP, the common knowledge of the ECB' financial risk management framework associated with the stricter qualifying rules used by investors might provoke portfolio rebalancing incentives towards CSPP-eligible bonds falling *slightly* below the "BBB- Market" cut-off (Vayanos and Vila, 2009, Gagnon et al., 2011, Joyce et al., 2011). In addition to the portfolio rebalancing mechanism, it is also possible for the CSPP to affect yield spreads of other "High Yield" assets through the liquidity channel by modifying the bargaining power of sellers towards buyers in the markets for CSPP-eligible securities (Christensen and Gillan, 2017).[3]

Our empirical strategy relies on a regression discontinuity (RD) design approach to identify the economic effects occurring precisely at the "BBB- Market" cut-off. We are thus able to examine the subsample of bonds (firms) that are "close" to the investment grade eligibility threshold, effectively homogenizing the violation and non-violation states by restricting attention to only those states separated by a small difference in the distance to the market credit rating cut-off.

Using a sample of around 1,300 bonds across 15 countries in the euro area, we empirically

[3]As the ECB is expected to reduce the stock of eligible bonds on the secondary market available for sale by holding the bonds to maturity.

show that the CSPP's announcement led to a decline of around 15 basis points in bond yield spreads across the euro area, especially noticeable for bonds located below, but close to, the "BBB-Market" cut-off. Interestingly, the ease of financing conditions extended to CSPP non-eligible corporate bonds with credit ratings below investment grade (high-yield bonds). Also, we find that the bid-ask spreads worsen –although some time later– for bonds eligible to the corporate QE: the deterioration of liquidity is likely to be due to the change in the bargaining power of sellers towards buyers in the markets for the CSPP-eligible securities.[4] When the programme was in operation,[5] however, securities targeted by the CSPP were positively affected by the liquidity channel as witnessed by the reduction of bid-ask spreads. We also find that the corporate QE has stimulated new issuance of corporate bonds, especially for firms below, but close to, the CSPP-eligibility frontier. More specifically, we show that firms which are CSPP non-eligible increase their corporate bond issuances substantially more – by around 1%. This suggests that the improvement of financing conditions following the CSPP was indeed helping firms to finance themselves through capital markets.

To summarize, our findings confirm that the corporate QE imparted monetary stimulus by lowering the yields on corporate bonds and reducing the cost of borrowing for eurozone non-financial companies after March 2016. Beyond these findings, our paper points a new way forward in learning about central banks' asset purchase programmes. For example, the increase in the new issuance of corporate bonds informs us about the change in firms' financing strategy decisions, following these policies. Furthermore, we believe that the CSPP effects could have a macroeconomic impact: the ease of financing conditions can have a long term effect on the Eurozone economy in particular for lower-investment grade firms, allowing the recovery after the European sovereign debt crisis.

[4] As mentionned by Khandani and Lo (2011), one commonly cited measure of liquidity is the magnitude of the bid/offer spread, measured as a percentage of the average of bid and offer prices (see, for example, Amihud and Mendelson, 1986). However, this measure can only be applied to those securities for which we observe regular bids and offers, i.e., those that trade on organized exchanges and with designated marketmakers. Despite the many issues of this liquidity proxy, we limit our attention to the bid-ask spread because other possible liquidity measurements such as trading volume – either euro volume or percentage turnover (see, for example, Brennan, Chordia and Subrahmanyam, 1998, and Lo and Wang, 2000) – are rarely available and virtually impossible to hand-collect.

[5] The Governing Council of the European Central Bank (ECB) decided that purchases under its Corporate Sector Purchase Programme (CSPP) will start on 8 June 2016. See: Section II.

"The ECB's surprise announcement in March to extend its asset-purchase programme to investment grade non-bank corporate bonds triggered a rapid, and indiscriminate, tightening of credit spreads and a jump in primary-market issuance. And that was all before the central bank purchased a single corporate bond." (From: Bloomberg (August, 2016))

I. Introduction

Following the world wide financial crisis of 2008 and the European Sovereign Debt Crisis 2009-12, the European Central Bank (ECB) has mainly responded by reducing its policy rate almost to the zero lower bound and enacting a series of non-standard measures such as the full allotment of liquidity, the Security Market Purchase (SMP) and the Long-Term-Refinancing-Operations (LTROs). The turning point, especially important to restore trust and confidence in the Eurozone was July 26, 2012 when the ECB's president Mario Draghi announced to do "whatever it takes" to preserve the euro and subsequently launched the Outright Monetary Transactions (OMT) programme. In effect, the Governing Council of the ECB was able to calm financial markets by announcing conditional support for all eurozone countries involved in a sovereign state bailout programme from the European Financial Stability Facility (EFSF) and the European Stability Mechanism (ESM).

Yet, few years later and despite the plethora of non-conventional monetary interventions, downside risks in the euro area tilted towards inflation rates remaining "too low for too long".[6] To address this issue, an important change of policy occurred on January 22, 2015 when the ECB's Governing Council announced a large-scale public sector purchase programme (PSPP). The PSPP comprised bonds issued by euro area central governments, government related agencies and European institutions. Together with purchases of private-sector assets (asset backed securities and covered bonds), which had been ongoing since September 2014, the PSPP constituted the ECB's so-called Expanded Asset Purchase Programme (APP). Purchases started in March 2015, and initially amounted to EUR 60 billion per month.[7] Complementing a series of policy rate cuts and other non-standard monetary policy measures, the APP was intended to help bring euro area inflation back to the ECB's desired level of below, but close to, 2%.

On March 10, 2016, the ECB decided to increase its monthly bond purchases by EUR 20 billion per month (EUR 80 billion in total), announced new accommodative four-year loans to banks (TLTRO II) and started to include corporate bonds under the corporate sector purchase programme (CSPP).[8] The aim of this paper is to examine the causal effects of the CSPP – commonly known as corporate quantitative easing (QE) – and evaluate its efficacy.

The theoretical motivation of our CSPP analysis follows from the recent literature on transmission channels of central bank asset purchases (i.e. quantitative easing or QE) and its effects on the

[6] https://www.ecb.europa.eu/press/pressconf/2014/html/is141204.en.html

[7] Public-sector securities accounted for more than 75% and thus constitute the largest part of the APP.

[8] https://www.ecb.europa.eu/press/pr/date/2016/html/pr160310.en.html

economy. The main mechanism for QE to affect the real economy is through its impact on (long term) interest rates. The most straightforward way QE can affect (long-term) interest rates is by modifying the supply of or demand for a given asset, which could affect its price and hence risk premium. The seminal model introduced in Vayanos and Vila (2009) suggests that, when assets with otherwise near-identical risk and return characteristics are considered imperfect substitutes by some investors (e.g., due to preferred habitat) and markets are segmented, a change in the relative market supply of an asset may affect its relative price. Such effects are usually referred to as portfolio rebalancing effects (Gagnon et al., 2011, Joyce et al., 2011). Recently, Christensen and Gillan (2017) have highlighted a novel channel through which the QE can affect the liquidity premium that investors demand for holding any security that is less than perfectly liquid.[9] The liquidity channel operates by temporarily increasing the bargaining power of sellers in the market for targeted securities, which can eventually lower their liquidity metrics as shown by Duffie et al. (2007). However, understanding the interaction between the portfolio rebalancing mechanism and the liquidity channel remains an empirical research obstacle. The CSPP offers a unique testing ground to tackle this challenge.

Studying the impact of the CSPP empirically requires solving an identification problem which relates to the endogeneity of eligible securities to be purchased by the ECB. Bonds that are accepted in the ECB's portfolio (i.e. eligible to the CSPP) differ on several dimensions from bonds that are not. For example, eligible corporate bonds tend to be safer (i.e. better rating) and more liquid (i.e. lower bid-ask spread) as compared to bonds that are not. Therefore, comparing bonds between eligible and those that are not is likely to capture the effect of these (observable and unobservable) differences rather than capturing the causal effect of the CSPP. We overcome this obstacle by using a research design that increases the likelihood of a CSPP-eligible bond (i.e. "Investment-Grade" from the viewpoint of the ECB) to be classified as "High Yield" by market participants (e.g. investment banks, mutual funds, pension funds). Put it differently, our analysis exploits the existence of a specific *rating wedge* between the ECB and investors in the corporate bond market to highlight the transmission channels through which the corporate QE may affect asset prices and subsequent firm decisions.

To see how this *wedge* comes about, note that according to the CSPP plan, debt instruments eligible for purchase must: (i) be issued by a non-bank corporation established in the euro area and denominated in euro; (ii) have a minimum remaining maturity of six months and a maximum remaining maturity of 30 years at the time of purchase, and, (iii) have a minimum first best credit assessment of at least credit quality step 3 (rating of BBB- or equivalent) obtained from an external credit assessment institution (rating agency; henceforth).

[9] A perfectly liquid security can be sold any time in arbitrarily small or large amounts at no trading costs (i.e., there is no bid-ask spread) and without affecting its price. Hence, the liquidity premium of a security represents investors' required compensation for assuming the risk of potentially having to liquidate a long position in the security prematurely at a disadvantageous price, say, in a stressed market environment when market makers and arbitrageurs are severely capital constrained (Christensen and Gillan, 2017).

We argue that steadfast adherence to stricter credit rating standards (i.e average/minimum rating rule) by investors to separate bonds from "Investment Grade" to "High Yield" create a sharp "market BBB-" cut-off around which there is a discontinuity in the probability of bond assignment to investment grade investors' portfolio from 0 to 1. We are then able to examine a subsample of corporate bonds that are below, but close to, the "market BBB-" threshold (i.e. perceived as "High Yield" by the market), and still eligible to the CSPP (i.e. perceived as "Investment Grade" by the ECB). This *rating wedge* generates an exogenous source of variation that we use to estimate the impact of the CSPP on the cost of borrowing and the availability of market-based funding of eurozone non-financial corporations.

Underwriting bond indices guidelines by *The Bank of America Merrill Lynch Global Bond Index*, *Bloomberg Barclays Indices*, *Markit iBoxx* and *S&P 500 Bond Index*, standardized bonds' inclusion into the portfolio of investors.[10] These guidelines illustrate the stricter credit rating standards used by market participants. For instance, as Bloomberg Barclays puts it:[11]

"The Bloomberg Barclays Aggregate Corporate Index is a flagship measure of global investment grade. Rule for inclusion [...] Quality: Securities must be rated ***investment grade (Baa3/BBB-/BBB- or higher)*** *using the* ***middle rating*** *of Moody's, S&P and Fitch; when a rating from only two agencies is available,* ***the lower is used.****"*

In other words, if a *bond I* has a rating vector $X_I = [BBB-, BBB-, BBB-, \#NA]$ obtained from the four credit rating agencies S&P, Moody's, Fitch and DBRS, this bond will be seen as "BBB-" for the market ("BBB- Market"; henceforth) and "BBB-" for the ECB ("BBB- ECB"; henceforth).[12] However, if another *bond J* has a rating vector $X_J = [BBB-, BB+, BB+, \#NA]$, this bond will *only* be considered as "BBB- ECB" (and thus eligible to the CSPP) while the market is more likely to assign a rating close to "BB+" (i.e."BB+ Market" or "High Yield").[13] By

[10]For example, *BNP Paribas Asset Management* explains its investment-grade credit strategy as follows: "Investment Philosophy and Process (...) Our eurozone investment-grade credit strategy invests primarily in European corporate bonds denominated in euros and rated BBB- or above (with up to 10% in BB rated bonds) (...) The strategy is managed against the *Barclays Euro Corporate Aggregate index*. See also Appendix B.

[11]`https://www.bloomberg.com/markets/rates-bonds/bloomberg-barclays-indices`

[12]#NA is an abbreviation for rating "Not Available". These four rating agencies are used to qualify the eligibility of a bond under the CSPP (Section II). Less than 1% of our corporate bonds are rated by DBRS.

[13]For example, Telecom Italia Spa, a telecommunication italian company has the following ratings on March 10, 2016: $X_{TelecomItalia} = [BBB-, BB+, BB+, \#NA]$. This firm has issued five corporate bonds from 2014 to 2017 that were all rated as follows: $[BBB-, BB+, BB+, \#NA]$. Interestingly, some of these bonds where effectively purchased by the ECB (for instance the corporate bond of Telecom Italia with ISIN "XS1497606365" was purchased on the third week of October) and three out of the five bonds were issued after the announcement of the CSPP. EDP Finance, Cellnex Telecom SA and ThyssenKrupp AG are in the same situation. Our intuitions rely on the fact the bonds issued by these companies are CSPP-eligible and likely to be perceived as "high yield" by market participants. As mentioned by The Financial Times:
" *Telecom Italia's bonds comprise 4.25 per cent of the euro high-yield index. Fitch already classes the company as investment grade, which has allowed the European Central Bank to purchase its debt under its bond-buying*

continuity, a *bond K* with a vector $X_K = [BB+, BB+, BB+, \#NA]$ is also likely to be considered as "BB+ Market" and "BB+ ECB" (and thus not eligible to the CSPP).

We conjecture that, at the announcement of the CSPP, the common knowledge of the ECB' financial risk management framework associated with the stricter qualifying rules used by investors might provoke portfolio rebalancing incentives towards CSPP-eligible bonds falling *slightly* below the "BBB- Market" cut-off (i.e *bond J*). In addition to the portfolio rebalancing mechanism, it is also possible for the CSPP to affect yield spreads of other "High Yield" assets (i.e *bond K*) through the liquidity channel by modifying the bargaining power of sellers towards buyers in the markets for CSPP-eligible securities.[14]

Our empirical strategy relies on a regression discontinuity (RD) design approach to identify the economic effects occurring precisely at the "BBB- Market" cut-off. We are thus able to examine the subsample of bonds (firms) that are "close" to the investment grade eligibility threshold, effectively homogenizing the violation and non-violation states by restricting attention to only those states separated by a small difference in the distance to the market credit rating cut-off. The methodology can be best understood using the following example. Bonds that have a "market eligibility score", say above C_{MKT}, are admitted to the investment grade investors' portfolio. Our methodology documents the causal effect of the corporate QE by comparing CSPP-eligible bonds that just qualified for investment grade investors' portfolio (i.e. *bond I*) to that of bonds who just failed to do so (i.e. *bond J*). In other words, the methodology compares several outcomes of interest for bonds with eligibility scores of $C_{MKT} + \epsilon$ (treatment group) to those with eligibility scores of $C_{MKT} - \epsilon$ (control group), arguing that the assignment of treatment (admission to "investment grade" market benchmarks) is driven by stricter credit rating models.[15]

Using a sample of around 1,300 bonds across 15 countries in the euro area, we empirically show that the CSPP's announcement led to a decline of around 15 basis points in bond yield spreads across the euro area, especially noticeable for bonds located below, but close to, the "BBB-Market" cut-off. Interestingly, the ease of financing conditions extended to CSPP non-eligible corporate bonds with credit ratings below investment grade (high-yield bonds). Also, we find that the bid-ask spreads worsen –although some time later– for bonds eligible to the corporate QE: the deterioration of liquidity is likely to be due to the change in the bargaining power of sellers towards buyers in the markets for the CSPP-eligible securities.[16] When the programme was in

programme. Telecom Italia carries the highest subinvestment grade ratings from Moody's and S&P, with both agencies upgrading its outlook earlier this year."(October 18, 2017).

[14] As the ECB is expected to reduce the stock of eligible bonds on the secondary market available for sale by holding the bonds to maturity.

[15] It is important to notice that around C_{MKT}, bonds have been assigned a "BBB-" from at least one of the "The Big Three" credit rating agencies which are Standard & Poor's (S&P), Moody's and Fitch Group.

[16] As mentionned by Khandani and Lo (2011), one commonly cited measure of liquidity is the magnitude of the bid/offer spread, measured as a percentage of the average of bid and offer prices (see, for example, Amihud and Mendelson, 1986). However, this measure can only be applied to those securities for which we observe regular bids and offers, i.e., those that trade on organized exchanges and with designated marketmakers. Despite the many issues of this liquidity proxy, we limit our attention to the bid-ask spread because other

operation,[17] however, securities targeted by the CSPP were positively affected by the liquidity channel as witnessed by the reduction of bid-ask spreads. We also find that the corporate QE has stimulated new issuance of corporate bonds, especially for firms located below, but close to, the CSPP-eligibility frontier.[18] More specifically, we show that firms which are CSPP non-eligible increase their corporate bond issuances substantially more – by around 1%. This suggests that the improvement of financing conditions following the CSPP was indeed helping firms to finance themselves through capital markets.

We conduct a large set of robustness checks to rule out alternative explanations for our results. First, differences in the performance of the bonds (firms) around the "BBB- Market" threshold could be driven by country, duration or industry risks. Importantly for our research design, we do not find any differences of these observable characteristics around the threshold. Second, our results are robust when we control for all of the observable characteristics of bonds (firms). In none of our specifications do we see a differential effect of the CSPP when we include a variety of smooth functions (e.g., polynomials) which increases our confidence that the choice of functional form for RD design is not driving the results (Lee and Card, 2008). In addition, we show that we do not see our results in placebo tests, e.g. in non-announcement dates, or for other rating cut-offs. Last, we repeat our RD falsification exercises with different estimation bandwidths and different time windows. The results are very similar, which gives us additional confidence that we are picking up the right effect.

In sum, our findings confirm that the corporate QE imparted monetary stimulus by lowering the yields on corporate bonds and reducing the cost of borrowing for eurozone non-financial companies after March 2016. Beyond these findings, we think that our paper points a new way forward in learning about central banks' asset purchase programmes. For example, the increase in the

possible liquidity measurements such as trading volume – either euro volume or percentage turnover (see, for example, Brennan, Chordia and Subrahmanyam, 1998, and Lo and Wang, 2000) – are rarely available and virtually impossible to hand-collect.

[17] The Governing Council of the European Central Bank (ECB) decided that purchases under its Corporate Sector Purchase Programme (CSPP) will start on 8 June 2016. See: Section II.

[18] This result contrasts with Grosse-Rueschkamp et al. (2017). One possible reason is that they use a different approach to classify firms as "Treatement/CSPP eligible" versus "Control/CSPP non-eligible". Indeed, out of their initial sample of 511 unique firms, 111 have an investment grade rating according to S&P (treatment sample). It must be noted, however, that the CSPP is a non-standard monetary policy measure tailored at bond level and not at firm level. In the case of Telecom Italia Spa previously mentioned, Rueschkamp et al. (2017) are likely to classify this firm as "high yield"/"non investment grade" even though most of the bonds issued by this firm were purchased by the ECB. We take a different approach to construct the treatment and the control samples by including not only S&P but the 4 rating agencies considered by the ECB and find opposite results (Telecom Italia Spa is rated BB+ by S&P on March 10, 2016). A firm can have an assigned credit rating from the four credit rating agencies above BBB-, even though some of its outstanding bonds might not be CSPP-eligible. We provide anecdotal evidences on the difficulty to extrapolate any inferences from bonds to companies in Appendix D. Indeed, firms (1) exhibit multiple ratings, and, (2) have multiple bonds (outstanding) which raises the issue of how many bonds must be eligible to qualify the firm as CSPP eligible. As a consequence, the ability to extrapolate any inferences from bonds to companies (even using a "weighting average across all outstanding issues of the firm") is of potential concern (See Section III.C).

new issuance of corporate bonds informs us about the change in firms' financing strategy decisions, following these policies. Furthermore, we believe that the CSPP effects could have a macroeconomic impact: the ease of financing conditions can have a long term effect on the Eurozone economy in particular for lower-investment grade firms, allowing the recovery after the European sovereign debt crisis.

The paper proceeds as follows. Section II presents the CSPP institutional framework. Section III describes the data and the hypotheses, while Section IV discusses the empirical methodology used in the paper. The empirical results are presented in Section V. Section VI presents evidence to address alternative explanations. Section VII concludes.

II. Institutional Framework: The CSPP

On March 10, 2016, the Governing Council of the ECB decided to establish a new programme to purchase investment-grade euro-denominated bonds issued by non-bank corporations in the euro area with the aim of further strengthening the pass-through of the Eurosystem's asset purchases to the financing conditions of the real economy. As a result, and in conjunction with the other non-standard measures in place (e.g. APP, TLTROs, Negative Interest Rates), the CSPP aimed to provide further monetary policy stimulus in order to achieve a return of inflation rates to levels below, but close to, 2% in the medium term.

Under the CSPP, outright purchases of investment-grade euro-denominated bonds issued by non-bank corporations established in the euro area are carried out by six Eurosystem national central banks (NCBs): Nationale Bank van België/Banque Nationale de Belgique, Deutsche Bundesbank, Banco de España, Banque de France, Banca d'Italia and Suomen Pankki/Finlands Bank. Each NCB is responsible for purchases from issuers in a particular part of the euro area.[19] The purchases are conducted in the primary and secondary markets.[20] The Eurosystem can also participate in the purchase of CSPP-eligible corporate bonds via private placements.[21] The ECB coordinates the purchases.

The Eurosystem's collateral framework (ECF)– the rules that lay down which assets are acceptable as collateral for monetary policy credit operations – is the basis for determining the eligibility of corporate sector securities to be purchased under the CSPP. More specifically, debt instruments are eligible for purchase, provided they fulfill all of the following criteria:

1. they are eligible as collateral for Eurosystem credit operations, based on the requirements defined in the Guideline on the implementation of the Eurosystem monetary policy framework (ECB/2014/60);
2. they are denominated in euro;

3. they have a minimum first-best credit assessment of at least credit quality step 3 (rating of BBB- or equivalent) obtained from an external credit assessment institution (ECAIs) according to Guideline ECB/2014/60. The four credit rating agencies considered by the ECB are Standard & Poor's, Moody's, FitchRatings and DBRS;[22]

[19]The CSPP holdings are also made available for securities lending by the relevant NCBs.

[20]The ECB's has also decided that no primary market purchases will involve debt instruments issued by entities that qualify as public undertakings.

[21]Market participants involved in private placements can contact the relevant NCB, which acts as the contact point for the Eurosystem in such situations.

[22]According to Guideline on the implementation of the Eurosystem monetary policy framework (ECB/2014/60). The use of these ratings is outlined in articles 83 and 84 of Guideline ECB/2014/60. Further, Article 84 specifies that an issue rating has priority over issuer or guarantor ratings. In general, the first-best rating must have a minimum credit assessment of credit quality step 3 (currently equivalent to an ECAI rating of BBB-/Baa3/BBBL) under the ECAF. Guarantor ratings are considered only in cases where

4. they have a minimum remaining maturity of six months and a maximum remaining maturity of 30 years at the time of purchase;

5. they have a yield to maturity above the deposit facility rate (DFR) at the time of purchase;[23]

6. the issuer:

   - is a corporation established in the euro area, defined as the location of incorporation of the issuer,[24]
   - is not a credit institution,[25]
   - does not have any parent undertaking (as defined in Article 4(15) of the Capital Requirements Regulation) which is a credit institution (as defined in Article 2 (14) of Guideline ECB/2014/60),
   - is not an asset management vehicle (as defined in the Bank Recovery and Resolution Directive and Single Resolution Mechanism Regulation) or a national asset management and divestment fund established to support financial sector restructuring and/or resolution

Conditional on being eligible for the CSPP, the Eurosystem also applies the additional restrictions:

1. An issue share limit of 70% per international securities identification number (ISIN) on the basis of the outstanding amount.[26]

2. A limit at issuer group level.[27]

the guarantee complies with the requirements set out in Part Four of Guideline ECB/2014/60.

[23]On 19 January 2017, the Governing Council decided that purchases of assets with a yield to maturity below the deposit facility rate are only permissible under the PSPP, confirming that no such purchases are foreseen for the CSPP. The DFR is the rate on the deposit facility, which banks may use to make overnight deposits with the Eurosystem.

[24]Corporate debt instruments issued by corporations incorporated in the euro area whose ultimate parent is not based in the euro area are also eligible for purchase under the CSPP, provided they fulfill all the other eligibility criteria.

[25]In practical terms, this means that bonds issued by an entity which is supervised under the Single Supervisory Mechanism (SSM), as well as its subsidiaries, are not eligible for purchase under the CSPP. At the same time, in order to ensure a level playing field between euro area and foreign issuers, issuers with a parent company that is subject to banking supervision outside the euro area are also excluded.

[26]However, in specific cases a lower issue share limit will apply, e.g. for securities issued by public undertakings, which will be dealt with in a manner consistent with their treatment under the Public Sector Purchase Programme (PSPP).

[27]A benchmark is defined at the issuer group level. The benchmark is neutral in the sense that it reflects proportionally all outstanding issues qualifying for the benchmark. This also implies that market capitalization provides a weighting for each of the jurisdictions of issuance within the benchmark. Issuer group limits is based on the benchmark to ensure a diversified ECB's portfolio, while at the same time they offer sufficient leeway to build up the portfolio.

Following the European Sovereign Debt Crisis 2009-12 and the weak macroeconomic dynamics, the CSPP has been created in addition to other existing asset purchase programmes with the aim to address the risks of a too prolonged period of inflation. The CSPP is the last component of the expanded asset purchase programme (APP). The APP consists of:

1. Third covered bond purchase programme (CBPP3)

2. Asset-backed securities purchase programme (ABSPP)

3. Public sector purchase programme (PSPP)

4. Corporate sector purchase programme (CSPP)

Figure 2 presents the monthly cumulative Eurosystem holdings under the CSPP. Purchases in both primary and secondary markets can take place under the CSPP.[28] Figure 3 shows the breakdown of primary and secondary market purchases (until May 2017).[29] Figure 4 provides a breakdown of the Eurosystem holdings by asset purchase programmes (APP). This figure documents the dynamics of the ECB's holdings under the expanded asset purchase programme (APP).

[Place Figure 2, 3 and 4 about here]

Regarding the CSPP timeline, it is important to notice that the March 2016 ECB's announcement was largely unexpected by financial markets.[30] As the International Capital Market Association (ICMA) points out:[31]

[28] However, for debt instruments issued by public undertakings, no primary market purchases take place as such purchases are forbidden owing to the prohibition on monetary financing laid down in Article 123 of the Treaty on the Functioning of the European Union (TFEU).

[29] According to the ECB: *"When implementing the CSPP, the Eurosystem is mindful of the potential impact of its purchases on market liquidity. Its participation in primary market purchases aim at striking a balance between the objective of the programme and the need to ensure continued market functioning. Similarly, when buying in the secondary market, it considers, inter alia, the scarcity of specific debt instruments and general market conditions, i.e. with a certain degree of flexibility to also take into account seasonal differences. Furthermore, the benchmark applied for purchases reflects proportionally all eligible outstanding issues. This also implies that market capitalization provides a weighting for each of the different jurisdictions of issuance within the benchmark. Finally, CSPP holdings are also available for securities lending by the relevant national central banks."* See: `https://www.ecb.europa.eu/mopo/implement/omt/html/cspp-qa.en.html`

[30] See also Bloomberg (August, 2017). Due to the unexpected announcement, we will consider (in priority) the cross-bond effects prior to the effective purchases (See CSPP Timeline).

[31] The ICMA is a self-regulatory organization and trade association for participants in the capital markets. `http://www.icmagroup.org/About-ICMA/`

"The announcement by the ECB on March 10 to extend its Asset Purchases Programme to include investment grade non-bank corporate bonds caught the market by ***complete surprise****. It resulted in an immediate and substantial tightening of credit spreads,* ***not only*** *for corporate bonds potentially eligible for purchase under the programme"*[32].

Figure 1 below presents the timeline of the CSPP programme:

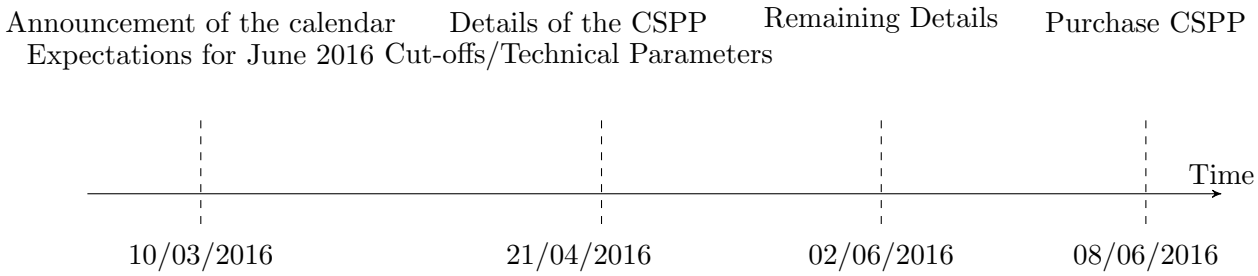

Figure 1. CSPP Timeline

- **10/03/2016**: The ECB adds the Corporate Sector Purchase Programme (CSPP) to the Asset Purchase Programme (APP) and announces changes to the APP.

- **21/04/2016**: Further to its decision of 10 March 2016 to add a Corporate Sector Purchase Programme (CSPP) to the Asset Purchase Programme (APP), the Governing Council of the European Central Bank (ECB) decided on the main technical parameters of the programme.

- **02/06/2016**: The Governing Council of the European Central Bank (ECB) decided that purchases under its Corporate Sector Purchase Programme (CSPP) will start on 8 June 2016. The Governing Council also has taken decisions on the remaining details of the CSPP. The Governing Council further clarified what constitutes an eligible issuer and conducted a review of all public undertakings that comply with the eligibility criteria of the CSPP.

- **08/06/2016**: The ECB began purchasing corporate bonds.

[32]For instance, 21 days after the CSPP announcement (i.e. March 31, 2016), Cellnex Telecom, S.A., a firm headquartered in Spain that operates infrastructure for wireless telecommunication said: "Cellnex Telecom bonds will be eligible for the ECB's *high-quality* corporate bond purchase programme (...) the announcement of the inclusion was released yesterday march 30th 2016 and is consistent with Fitch's "investment grade" (BBB-) rating for Cellnex bonds". It is important to notice that, at the same time, S&P has provided a BB+ rating for this firm. Cellnex was therefore CSPP-eligible, at the margin, thanks to the rating of Fitch. `https://www.cellnextelecom.com/content/uploads/2016/03/CP-Bonos-elegibles-BCE_EN.pdf`

III. Data and Hypotheses

A. *Sample Construction*

The focus of our study is the Eurozone non-financial sector. We aim to construct a representative sample of corporate bonds that complies with all the CSPP criteria defined in Section II but the *"minimum first best credit assessment of at least credit quality step 3"* (i.e. ECB's first best rating rule or rating based "rule of thumb" henceforth).

A.1. Bloomberg

From Bloomberg, we collect information that includes bond level characteristics such as Yield-to-Maturity, ISINs, Amount Outstanding, Coupons, Bid-Ask Spreads and Maturity to Redemption. We match each bond with its issuer (and ultimate parent company), which allows us to retrieve firm-level variables and draw a clear picture of financing conditions during the period covered. We match the bond characteristics with firm level information such as total assets, industry, country of incorporation, leverage, market capitalization and other balance sheet/income statement figures. For the purposes of this study, we focus our attention on the sample of bonds with available market information at the date of the announcement (i.e. March 10, 2016). Since we are using the credit rating vector of a bond and the pivotal roles of some rating agencies (with regard to bond's eligibility to the corporate QE) as the most important pieces of information to evaluate the CSPP, we require that each bond contains at least a rating available from Standard & Poor's, Moody's, FitchRatings and DBRS. If a rating of a specific credit rating agency is not available through bloomberg, we complete the rating vector (at the bond and firm level), with DEALOGIC. Additionally, we exclude bonds with remaining maturity outside the desirable range (i.e. six months and a maximum remaining maturity of 30 years).[33] We finally identify 301 non-financial corporations (i.e. issuers) with 1310 publicly traded bonds outstanding. For brevity, we will refer to this dataset as the Bloomberg sample and all variables constructed from these data are formally defined in Appendix C. Our unit of observation for the Bloomberg sample is a bond-day.

Figure 5 shows the distribution of the corporate bond universe by first best credit rating (under S&P scale). Above the red dashed-line (i.e. "BBB- ECB"), bonds are eligible to the CSPP (and thus classified as "Investment-grade" by the ECB (ECB, 2017)).[34] In other words, out of the 1,310 corporate bonds, around 70% are eligible to the corporate QE and 30% are below the *"minimum*

[33] This corresponds to a drop of around 5.8% of the data. We also exclude bonds that do not comply with the other CSPP requirements (i.e. currency, DFR floor, issuer industry, country of incorporation ...). See Section II.

[34] On the CSPP Questions & Answers (6 March 2017), the ECB replies to the following question: *Will the Eurosystem sell its holdings of bonds if they lose eligibility? For example, if they are downgraded and lose* ***investment grade status****?* Here is the answer: *The Eurosystem is not required to sell its holdings in the event of a downgrade below the credit quality rating requirement for eligibility.*
`https://www.ecb.europa.eu/mopo/implement/omt/html/cspp-qa.en.html`

first best credit assessment of at least credit quality step 3" and thus considered as "High Yield" from the viewpoint of the ECB (ECB, 2015).

[Place Figure 5 about here]

A.2. Dealogic DCM Analytics

We further collect a sample of corporate bond issuances through Dealogic DCM Analytics. We obtain all the available deals since January 2014 that: (i) are denominated in euro, and, (ii) whose issuer is a non-financial corporation, incorporated in the Eurozone. This dataset initially provides 1404 different ISINs. We obtain the rating of the corporate bonds as well as their issuers from S&P, Moodys, Fitch and DBRS. Overall, we have around 253 different non-financial corporations (i.e. among them 200 issuers are in the Bloomberg sample) with complete information. The issuance database contains valuable information such as the deal total value, issuer nationality, rating at launch and deal nationality. For simplicity, we will refer to this dataset as the Dealogic sample and all variables constructed from these data are formally defined in Appendix C. Our unit of observation for the Dealogic sample is a firm-quarter.

B. Corporate Credit Ratings and the rating wedge

B.1. Mapping of the Rating into 17 numerical values

Appendix A maps the corporate ratings into seventeen numerical values, with 10 corresponding to the highest rating (AAA/Prime) and -6 to the lowest (CCC+/substantial risks). The traditional "BBB-" cut-off that separates bonds from "High Yield" to "Investment Grade" is represented by the horizontal dashed line located below the "BBB-" (using the S&P scale). In the next subsection, we show that the "BBB-" threshold is not the same for the ECB and investors.

[Place Appendix A about here]

B.2. Market- versus ECB-Eligibility: A view of the *rating wedge*

Our analysis relies on steadfast adherence to stricter credit rating standards (i.e average/minimum rating rule) by investors to separate bonds from "Investment Grade" to "High Yield". The "market BBB-" creates a sharp cut-off around which there is a discontinuity in the probability of bond assignment to investment grade investors' portfolio from 0 to 1. The ECB, however, considers the *"minimum first best credit assessment of at least credit quality step 3"* (i.e. "BBB- ECB") as a threshold to separate bonds from "Investment Grade" (i.e. eligible to the CSPP) to "High Yield" (i.e. not eligible to the CSPP).[35] In other words, there exists a set of CSPP-eligible bonds that

[35]Credit quality step 3 is considered equivalent to a probability of default of between 0.10% and 0.40% over a one-year horizon (ECB, 2015).

are perceived as "risky" (or "High Yield") by investors and classified as "Investment Grade" by the ECB. For simplicity and tractability, we define the *rating wedge* as the difference in the credit assessment framework between investors and the ECB, in particular regarding the ratings selection necessary to classify a bond as "Investment Grade".

The ECB's rating cut-off (i.e. first best rating rule) is not new. Defining a minimum level of credit quality market risks is at the heart of the Eurosystem collateral framework (ECB, 2015, Nyborg, 2016, Bindseil, 2017).[36] Since October 2008, the minimum requirement is a rating of "BBB-" on Standard & Poor's scale. As mentioned in Section II, there are four accepted rating agencies (S&P, Fitch, Moody's, and Dominion Bond Rating Services (DBRS)) and importantly for the monetary policy framework of the ECB, *only the highest rating matters*. Recently, the Eurosystem's collateral framework has been heavily criticized, in particular regarding the first best rating rule (Nyborg, 2016). In analyzing the pivotal roles of some rating agencies (especially DBRS), Nyborg (2016) concludes: "That *one rating agency* can have such a large impact is the result of the rating within the Eurosystem's collateral framework being determined by the *highest external rating* rather than, for example, *an average*".[37]

Guidelines established by *The Bank of America Merrill Lynch Global Bond Index*, *Bloomberg Barclays Indices*, *Markit iBoxx* and *S&P 500 Bond Index* suggest, however, that "average rating rule" or "worse rating rule" (where the lowest rating matters in case of missing information) are mainly used by market participants (Appendix B). Theoretically, investors might not rely on the first best rating rule because (i) the average rating aggregates the information content of ratings more efficiently, and, (ii) central banks are not subject to liquidity risk in the way "normal" investors are, and can therefore accept less liquid assets for monetary policies (ECB, 2017).

[Place Appendix B about here]

We capture the *rating wedge* between the ECB and investors by constructing a measure, called G, that weights (i) the availability of rating information, and, (ii) the dispersion of ratings across the four agencies. This statistic provides insights on any rating framework differences between the ECB and investors when they occur. We denote $G_{i,t}$ the rating value ("rating score" or "G score" or "G value", henceforth) of bond i at date t as follows:

[36] Collateral frameworks determine what collateral central bank money is issued against and on what terms. The list of marketable eligible collateral is updated daily and published on the ECB's website. The list contains all marketable collateral that is eligible by virtue of having a *public rating*, or being guaranteed by an entity with a public rating, that meets with the minimum threshold as determined by the ECB.

[37] Nyborg (2016) casts doubts on whether the Eurosystem collateral framework's design is optimal, in particular regarding the ratings selection necessary to determine the asset's eligibility. Regarding the critics about the Eurosystem collateral framework, Bindseil et al. (2017) reply as follows: "These comments are not supported by the evidence and also often reflect misconceptions about the economics of a central bank collateral framework". Our claim rely solely on the observable differences between the ECB and market participants (Appendix B). We do not discuss about the optimality of risk management frameworks.

$$G_{i,t} = \begin{cases} \max_r\{ R_r \}_{i,t} & \text{if } \{\sum_r \mathbb{1}_{[R_r \neq \varnothing]} = 4\} \\ \max_r\{ R_r \}_{i,t} - (1 - \frac{1}{4}\sum_r \mathbb{1}\{R_r \neq \varnothing\}) & \text{if } \{\sigma\{ R_r \}_{i,t} = 0\} \cap \{\sum_r \mathbb{1}_{[R_r \neq \varnothing]} \leqslant 4\} \\ \max_r\{ R_r \}_{i,t} - \lambda(\{ R_r \}_{i,t}) & \text{if } \{\sigma\{ R_r \}_{i,t} \neq 0\} \cap \{\sum_r \mathbb{1}_{[R_r \neq \varnothing]} \leqslant 3\} \end{cases} \quad (1)$$

The term $\max_r\{ R_r \}$ represents the first best rating, R_r is rating assigned by the rating agency r (r=Standard & Poor's, Moody's, FitchRatings and DBRS) converted in numerical values (Appendix A), σ is the standard deviation of the ratings (i.e. measure of rating disagreement), $\mathbb{1}\{.\}$ is the indicator variable and $\lambda(\{ R_r \})$ is a penalty rate that reflects the lack of rating information (i.e. missing rating) as well as the disagreement among these agencies (dispersion of ratings). In our baseline estimations, we consider $\lambda(\{ R_r \}_{i,t}) = \frac{2}{4}$ if $\sum_r \mathbb{1}_{[R_r = \max_r\{ R_r \}_{i,t}]} \geqslant 2$ and $\lambda(\{ R_r \}_{i,t}) = \frac{3}{4}$ otherwise. This suggests that, a bond with only one available rating, say BBB- from Moody's, will have a G value of 1-0.75 (=0.25) making this bond "closer" to a BB+ bond with 4 similar ratings (G value of 0). A numerical value of 0.25 is also obtained for bonds with 3 available ratings, say BBB-, BB+, BB+, or for bonds with 2 available ratings, say BB+, BBB-.[38] The term $(1 - \frac{1}{4}\sum_{r=1}^{4} \mathbb{1}\{R_r \neq \varnothing\})$ penalizes for the lack of available rating information. We take the middle rating when the bond presents the full information and disagreement among rating agencies.[39] Our findings are robust to a number of alternative approaches, e.g. excluding DBRS rating, increasing the weight on large rating disagreements or using a more conservative penalty rates [i.e. $\lambda(\{ R_r \}_{i,t}) = \frac{3}{4}$].

Figure 6 shows the distribution of the 1,310 corporate bonds by G score (under S&P scale). Above the red dashed-line (i.e. "BBB- ECB" or C_{ECB}), bonds are eligible to the CSPP. C_{ECB} stands for the cut-off used by the ECB to separate bonds from "Investment Grade" to "High Yield" (ECB, 2015). The red solid line illustrates the market cut-off, denoted C_{MKT}. Below C_{MKT}, bonds are considered as "High Yield" by investors. We highlight the bonds within the *rating wedge* in light blue ($\approx$ 60 bonds). These securities are eligible to the CSPP but viewed as "High Yield" from the perspective of market participants (Appendix B).

[Place Figure 6 about here]

If the transmission mechanism of the (corporate) QE, emphasized by policymakers (Bernanke, 2013, Coeure, 2017), is the "portfolio rebalancing" channel, we would expect that after the announcement of the CSPP:

- **HYPOTHESIS 1**: **Bonds *within* the *rating wedge* are more likely to experience**

[38] For a bond with the following 3 available ratings: BBB-, BBB-, BB+, using the average rating or the procedure in Eq.1 is equivalent (7 bonds are in this situation). The main idea of our measure G is to classify a bond in the "BBB- Market" bucket if we are "sure" that all investors are likely to rank this bond as "BBB-", in all other cases, we classify the bond in the lower bound of its rating (i.e. we assign a penalty rate).

[39] One bond has these features: Repsol (Spanish Bond). Excluding this bond does not alter the results.

favorable financial performances (i.e. lower yield spreads) compared to bonds located above C_{MKT}.

In other words, if portfolio rebalancing effects matter (Gagnon et al., 2011, Joyce et al., 2011), we would expect that investors will shift (or "rebalance") in priority their portfolios towards bonds within the *rating wedge* (i.e. more risky and CSPP-eligible). We might also expect that holders of CSPP-eligible bonds will be less likely to sell their securities in anticipation of ECB's future purchases. Put it differently, by temporarily increasing the bargaining power of sellers in the market for targeted securities, the corporate QE might provoke a change in the bid-ask spreads across bonds. In particular, we test the following hypothesis:

- **HYPOTHESIS 2**: **Liquidity (i.e. bid-ask spreads) is likely to worsen for bonds located above C_{ECB}.**

This hypothesis highlights the idea that, in addition to the portfolio rebalancing mechanism, it is also possible for the CSPP to affect yield spreads of "High Yield" assets through the liquidity channel (Christensen and Gillan, 2017).[40] If *HYPOTHESIS 1* and *HYPOTHESIS 2* are true, it is possible to observe a drop in yield spreads for bonds located below the lower bound of the *rating wedge*, C_{ECB}. The findings from these hypotheses will allow us to better assess the effects of the corporate QE and to understand the interaction between the portfolio rebalancing mechanism and the liquidity channel.

C. CSPP-eligibility at a firm level

A bond is in violation of the CSPP if the value of its underlying characteristic breaches the CSPP thresholds (Section II). In this study, that situation arises when, for example, the rating falls below the *"minimum first best credit assessment of at least credit quality step 3"*. While conceptually straightforward at a bond level, the application of the ECB's first best rating threshold, and consequently the CSPP violation at a firm level, is subtle. Indeed, firms (1) exhibit multiple ratings, and, (2) have multiple bonds (outstanding) which raises the issue of how many bonds must be eligible to qualify the firm as CSPP eligible. Therefore, the ability to extrapolate any inferences from bonds to companies is of potential concern. Appendix D presents some evidences about the rating discrepancies between bonds and firms.

[Place Appendix D about here]

We propose a methodology that aims to ensure a robust ranking of firms according to their likelihood of being CSPP-eligible. Specifically, we replicate the Eq.1 using firm ratings from the four rating agencies. Unsurprisingly, a simple comparison of the "firm G score" with the "bond G

[40] As the ECB is expected to reduce the stock of eligible bonds on the secondary market available for sale by holding the bonds to maturity.

score" reveals similar characteristics, suggesting that high quality firms issue more frequently high quality bonds and vice-versa. Figure 7 shows the positive strong correlation between the ratings of the firm and its bonds. Immediately, we see that the fitted line is close to the 45 degree line. Because of the similarity of the results, a firm will be considered as eligible to the CSPP if its "G score" is higher than C_{ECB}.

[Place Figure 7 about here]

Having a measure of CSPP-eligibility at a firm level, we would like to evaluate the impact of the corporate QE on the financing decisions of firms. Indeed, if the effect of the corporate QE on bond yield spreads (Hypothesis 1) has stimulated new issuance of corporate bonds, we would expect that:

- **HYPOTHESIS 3**: **Firms below C_{MKT} are more likely to increase their market-based funding.**

In other words, if the drop of bond yield spreads matters, we expect that the improvement of financing conditions following the CSPP will help firms to finance themselves through capital markets, especially those located below C_{MKT}.

D. Summary Statistics

Panel A of Table 1 presents summary statistics of the dataset used for the study of the corporate bond yield spreads, with a particular focus on bonds located between "Highly speculative" (i.e. B+, G=-3) and "Lower Medium Grade" (i.e. BBB+, G=3).[41] We divide the CSPP time bandwidth into two separate dates: March 9, 2016 (1 trading day before) and March 10, 2016 (i.e day of announcement). We rank bonds according to their "G score" (Eq.1). Bonds with a G strictly positive (i.e. above "ECB BBB-") are in the sample of CSPP eligible bonds (i.e. "Investment Grade" from the viewpoint of the ECB) while the others are in the non-eligible group. Bonds within "ECB BBB-" and "Market BBB-" (58 securities) are considered to be within the *rating wedge*. In other words, they are all eligible for the corporate QE but considered as "risky" (or "High Yield") for market participants. Importantly, these bonds have been assigned a "BBB-" by at least one of the 4 rating agencies considered in this study.[42]

[Place Table 1: Panel A about here]

[41] Corporate bond yield spreads in this paper are constructed with the closest maturity match against the euro-area risk-free rate proxied by the German Bund. We derive the spreads using linear interpolation methods.

[42] In reality, the "BBB-" has been assigned by "The Big Three" credit rating agencies which are Standard & Poor's (S&P), Moody's and Fitch Group. Indeed, we have only 13 bonds rated by DBRS out of a sample of 1,310 securities (See Internet Appendix).

This table shows that the bond yield spreads are closely related to the G score. Indeed, in an almost perfect monotonic fashion, higher G values (i.e. better rating score) are associated with lower yield spreads. More importantly, we observe an overall reduction of the yield spreads after the announcement for all eurozone corporate bonds ranging from 3 to 26 basis points. There is an interesting change around the "market BBB-" threshold: spreads decreased by around 5 basis points for $C_{Market} + \epsilon$ bonds (i.e. treatment group, "market investment grade") and by around 15 basis points for $C_{Market} - \epsilon$ bonds (i.e. control group, "market high yield")

Panel B of Table 1 presents descriptive statistics for our set of firm-level variables, split into eligible- and non-eligible-firms and into before- and after-CSPP announcement period. Eligible firms tend to be larger, have higher Tobin Q and lower leverage ratios. Our main dependent variable (Bond Issuance scaled by Total Assets) reveals that CSPP non-eligible companies have an average issuance (scaled by assets) of 1% before the announcement of the corporate QE. This value jumps to 1.4% after the first quarter of 2016. In relative terms, the increase is less important for the sample of firms located within the rating wedge or above the Market Cutoff. The main observation that emerges from the table is that corporate bond issuance behaviour differs significantly after the announcement of the CSPP and across the subsamples of firms.

[Place Table 1: Panel B about here]

Figure 12 shows the corporate bond issuance dynamics at an aggregate level by subsample of firms, on a monthly basis from January 2013 until May 2017. The top of Figure 12 shows the aggregate amount of corporate bond issued in value, while the bottom of Figure 12 represents the same dynamics by counting the number of deals. As in Panel B (of Table 1), we separate firms into three groups where G∈[-3,3]: Below ECB Cutoff, Within the rating wedge, Above the Market Cutoff. We replicate the same exercise in Figure 13 by focusing on a more restrictive interval where G∈[-2,2].

[Place Figures 12 and 13 about here.]

Figures 3-11 in the Internet Appendix depict the corporate bond sample per G Score where the different country, industry and maturity classifications are displayed.

[Place Figures 3-11 about here: Internet Appendix]

IV. Empirical Strategy

Our empirical strategy uses the credit rating vector of a bond and the pivotal roles of some rating agencies (with regard to bond's eligibility to the corporate QE) as the most important pieces of information to causally link the CSPP with a variety of outcome of interests (i.e. yield spreads,

liquidity, bond issuance). By focusing on the bond (firm) as a unit of observation we attempt to learn about the impact of the CSPP on the cost of borrowing and the availability of market-based funding.

In our framework, when a firm issues a bond, this debt instrument obtains (at best) a credit rating from the four external credit assessment institutions (or rating agencies). The central claim of our paper is that CSPP-eligible bonds (i.e. "Investment Grade" from the perspective of the ECB) located below, but close to, the "BBB- Market" cut-off are "similar" in terms of credit risk profile from the viewpoint of the market participants (i.e. perceived as "High Yield"). Through the portfolio rebalancing mechanism, we expect the corporate QE to affect (in priority) risk premium of bonds located within the *rating wedge*, that is, bonds that are "riskier" and eligible to the CSPP (Hypothesis 1).

The main problem with comparing bond (firm) outcomes by institutional investors portfolio rules (i.e. "High Yield" vs "Investment Grade") is that assignment of bond (firm) type is discrete (Card and Lee, 2008) and not random (Angrist and Pischke, 2014); for example, the bonds (firms) most likely to be "Investment Grade" from the viewpoint of investors may also be those where the cost of borrowing is less constrained for other reasons (i.e. country credit risk). Such unobserved factors could then lead to lower yield spreads, for instance, and therefore estimates from standard regression analysis may be biased.

In essence, our main identification strategy consists in comparing bonds around the *rating wedge*. More precisely, our RD design exploits a discontinuity in the treatment assignment to identify a causal effect of the corporate QE. Hahn, Todd, and Van der Klaauw (2001) note that, "the regression discontinuity data design is a quasi experimental data design with the defining characteristic that the probability of receiving treatment changes discontinuously as a function of one or more underlying variables". In the current context, bonds above C_{Market} are included in the treatment group (i.e. market "investment grade" portfolio).

All else being equal, what enables our research design to fit into the regression discontinuity paradigm is that the function mapping the underlying "G score" (Eq.1.) variable into the treatment effect is discontinuous. Specifically, our treatment variable, $MIG_{i,t}$ ("market investment grade"), is defined as:

$$MIG_{i,t} = \begin{cases} 1 & \text{if } G_{i,t} \geqslant C_{Market} \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

where i and t index bond (firm), and time observations, $G_{i,t}$ is the observed rating score, and C_{Market} is the "market investment grade" cut-off. The bonds (firms) that fall below the "market investment grade cut-off" ($MIG_{i,t} = 0$), the control group, are perceived as "High Yield" by investors. However, those above the cut-off, the treatment group ($MIG_{i,t} = 1$) are classified as "Investment Grade" by market participants (Appendix B). The assignment follows a known deterministic rule, $MIG_{i,t} = \mathbb{1}\{G_{i,t} \geqslant C_{Market}\}$, where $\mathbb{1}\{.\}$ is the indicator variable. The forcing

variable in this design, $G_{i,t}$, is the observed rating score, and the cut-off C_{Market} is therefore "BBB-Market" (Figure 6).

We measure the extent of the jump in our outcomes of interest by using techniques which are commonly used in the literature on regression discontinuity (DiNardo and Lee, 2004, Card et al., 2007). Specifically, we consider the following specification for estimating the RD treatment effect:

$$\begin{aligned} Y_{i,t} &= \alpha + \beta MIG_{i,t} + \theta f(G_{i,t}) + \delta MIG_{i,t} * f(G_{i,t}) + \epsilon_{i,t} \\ &\forall G_{i,t} \in \mathcal{G} \end{aligned} \tag{3}$$

where $Y_{i,t}$ is the outcome in question, $MIG_{i,t}$ is the treatment, $G_{i,t}$ is the forcing variable, $\mathcal{G} = [C_{Market} - g, C_{Market} + g]$ is a neighborhood around C_{Market} and g is referred as the bandwidth. $f(X)$ and $MIG * f(X)$ are flexible *n-order* polynomials, with the goal of these functions being to smooth curves on either side of the "BBB- Market" cut-off as closely as the data presented in the figures as possible.[43] The magnitude of the discontinuity, β, is estimated by the difference in these two smoothed functions evaluated at the cut-off (Card and Lee, 2008). We perform these regressions using ratings between CCC+ and AAA which corresponds to the range of nearly all rating scores observed in the data. In this framework, the coefficient on the indicator $MIG_{i,t}$, yields a consistent estimate of the discontinuity at the C_{Market} threshold. This coefficient should be interpreted locally in the immediate vicinity of the market credit score threshold.[44]

Our main source of motivation for our empirical specification is that the nonlinear relation in equation (2) provides for identification of the treatment effect under very mild conditions. Indeed, in order for the treatment effect (β) to not be identified, it must be the case that the unobserved component ($\epsilon_{i,t}$) exhibits an identical discontinuity as that defined in equation (2). Even if $\epsilon_{i,t}$ is correlated with $G_{i,t}$, our estimate of (β) is unbiased as long as $\epsilon_{i,t}$ does not exhibit precisely the same discontinuity as $MIG_{i,t}$ does. Our key identification assumption is that as we approach the cut-off from either side, any unobserved differences in the features of the bonds (firms) should disappear in the limit.[45] Thus any comparison around the discontinuity will be a consistent estimate of the impact of CSPP.

Because the discontinuity is the source of identifying information, we also estimate equation (3) on the subsample of bonds (firms)- day (quarter) observations that are close to the point of discontinuity (Angrist and Lavy, 1999).[46] To remove some of the subjectivity associated with the

[43] We have estimated these functions up to the 7th order polynomial, as well as relaxing parametric assumptions. The main estimates throughout are not sensitive to the specification of these functions.

[44] It is also important to keep in mind that around the market cut-off, at least a "BBB-" has been assigned by "The Big Three" credit rating agencies which are Standard & Poor's (S&P), Moody's and Fitch Group. Indeed, we have only 13 bonds rated by DBRS out of a sample of 1,310 securities.

[45] Formally, $\lim_{X_{i,t} \to C^-_{Market}} E(\epsilon_{i,t} | MIG_{i,t} = 0, controls) = \lim_{X_{i,t} \to C^+_{Market}} E(\epsilon_{i,t} | MIG_{i,t} = 1, controls)$, where "*controls*" are any other observable bond (firm) characteristics.

[46] Angrist and Lavy (1999) use a "discontinuity sample" to compare means on each side by only using observations arbitrarily close to the cut-off (i.e. setting g low and excluding $f(X)$ altogether). This method although simple and straightforward, can be demanding if the number of observations is limited, and could

definition of "close" we turn to the literature on non-parametric density estimation (Silverman (1986) to identify an optimal window width, $\hat{g}$.[47] We begin with a robust measure of the optimal window width assuming that the reference distribution is unimodal, a reasonable assumption for G (Figure 6). Specifically, the window width is defined as $0,79Rn^{-1/5}$, where R is the interquartile range and n is the number of observations. This measure corresponds to an optimal tradeoff between bias and variance and, as discussed in Silverman (1986), is robust to skewness and kurtosis in the underlying distribution. Most importantly, this definition is independent of corporate behavior (Chava and Roberts, 2008). For consistency issues (Imbens and Lemieux, 2008), we present our results for multiple bandwidths g.

We then present a whole range of robustness checks. First, we add observable controls to the regressions as a concern that $C_{Market} - \epsilon$ bonds (firms) might not be a suitable counterfactual group (the Internet Appendix provides the country, industry and maturity distribution by G). Second, we pursue the analysis focusing only on bonds (firms) around *the rating wedge*, to make the bonds (firms) more comparable in terms of their credit risk. Third, we allow the penalty rate to be a more conservative in order to construct an alternative ranking of bonds (firms). Fourth, we undertake placebo tests. We conduct our entire analysis on various monetary announcements (APP, TLTRO I, policy rate cuts and day before CSPP announcement), and find that the result (i.e. the discontinuity) turns only significant on March 10, 2016. We also show that we do not see our results for other rating cut-offs. Finally, we repeat our RD falsification exercises with different estimation bandwidths and different time windows. Our conclusions are unchanged.

V. Main Empirical Results

A. *Cost of borrowing Around C_{MKT}*

As mentioned earlier, the specific *rating wedge* between the ECB and market participants in the corporate bond market might impact the financial performances (i.e. yield spreads) of bonds located below, but close to, the credit score cut-off of C_{MKT} (Hypothesis 1). We therefore expect to see a substantial decrease in the yield spreads of bonds positioned just below this market credit threshold as compared to bonds standing just above this threshold. In order to examine this, we start by plotting the changes in yield spreads at each G score, with a particular focus around the *rating wedge*. In order to capture the effects of the corporate QE, we restrict the time bandwidth at 1-trading day starting with March 9, 2016 and ending in March 10, 2016. Figure 8 shows a marked decrease in yield spreads, especially noticeable for bonds located around the credit score of

also result in noisy estimates.

[47] We note that the optimal window width, in and of itself, has little to do with our regression discontinuity design. Rather, our motivation for using nonparametric analysis to define what we mean by "close" is simply to impose some structure on the definition that is removed from firm behavior and limits, to some extent, the subjectivity associated with this definition.

C_{MKT} – that is, at $C_{MKT} - \epsilon$ relative to bonds at $C_{MKT} + \epsilon$. We do not find any such jump for other cut-offs. Strikingly, the impact of the CSPP also extends to the sample of CSPP non-eligible bonds.[48]

From Figure 8, it is clear that yield spreads dropped by around 15bps for bonds located below C_{MKT} – i.e., the decrease in the cost of borrowing at $C_{MKT} - \epsilon$ are 3 times higher (in absolute value) as compared to bonds at $C_{MKT} + \epsilon$ (around 5bps drop). Clearly, this is consistent with the Hypothesis 1: the portfolio rebalancing incentives are substantially higher at $C_{MKT} - \epsilon$ as these bonds are slightly "riskier" but still eligible to the corporate QE. To provide a theoretical justification for our findings, the remarkable model introduced in Vayanos and Vila (2009) is a adequate reference. This model suggests that, when assets with otherwise near-identical risk and return characteristics are considered imperfect substitutes by some market participants (i.e., around C_{MKT}) and markets are segmented (i.e. "Investment Grade" versus "High Yield"), a change in the relative market supply of an asset may affect its relative price. Gagnon et al. (2011) and Joyce et al. (2017) are also among the studies that emphasize the portfolio rebalancing channel.

[Place Figure 8 about here]

To estimate the jump in the bond yield spreads, we employ the methods described above in Section IV using the specification provided in equation (3). As reported in Table 2, we find that bonds located below, but close to, C_{MKT} observed an important decrease in yield spreads after the announcement of the corporate QE – on March 10, 2016. In particular, the coefficient estimate (β) is significant at the 1% level and oscillates from 5bps to 15bps. This jump was plainly visible from the graph in Figure 8. Table 2 answers the question: Comparing two bonds of the same characteristics (i.e. maturity, country, industry) that are facing the same economic conditions, does the bond that happens to be CSPP-eligible and "riskier" (i.e. High Yield from the viewpoint of investors) observe a significant drop in its yield spreads after the announcement of the corporate QE? The answer is unambiguous and highly significant: $C_{MKT} - \epsilon$ bonds observe a larger drop in yield spreads of around 0.1% (that is 10 basis points) after the announcement compared to $C_{MKT} + \epsilon$ bonds. Columns (1)-(2) are OLS specifications using the entire sample with and without any controls.[49] Specifications in columns (3)-(4), are RD specifications with and without controls. Both these specifications include a linear control for the G (Eq.1) on each side of the discontinuity. The discontinuity is determined by the "BBB- Market" cut-off, defined in Equation 2. In both columns, the sample is restricted to a bandwidth of $\hat{g}$, determined by the Silverman (1986) algorithm. Columns (5)-(7) are alternative RD specifications using the control function and bandwidth pairs: linear and $2\hat{g}$, quadratic and $\hat{g}$, as well as cubic and $\hat{g}$. The results are basically

[48] This important result was established in our previous version: "Who Benefits from the ECB's Corporate Sector Purchase Programme? A Difference-in-Discontinuities Approach" (February, 2017).

[49] Covariates include the change in bid-ask spreads (lagged it by 1 trading day), the remaining maturity and the change in market bond returns. Adding dummies for bond types, country and industry fixed effects do not change the results.

robust to all these specifications.

[Place Table 2 about here]

As an additional check, we conducted permutation tests (or "randomization" tests), where we varied the location of the discontinuity (C_{MKT}) across the range of all possible G scores and re-estimated equation (3). Although there are other gaps in other locations, the estimates at C_{MKT} are strong outliers relative to the estimated jumps at other locations in the distribution. Table 3 estimates the change in corporate bond yield spreads around the ECB's threshold. We compare "ECB High Yield" (i.e. below "ECB BBB-") and "ECB Investment Grade" (i.e. above "ECB BBB-") bonds using the same type of analyses, and find no significant difference in our most demanding specification. The fact that the drop in corporate bond yield spreads is mainly noticeable at the market threshold rather than ECB cut-off is consistent with most observations related to the stricter rating frameworks employed by investors (Appendix B). Furthermore, while the coefficient estimate (β) is not statistically significant when we add the linear and the quadratic specification, the coefficient estimate (α) shows that the bonds below the frontier of eligibility benefited (in terms of lower yield spreads) from the CSPP.

[Place Table 3: Placebo at C_{ECB} about here]

B. The Liquidity Channel

As mentionned by Khandani and Lo (2011), one commonly cited measure of liquidity is the magnitude of the bid/offer spread, measured as a percentage of the average of bid and offer prices (see, for example, Amihud and Mendelson, 1986). However, this measure can only be applied to those securities for which we observe regular bids and offers, i.e., those that trade on organized exchanges and with designated marketmakers. Despite the many issues of this liquidity proxy, we limit our attention to the bid-ask spread because other possible liquidity measurements such as trading volume – either euro volume or percentage turnover (see, for example, Brennan, Chordia and Subrahmanyam, 1998, and Lo and Wang, 2000) – are rarely available and virtually impossible to hand-collect. Therefore, the results on liquidity have to be taken with caution.

In the context of the CSPP, we formally test the liquidity channel using an approach equivalent to equation (3), replacing the dependent variable $Y_{i,t}$ in the regression framework by the bid-ask spreads and present the results in Table 4. Columns (1) to (7) show that the effects on liquidity, over the short term, are ambiguous: depending on the specifications, results do change substantially. We find only limited evidence for the deterioration in market liquidity (Hypothesis 2), at least at the announcement of the CSPP.

[Place Table 4 about here]

Figure 9 replicates Figure 8 but using as a dependent variable the change in bid-ask spreads. This figure confirms the results of Table 4 where findings on liquidity are ambivalent. We cannot conclude about a change in liquidity following the announcement of the corporate QE.

[Place Figure 9 about here]

Subsequently, we are interested in the dynamics of realized bid-ask spreads across sub-samples of bonds. Figure 10 conducts placebo tests separately for each week (omitting the baseline week). If the deterioration of liquidity is not immediate, we might expect to see a statistically significant effect on the interaction terms for the weeks following the announcement of the corporate QE, and none before (see Eq.8.). The placebo tests are in line with Hypothesis 2, showing significant results for most specifications only in the post-announcement weeks. The fall in liquidity is strongest three weeks after the announcement and does not fade out until the end of the time window. The strongest and most persistent negative effect on liquidity is visible within the sample of CSPP-eligible bonds. In other words, the deterioration of liquidity was not immediate (i.e. no visible effects on March 10, 2016) but the dynamics (Eq.8) reveal a substantial and progressive change after the announcement of the corporate QE (results are also observable in Table 7).

[Place Figure 10 about here]

Figure 11 shows the impact of the effective corporate bonds purchases by the ECB. Unsurprisingly, we see that the effects on liquidity are the reverse of the ones observed in Figure 10. When the programme was in operation (June 8, 2016), securities targeted by the CSPP (i.e. eligible or "investment grade" for the ECB) were positively affected by the liquidity channel as witnessed by the reduction of bid-ask spreads.

[Place Figure 11 about here]

C. Bond Issuance

The following tables analyze firms' corporate bond issuance decisions.[50]

In Table 5 we start by comparing the bond issuance behavior of firms that are seen as "Investment Grade" by investors (treatment group) to the one of those recognized as "High Yield"

[50] Our main regression takes the following specification:

$$\begin{aligned}\Delta B_{i,[t]_k}/TA_{i,[t]_k} = \delta_0 + \delta_1 Post_{2016Q1} + \delta_2 CSPPEligible_{i,[t]} * Post_{2016Q1} \\ + \Gamma X_{i,[t]_k} + \nu_i + \xi_{[t]_k} * Country + \epsilon_{i,[t]_k}\end{aligned} \tag{4}$$

where $\Delta B_{i,t_k} = B_{i,[t]_k} - B_{i,[t-1]_k}$ and defines the seasonally adjusted change in bond issuance of firm i in quarter t_k ($k = 1, \ldots, 4$) and $TA_{i,[t]_k}$ is the total asset. As McLean et al (2014), we control for Tobin'q, leverage and other observable characteristics. We also allow for firm and quarter*country fixed effects. In all regressions, standard errors are two-way clustered at the firm and quarter*country level, to allow for a correlation of the error within firms across years, and across firms in the same country in a given year.

(control group). The dependent variable is the seasonally adjusted change in bond issuance of firm i (scaled by its total assets), and the main regressor is an interaction term between a Market eligible dummy (=1 if $G_{i,t} > C_{MARKET}$) and a time dummy for the announcement of the programme (which is turned on in Q2-2016 and after). Columns (1) and (2) provide the simplest OLS specification. Column (2) controls for firm-specific characteristics using the Tobin'q, Leverage and demand conditions (i.e. sales's growth). Also, firm level fixed effects allow us to control for any other time invariant unobserved firm heterogeneity. In other words, the table answers the question: Comparing two firms of the same size that are facing the same demand conditions, does the firm that happens to be perceived as high yield by market participants tend to issue more corporate bonds after March 2016? The answer is unambiguous and highly significant: high yield firms issue more corporate bonds by around 0.81% after the announcement of the CSPP compared to investment grade firms. In column (4) we add quarter fixed effects to capture any common, time varying aspects of the period that are not yet captured by time varying controls, and the effect is the same. Column (5) is our most demanding specification, which allows for firm and country*quarter fixed effects, and the result is stronger, with high yield firms increasing their issuances by around 0.84

[Place Table 5 about here]

Table 6 replicates Table 5 by adding however another interaction term for firms located within the rating wedge. By taking the firms that are perceived as high yield by market participants as the reference group, this table proposes to explore the possible differences in terms of corporate bond issuance behavior with respect to the firms that are (i) within the rating wedge and, (ii) above the investment grade market threshold. The answer is unequivocal: After the first quarter of 2016 and compared to the control group, "high yield" firms increased their market based funding by around 0.9%. This suggests that most of the effects (if any, because the sample size is still limited) are coming for the group of firms that have observed the larger bond yield spreads decline. The negative relationship between bond yields and issuances has also been documented by Boneva and Linton (2017).

[Place Table 6 about here]

VI. Robustness Checks

We conduct a number of robustness checks using alternative specifications to confirm our results. Other findings are reported in the Internet Appendix. In this section, we will present mainly the placebo tests.

A. *Corporate Bond Yield Spreads: Placebo Tests*

We conduct a number of robustness checks using alternative announcement dates (i.e. placebo tests). These are reported in Tables 7 and 8 where the date corresponds to the announcement of the Asset Purchase Programme (APP, January 22, 2015). Each regression follows our baseline setup by including a full set of control variables, optimal bandwidths and control functions. We do not expect a statistically significant effect on the market cut-off dummy. The placebo tests are in line with our analysis so far, showing weak results for most specifications. In particular, results are unstable with respect to control functions. Most of the results are very different to the baseline specification (Tables 2 and 3), suggesting that the CSPP is indeed driving the decline in bond yield spreads.

[Place Table 7 and 8 about here]

Figure 14 presents an even stronger check: It conducts placebo tests separately for various announcement dates (TLTRO I, CSPP Purchase, one day before the CSPP announcement and PSPP announcement). We expect a non-statistically significant effect across these placebo dates. The findings are in line with our analysis, we show that significant results for the decline in bond yields are only visible for the announcement of the CSPP, namely March 10, 2016.

[Place Figure 14 about here]

B. *Corporate Bond Bid-Ask Spreads: Placebo Tests*

Table 9 conducts separately two placebo tests at a weekly level: (1) around the announcement of the CSPP and, (2) around the effective corporate bonds purchases by the ECB.[51] We expect a statistically significant effect on the interaction terms only for the weeks following the respective announcements and none before. The placebo tests are in line with our analysis, showing significant results for most variables only in the post event weeks. The fall in liquidity (measured by the bid-ask spreads) is considerably stronger three weeks after the announcement of the CSPP, and does not fade out until the end of the time window. As the ECB increases the expected demand of investment grade assets on the secondary market, the bargaining power of current CSPP-eligible asset holders seems to have been enlarged. Column (2) replicates the placebo by changing the time window around the ECB's effective purchases. The strongest and most persistent positive effect on liquidity is visible three weeks after June 8, 2016. The interaction terms are negative and significant after the third week. This effect comes about because the operation of a QE program is tantamount to introducing into financial markets a large committed buyer – the ECB.

[Place Table 9 about here]

[51] Each regressions omit the baseline week (first week).

VII. Conclusion

The goal of this paper is to empirically investigate the effects of the corporate QE on imparting monetary stimulus and easing the financing conditions of eurozone non-financial firms. We exploit the differences between institutional investors risk approach and the specific "rule of thumb" used to determine the eligibility of corporate bonds to be purchased under the CSPP (i.e. first best rating rule) to test the portfolio rebalancing mechanism as well as the liquidity channel. Our paper has three main conclusions.

First, we empirically demonstrate the decline in the cost of borrowing after the announcement of the CSPP. Interestingly, we show that the effects are more pronounced for the bonds that are located within the *rating wedge* and extend beyond the ECB's eligibility criteria (i.e. towards riskier assets). This finding sheds some light on the portfolio rebalancing mechanism (Gagnon et al., 2011, Joyce et al., 2011). Second, we show that liquidity effects are ambiguous at the announcement of the corporate QE (i.e. March 10, 2016). Nevertheless, the dynamics of bid-ask spreads (despite its measurement limits) reveal that eligible corporate bonds seem to have suffered from a deterioration of liquidity until the ECB's effective purchase date (i.e. June 8, 2016). As the ECB is expected to reduce the stock of "investment grade" bonds on the secondary market, the corporate QE seems to have altered the bargaining power of sellers towards buyers in the market for CSPP-eligible securities. A careful examination highlights however that bid-ask spreads were compressed in the segment of "high-yield" corporate bonds. Finally, our findings point a new way forward in learning about the impact of central banks' asset purchase programmes on corporate financing decisions. Indeed, we show that firms that have observed the larger drop in their cost of borrowing increased substantially their market-based funding.

All in all, the credit relaxing post-CSPP does not appear to be placing non-eligible eurozone firms at a severe disadvantage relative to their eligible competitors. On the contrary, the CSPP led to an interesting drop in the cost of borrowing that is likely to persist quite far into the future, given the low interest rate environment. Future research must quantify the impact of the CSPP on funds' holdings, corporate investment, employment as well as bank loan substitutability.

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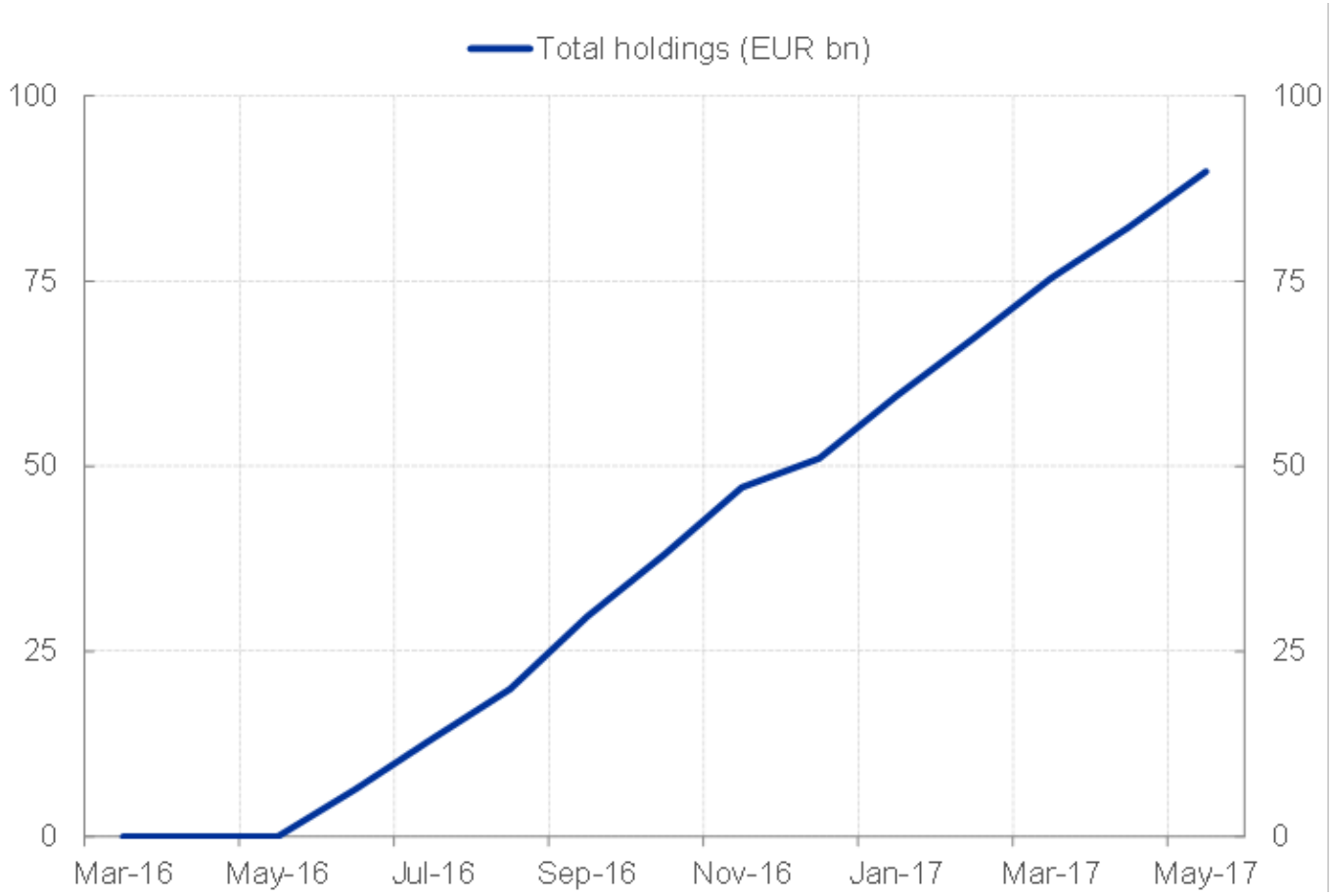

Figure 2. Eurosystem Cumulative holdings under the CSPP (in euro billion).

The figure presents the Eurosystem corporate sector purchase programme (CSPP) cumulative holdings. The Eurosystem started to buy corporate bonds under the CSPP on 8 June 2016. The total holdings include primary and secondary market purchases. Data are monthly and are taken from ECB.
Source: `https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html`

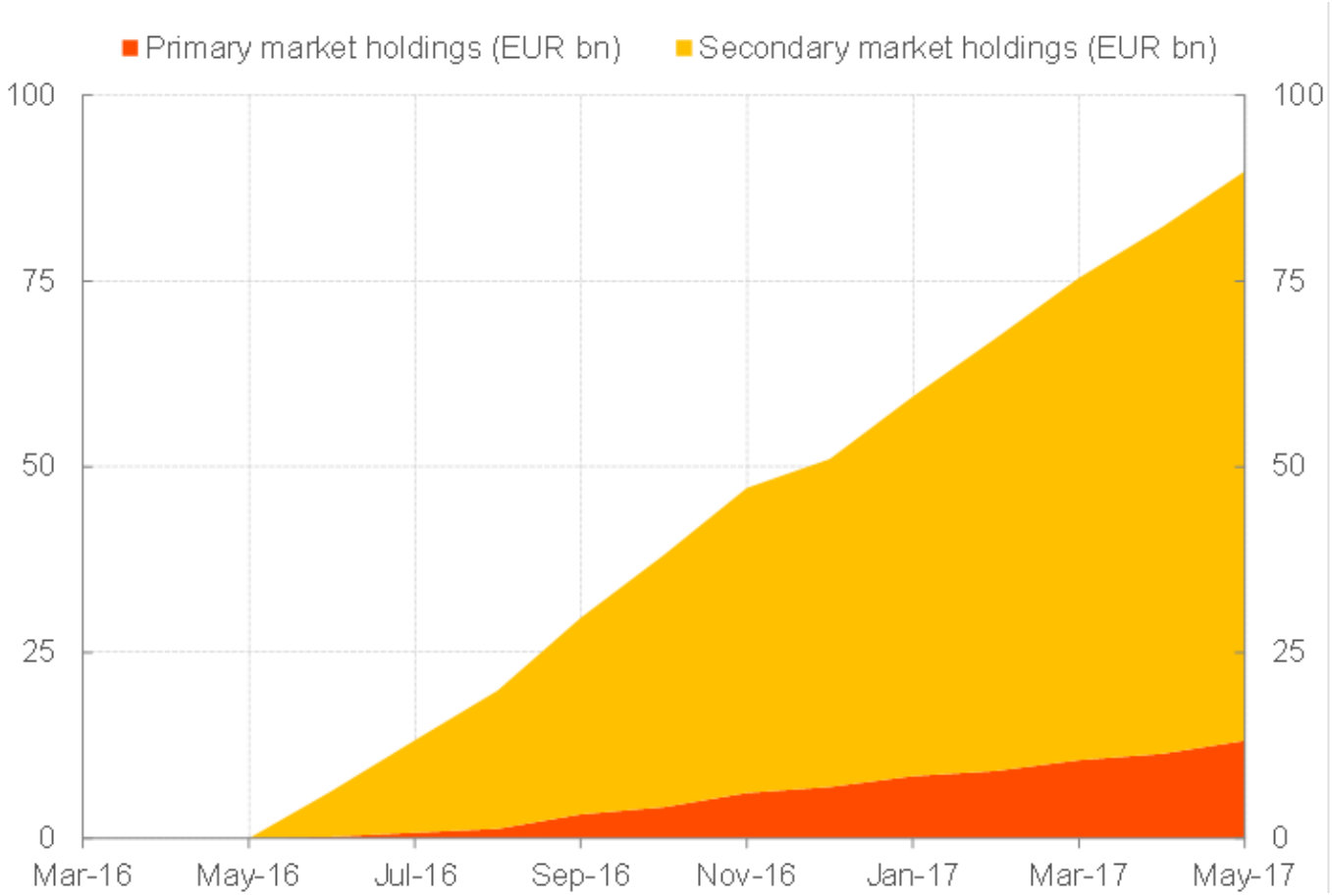

Figure 3. CSPP: Primary and Secondary markets cumulative holdings (in euro billion).

The figure presents the Eurosystem corporate sector purchase programme (CSPP) cumulative holdings in the primary and secondary markets. The Eurosystem started to buy corporate bonds under the CSPP on 8 June 2016. Data are monthly and are taken from ECB.
Source: `https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html`

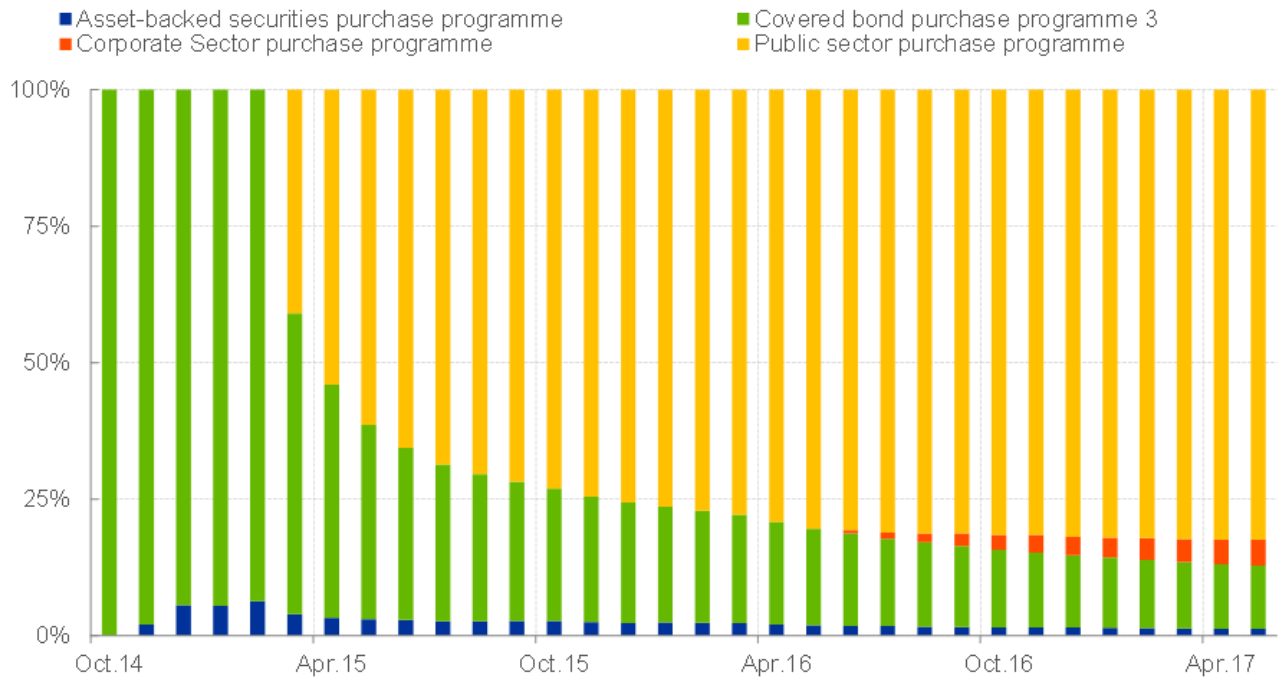

Figure 4. Asset purchase programmes: A Breakdown.

The figure presents the Eurosystem's cumulative holdings by asset purchase programmes (APP). The expanded asset purchase programme (APP) includes all purchase programmes under which private sector securities and public sector securities are purchased to address the risks of a too prolonged period of low inflation. It consists of the: (I) third covered bond purchase programme (CBPP3), (II) asset-backed securities purchase programme (ABSPP), (III) public sector purchase programme (PSPP) and (IV) corporate sector purchase programme (CSPP). Data are monthly and are taken from ECB.
Source: `https://www.ecb.europa.eu/mopo/implement/omt/html/index.en.html`

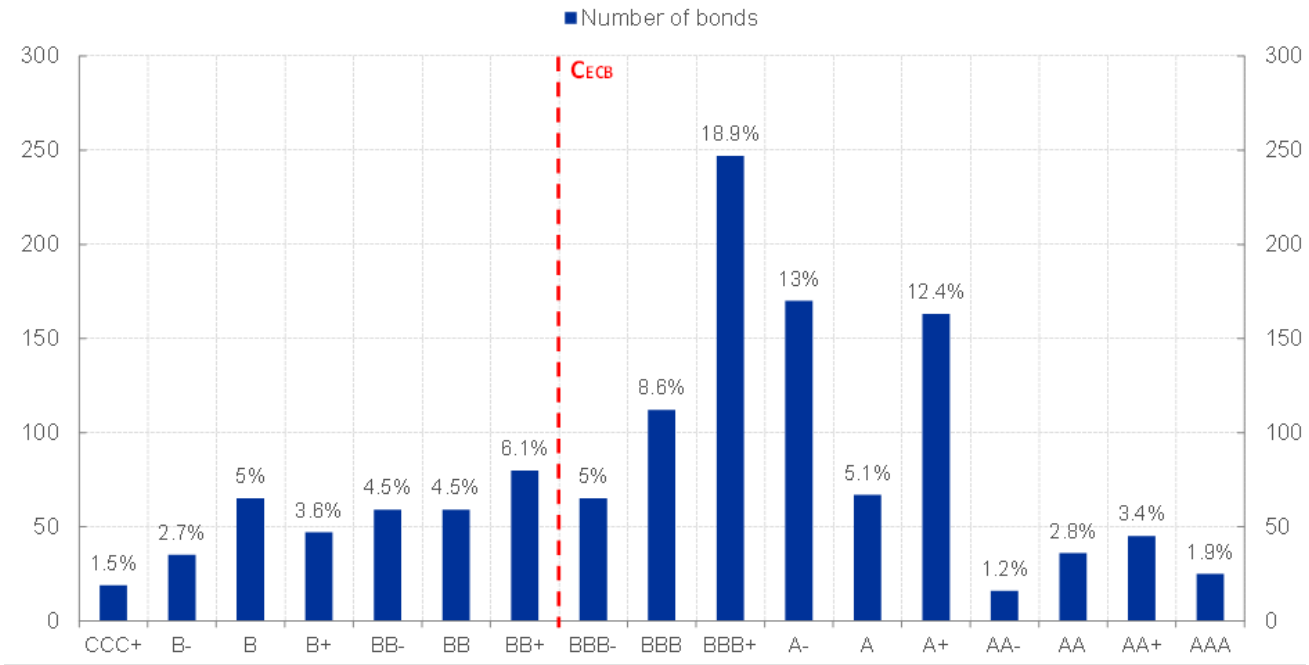

Figure 5. Histogram of Corporate Bond by First Best Ratings.

This figure shows the distribution of corporate bonds (number/percentage) by first best ratings (under S&P scale). For the corporate sector purchase programme (CSPP), the first-best rating of the bond must have a minimum first-best credit assessment of credit quality step 3 (currently equivalent to a rating of BBB-/Baa3/BBBL). In other words, above the cut-off (vertical dashed-line) bonds are eligible for the CSPP (i.e. perceived as "Investment Grade" from the viewpoint of the ECB, (ECB, 2017)).
Source: Bloomberg, Authors' computation.

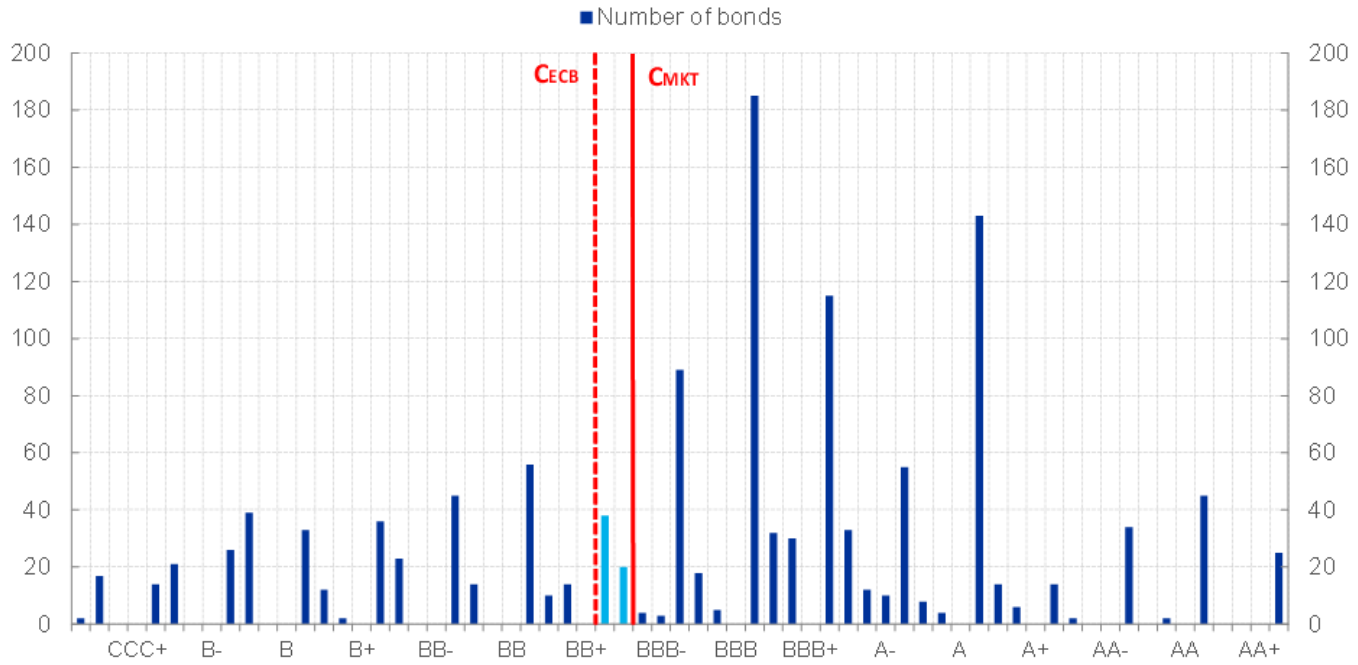

Figure 6. Histogram of Corporate Bond by G (Eq.1).

This figure shows the distribution of corporate bonds (in number) by G (under S&P scale). Corporate ratings are converted using Equation (1). Above the vertical dashed-line bonds are classified as investment grade by market participants. Below the vertical dashed-line bonds are not eligible for the corporate sector purchase programme (CSPP). We highlight the bonds within the *rating wedge* in light blue ($\approx$ 60 bonds). These securities are eligible to the CSPP but viewed as "High Yield" from the perspective of investors.
Source: Bloomberg, Authors' computation.

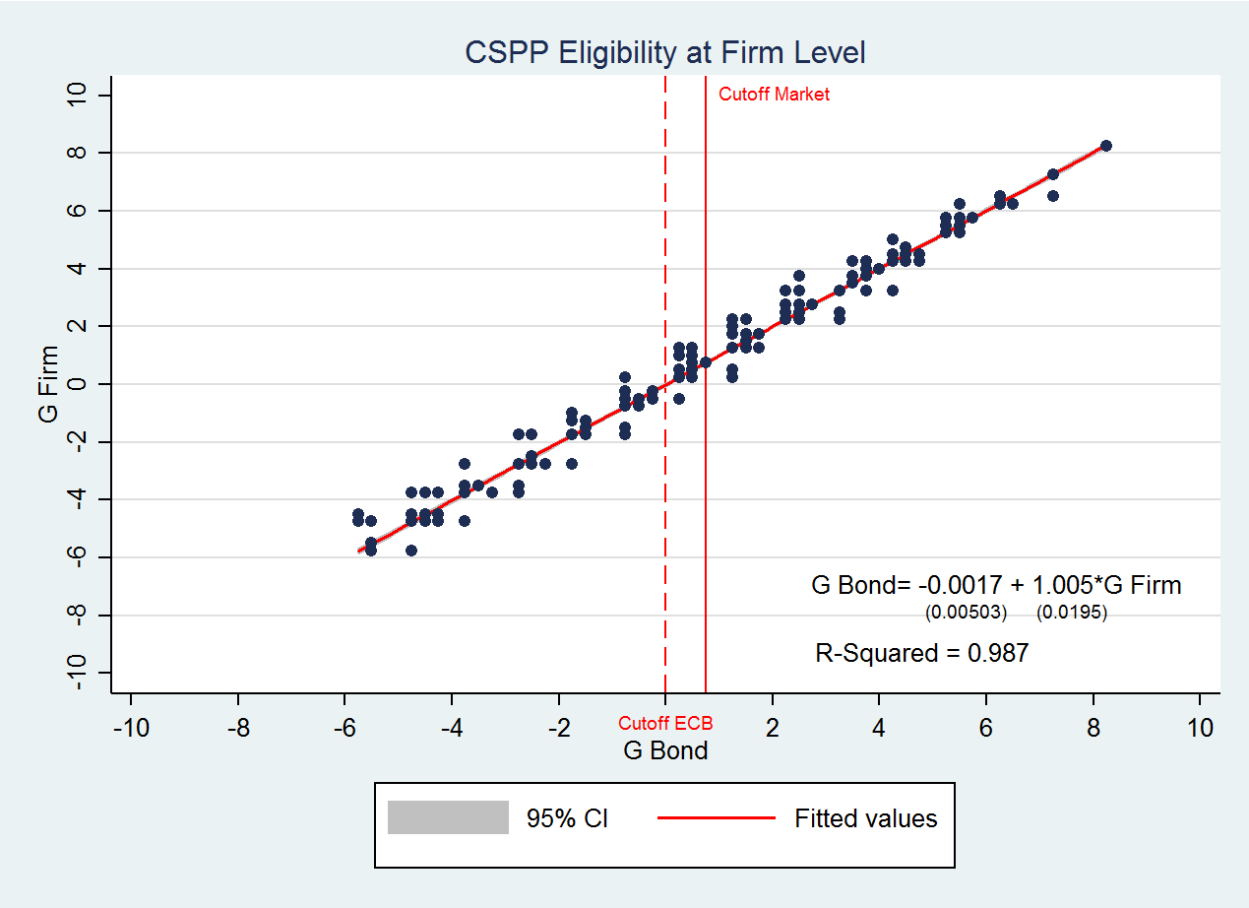

Figure 7. CSPP-eligibility at a firm level.

This figure depicts the "G Bond Score" and "G Firm Score" during the period 2014-2017. We immediately see the close relationship between bond and firm ratings. More specifically, we see that the OLS fitted line is close to 45 degree line. Because of the similarity of the results, a firm will be considered as eligible to the CSPP if its "G score" is higher than C_{ECB}.

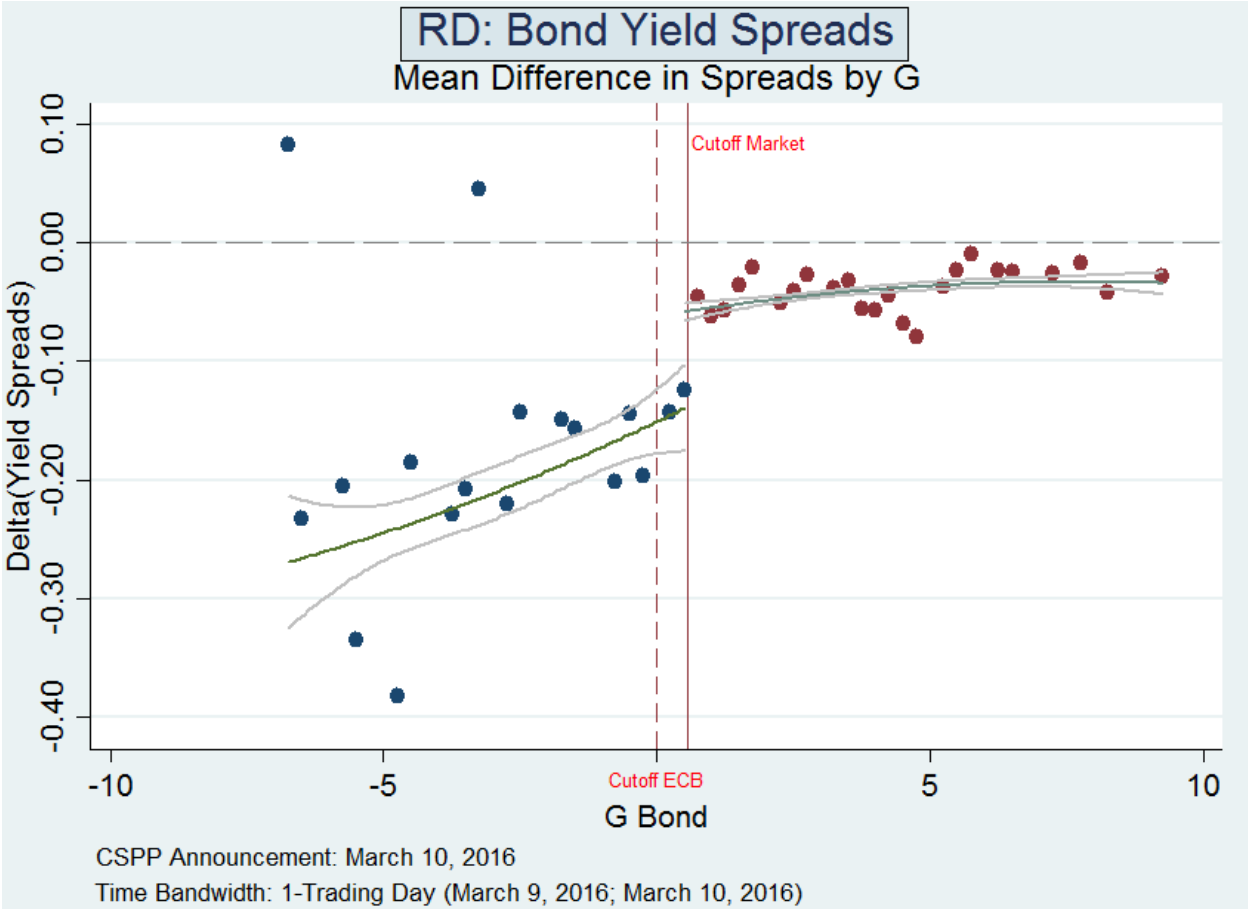

Figure 8. Changes in bond yield spreads: 1-trading day.

Graphical illustration of RD design: The figure shows the difference in unconditional bond yield spreads means by G. The solid lines represents the predicted values of a quadratic local smoother polynomial on each side of the threshold at C_{MKT}. The outer grey lines denote 95 percent confidence intervals. The reaction of bond yield spreads is computed using the following time bandwidths: March 9, 2016 - March 10, 2016. Above the vertical solid-line bonds are classified as investment grade by investors. Below the vertical dashed-line bonds are not eligible for the corporate sector purchase programme (CSPP).

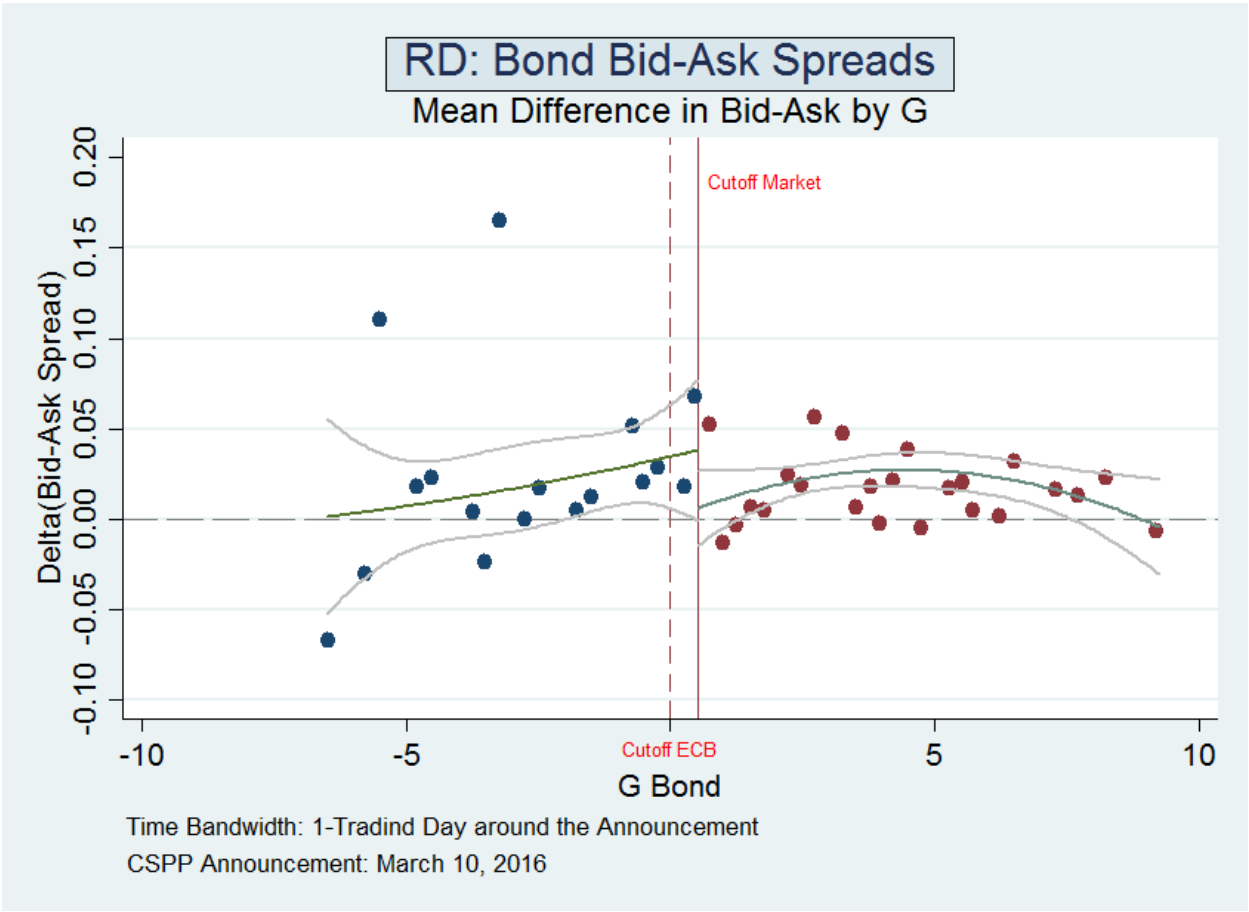

Figure 9. Changes in bond bid-ask spreads: 1-trading day.

Graphical illustration of RD design: The figure shows the difference in unconditional bond bid-ask spread means by G. The solid lines represents the predicted values of a quadratic local smoother polynomial on each side of the threshold at C_{MKT}. The outer grey lines denote 95 percent confidence intervals. The reaction of bid-ask spreads is computed using the following time bandwidths: March 9, 2016 - March 10, 2016. Above the vertical solid-line bonds are classified as investment grade by investors. Below the vertical dashed-line bonds are not eligible for the corporate sector purchase programme (CSPP).

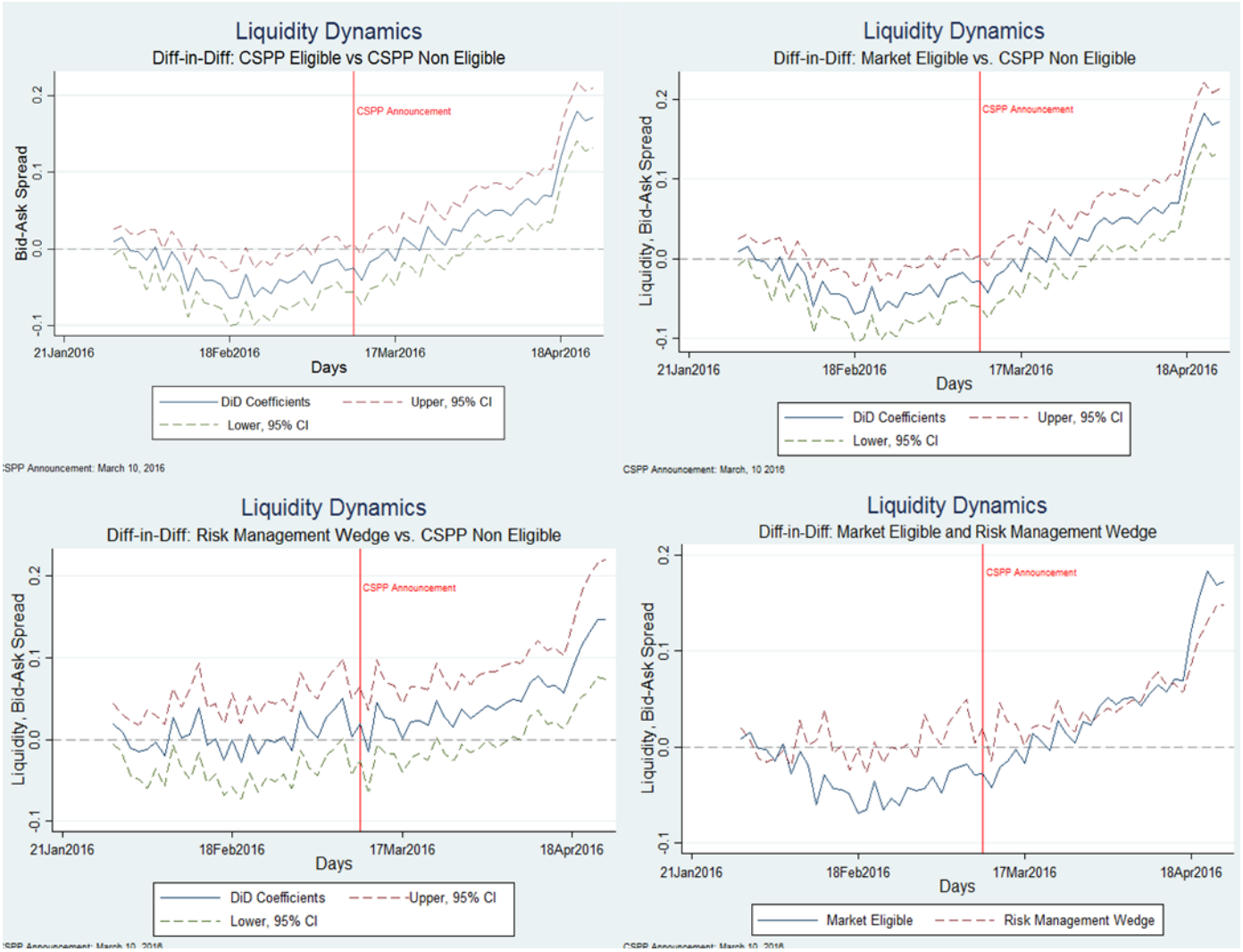

Figure 10. Liquidity Dynamics: At the Announcement (March 10, 2016).

This figure compares the liquidity of CSPP eligible and CSPP non eligible bonds in every days around the ECB's announcement of March 10, 2016.
The difference-in-differences coefficients are extracted from the following regression:

$$BidAsk_{i,t} = \sum_{t=(\text{March } 10)-30}^{t=(\text{March } 10)+30} \beta_t * (Day = t) + \sum_{t=(\text{March } 10)-30}^{t=(\text{March } 10)+30} \gamma_t * (Day = t) * (\text{CSPPEligible}) + \nu_i + u_{i,t} \quad (5)$$

The dependent variable is the bid-ask spread. The regressors are interaction terms of a CSPP eligibility dummy and a dummy variable that indicates the specified date. In other words, $(Day = t)$ is a dummy variable set equal to 1 if the observation falls during day t and CSPPEligible is a dummy variable that takes value 1 if the bond is eligible for the CSPP. We include bond fixed effects. All standard errors are clustered at bond level.

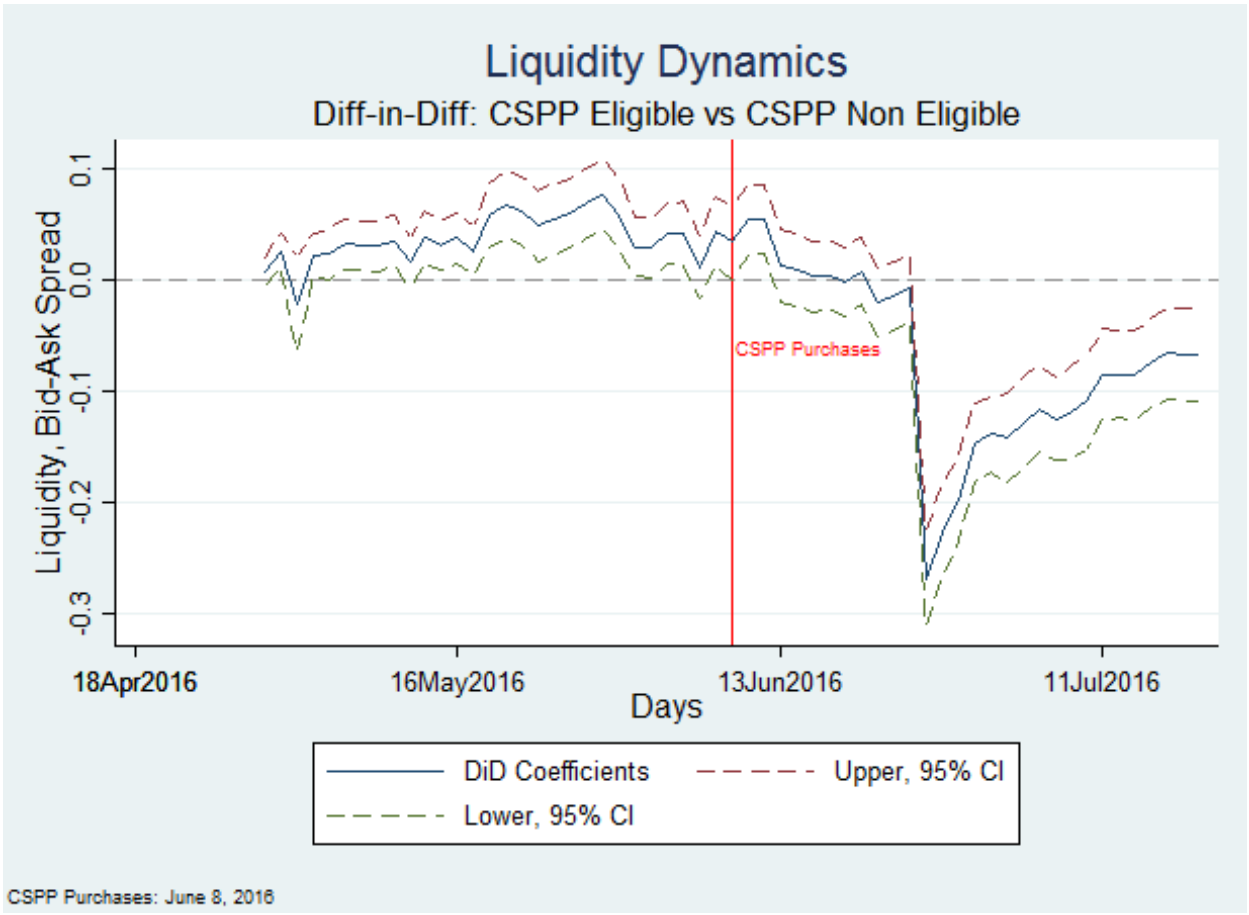

Figure 11. Liquidity Dynamics: Effective Purchases (June 8, 2016).

This figure compares the liquidity of CSPP eligible and CSPP non eligible bonds in every days around the ECB's effective purchases starting on June 8, 2016.
The difference-in-differences coefficients are extracted from the following regression:

$$BidAsk_{i,t} = \sum_{t=(\text{June } 8)-30}^{t=(\text{June } 8)+30} \beta_t * (Day = t) + \sum_{t=(\text{June } 8)-30}^{t=(\text{June } 8)+30} \gamma_t * (Day = t) * (\text{CSPPEligible}) + \nu_i + u_{i,t} \quad (6)$$

The dependent variable is the bid-ask spread. The regressors are interaction terms of a CSPP eligibility dummy and a dummy variable that indicates the specified date. In other words, $(Day = t)$ is a dummy variable set equal to 1 if the observation falls during day t and CSPPEligible is a dummy variable that takes value 1 if the bond is eligible for the CSPP. We include bond fixed effects. All standard errors are clustered at bond level.

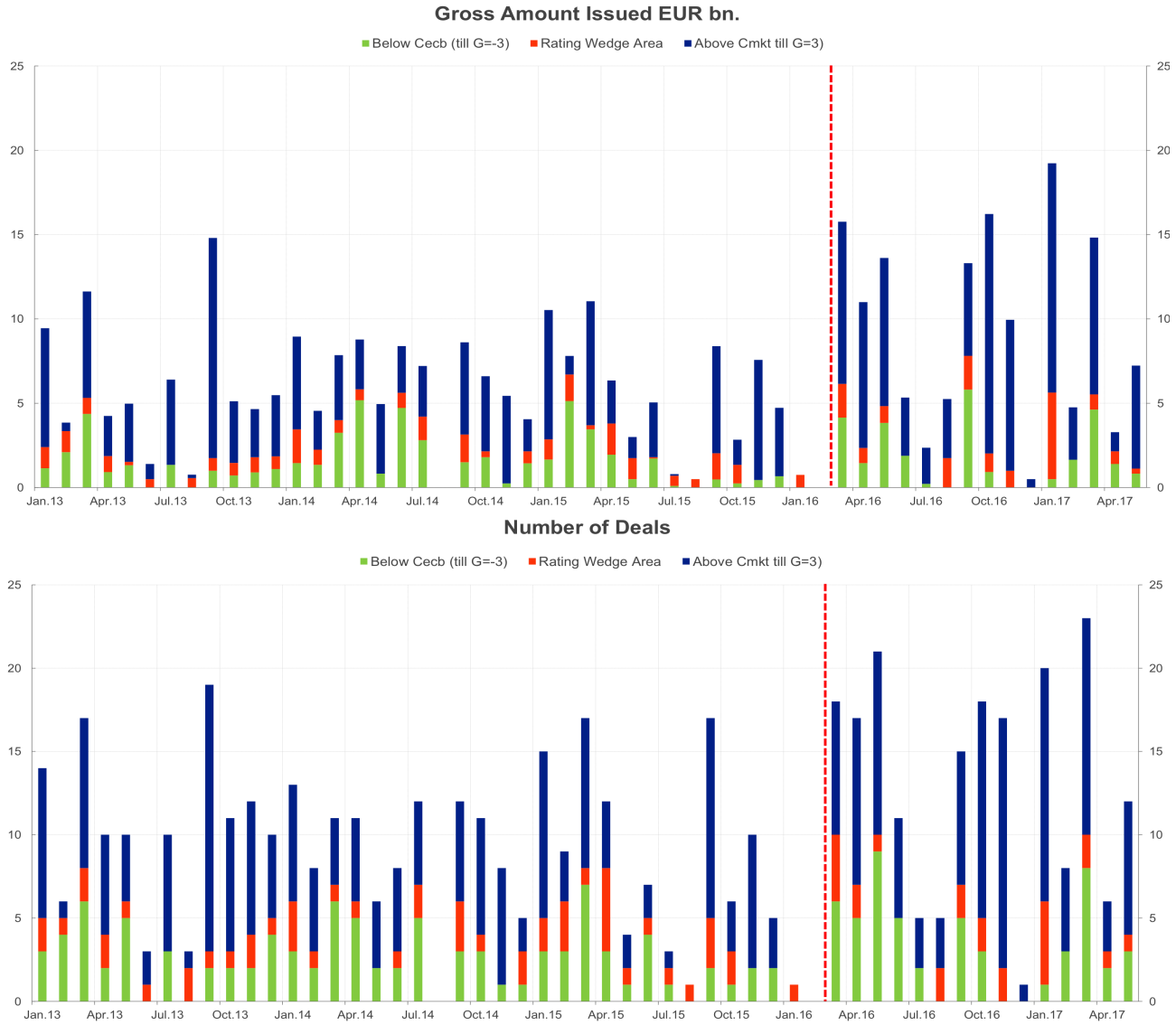

Figure 12. Corporate Bond Issuance, $G \in [-3, 3]$, in EUR bn and in number of deals.

The graphs depict the corporate bond (gross) issuance by companies belonging to the following three groups: below the ECB threshold "ECB BBB-" till G=-3, along the rating wedge and above the market threshold "Market BBB-" till G=3. The graph on top shows the amount issued in EUR bn and the one below shows the number of deals. The dashed red vertical line shows the CSPP announcement date.

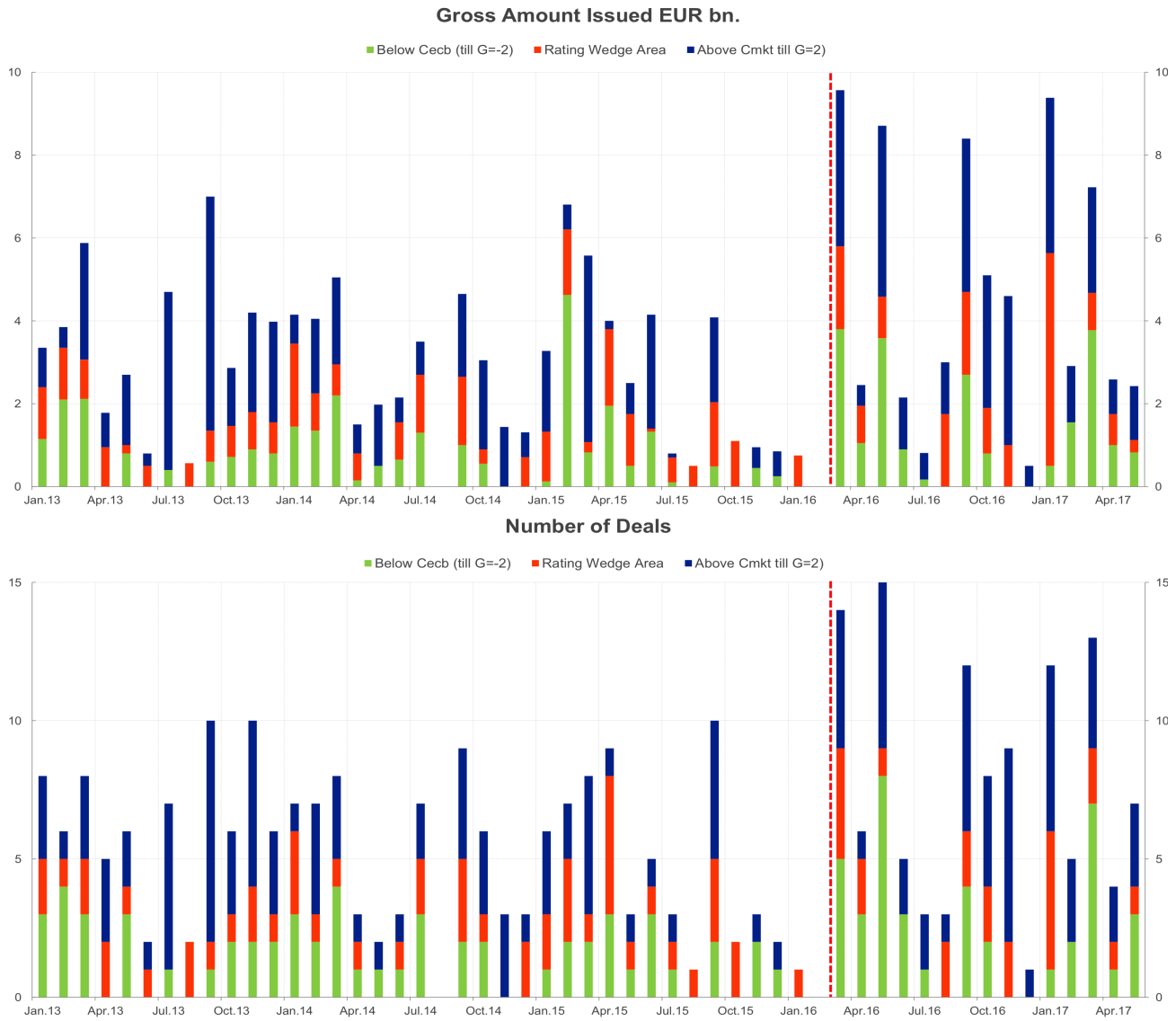

Figure 13. Corporate Bond Issuance, $G \in [-2, 2]$, in EUR bn and in number of deals.

The graphs depict the corporate bond (gross) issuance by companies belonging to the following three groups: below the ECB threshold "ECB BBB-" till G=-2, along the rating wedge and above the market threshold "Market BBB-" till G=2. The graph on top shows the amount issued in EUR bn and the one below shows the number of deals. The dashed red vertical line shows the CSPP announcement date.

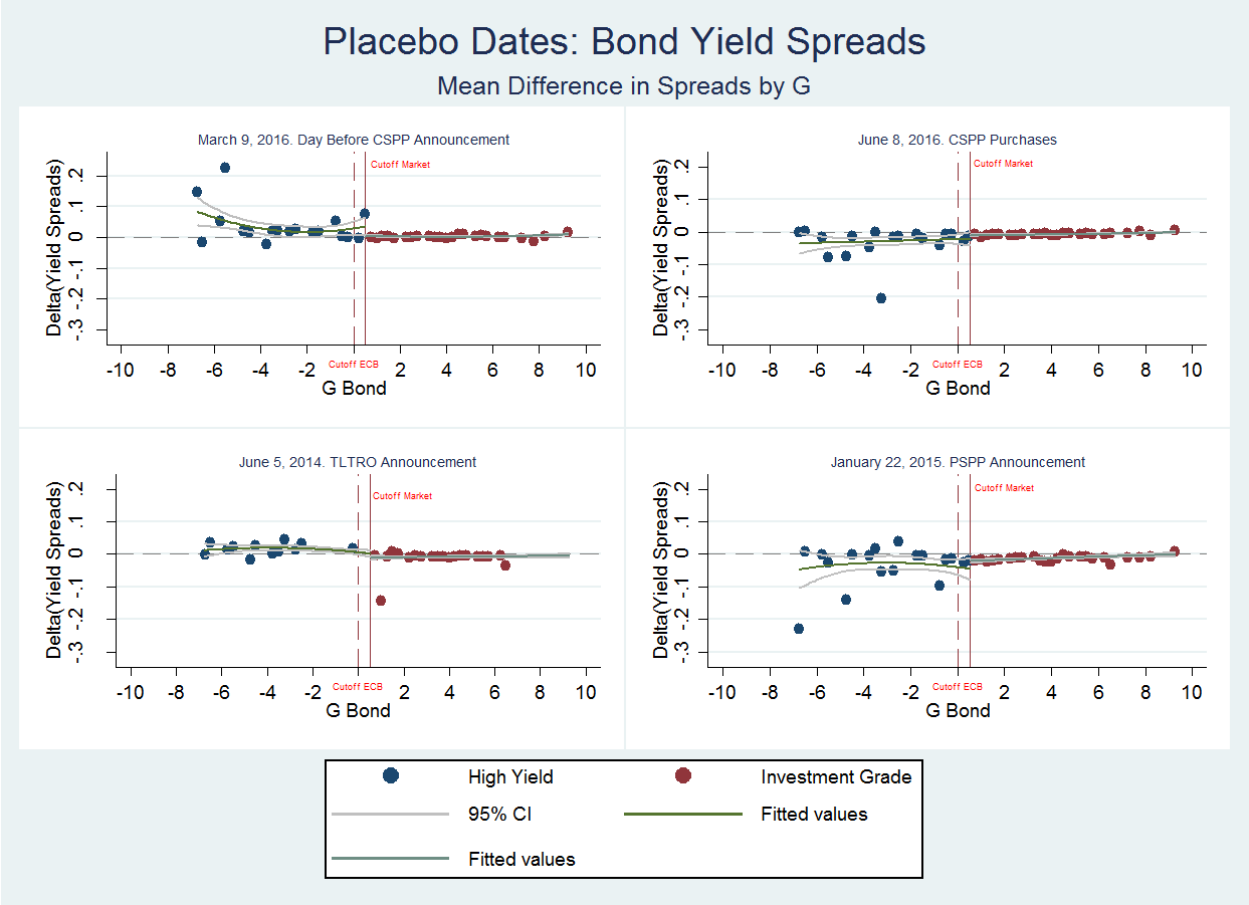

Figure 14. Placebo: 1-trading day.

Graphical illustration of RD design: The figure shows the difference in unconditional bond yield spreads means by G. The solid lines represents the predicted values of a quadratic local smoother polynomial on each side of the threshold at C_{MKT}. The outer grey lines denote 95 percent confidence intervals. The reaction of bond yield spreads is computed using the following time bandwidths: March 9, 2016 - March 10, 2016. Above the vertical solid-line, bonds are classified as investment grade by investors. Below the vertical dashed-line bonds are not eligible for the corporate sector purchase programme (CSPP).

Table 1: Summary Statistics, Bond-level

Panel A: Corporate Bond Yield Spreads

Notes: This table presents descriptive statistics about bond yield spreads, "G score" (from "B+" to "BBB+", Appendix A) and the number of bonds within each bucket. The ECB and the Market thresholds, *ECB BBB-* and *Market BBB-* respectively, are highlighted with two horizontal dashed-lines. Bonds included in the analysis have market information (yield and liquidity) on March 10, 2016 (i.e. CSPP announcement) and must be actively traded during the period covered. Time bandwidths: [March 9, 2016; March 10, 2016].

		March 9, 2016					March 10, 2016					
Cut-offs	G	# Bonds	Mean	Std. Dev.	Min	Max	# Bonds	Mean	Std. Dev.	Min	Max	Difference
	-2.75	36	5.71	2.48	1.67	11.73	36	5.49	2.49	1.72	11.38	-0.22
	-2.5	23	4.40	0.4	3.77	4.99	23	4.25	0.41	3.54	4.87	-0.15
	-2.25	0					0					
	-2	0					0					
	-1.75	43	4.51	1.54	1.38	8.89	45	4.34	1.53	1.28	8.76	-0.17
	-1.5	14	3.53	1.10	1.62	6.33	14	3.38	1.08	1.46	6.09	-0.15
	-1.25	0					0					
	-1	0					0					
	-0.75	56	4.83	3.3	1.61	13.48	56	4.62	3.25	1.46	13.68	-0.21
	-0.5	10	2.07	0.53	1.13	2.67	10	1.92	0.52	1.04	2.54	-0.15
	-0.25	14	2.35	0.56	1.31	3.16	14	2.09	0.53	1.12	2.83	-0.26
	0	0					0					
ECB BBB-	0.25	38	2.35	1.04	1.03	5.88	38	2.20	1.01	0.95	5.68	-0.15
	0.5	20	2.7	2.19	0.89	6.49	20	2.57	2.04	0.87	6.09	-0.13
Market BBB-	0.75	4	1.34	0.18	1.17	1.52	4	1.3	0.18	1.12	1.47	-0.04
	1	3	1.3	0.33	1.04	1.66	3	1.23	0.34	0.96	1.62	-0.07
	1.25	89	1.9	0.77	0.68	3.68	89	1.84	0.76	0.64	3.68	-0.06
	1.5	18	1.42	0.42	0.71	2.47	18	1.39	0.42	0.62	2.43	-0.03
	1.75	5	1.33	0.38	0.97	1.96	5	1.31	0.39	0.93	1.95	-0.03
	2	0					0					
	2.25	185	1.33	0.48	0.54	3.21	185	1.28	0.48	0.52	3.17	-0.05
	2.5	32	1.44	0.48	0.77	2.55	32	1.4	0.47	0.76	2.52	-0.04
	2.75	30	1.04	0.37	0.55	2.22	30	1.01	0.37	0.52	2.18	-0.03
	3	0					0					

Panel B: Firm characteristics & Bond Issuances

Notes: Panel B of Table 1 presents the summary statistics for the main variables that are the object of our analysis, "Before" (i.e. Q1-2014 to Q1-2016) and "After" (i.e. Q2-2016 to Q2-2017) the announcement of the CSPP. It shows the explanatory variables split into three group of firms: (i) above Market cut-off (i.e. *From G = 0.75 to G = 3*), (ii) within the rating wedge (i.e. *From G = 0.25 to G = 0.5*) and (iii) below the ECB cut-off (i.e. *From G = -3 to G = 0*). The sample consists of all firms in the Dealogic Database that are located in the euro area.

		Before Announcement *Q1 2014 - Q1 2016*			**After Announcement** *Q2 2016 - Q2 2017*		
		Obs	Mean	Std. Dev	Obs	Mean	Std. Dev
Before ECB Cutoff	Issuance to Assets	428	0.010	0.039	248	0.014	0.055
	ln(Assets)	428	8.772	1.113	248	8.841	1.118
	Tobin Q	309	0.997	0.76	189	1.01	0.774
	Leverage	428	0.378	0.161	248	0.375	0.162
	Cash to Assets	428	0.08	0.058	248	0.084	0.053
	ST Debt to Tot.Debt	363	0.121	0.138	241	0.122	0.142
	Sales Growth	410	0.063	0.226	248	0.07	0.239
	Employees	383	34987	49766	238	33979	47743
Rating Wedge	Issuance to Assets	166	0.014	0.042	99	0.016	0.046
	ln(Assets)	166	9.119	1.196	99	9.24	1.129
	Tobin Q	132	0.902	0.473	77	0.919	0.553
	Leverage	166	0.404	0.23	99	0.404	0.237
	Cash to Assets	166	0.069	0.069	99	0.06	0.053
	ST Debt to Tot.Debt	141	0.202	0.168	86	0.187	0.179
	Sales Growth	150	0.036	0.246	94	0.020	0.252
	Employees	153	58688	83327	92	57080	90150
After Market Cutoff	Issuance to Assets	693	0.008	0.032	398	0.012	0.033
	ln(Assets)	693	9.564	1.16	398	9.689	1.123
	Tobin Q	549	1.094	0.537	327	1.092	0.553
	Leverage	693	0.345	0.168	398	0.339	0.146
	Cash to Assets	693	0.068	0.052	398	0.065	0.049
	ST Debt to Tot.Debt	545	0.182	0.159	345	0.168	0.164
	Sales Growth	678	0.04	0.205	391	0.066	0.192
	Employees	647	49697	70989	382	51360	74267

Table 2: CSPP Effects on Bond Yield Spreads (March 10, 2016)

Notes: Table (2) presents bond level regressions. The first row in each panel shows the outcome mean for the relevant sample. Columns (1)-(2) are OLS specifications using the entire sample with and without any controls. Specifications in columns (3)-(4), are RD specifications with and without controls. Both these specifications include a linear control for the G (Eq.1) on each side of the discontinuity. The discontinuity is determined by the "BBB- Market" cut-off, defined in Equation 2. In both columns, the sample is restricted to a bandwidth of $\hat{g}$, determined by the Silverman (1986) algorithm. Columns (5)-(7) are alternative RD specifications using the control function and bandwidth pairs: linear and $2\hat{g}$, quadratic and $\hat{g}$, as well as cubic and $\hat{g}$. Covariates include the change in bid-ask spreads (lagged it by 1 trading day), the remaining maturity and the change in market bond returns. Standard errors, clustered by bond, are in parentheses.*** p <0.01, ** p<0.05, * p<0.1.

DEPENDENT VARIABLE Δ Yield Spread	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome mean	-0.093	-0.093	-0.096	-0.096	-0.088	-0.096	-0.096
MIG	0.159***	0.157***	0.0763***	0.0638***	0.0584***	0.0899**	0.0862**
	(0.00788)	(0.00769)	(0.0243)	(0.0202)	(0.0202)	(0.0445)	(0.0368)
Constant	-0.201***	-0.212***	-0.121***	-0.0993***	-0.118***	-0.0967***	-0.0967***
	(0.00779)	(0.00880)	(0.0226)	(0.0183)	(0.0178)	(0.0267)	(0.0267)
Control Function	None	None	Linear	Linear	Linear	Quadratic	Cubic
Bandwidth (g)	-	-	$\hat{g}$	$\hat{g}$	$2\hat{g}$	$\hat{g}$	$\hat{g}$
Covariates	No	Yes	No	Yes	Yes	Yes	Yes
R-squared	0.378	0.386	0.282	0.351	0.372	0.351	0.351
Observations (# Bonds)	1,310	1,310	168	168	442	168	168
# Bonds $> C_{MKT}$	888	888	96	96	304	96	96
# Bonds $\leqslant C_{MKT}$	422	422	72	72	138	72	72

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Placebo, "ECB BBB-" cut-off (March 10, 2016)

Notes: Table (3) presents bond level regressions. The first row in each panel shows the outcome mean for the relevant sample. Columns (1)-(2) are OLS specifications using the entire sample with and without any controls. Specifications in columns (3)-(4), are RD specifications with and without controls. Both these specifications include a linear control for the G (Eq.1) on each side of the discontinuity. The discontinuity is determined by the "BBB- Market" cut-off, defined in Equation 2. In both columns, the sample is restricted to a bandwidth of [-0.5; 0.5]. Column (5) is a RD specification with a quadratic control function. Covariates include the change in bid-ask spreads (lagged it by 1 trading day), the remaining maturity and the change in market bond returns. Standard errors, clustered by bond, are in parentheses.*** p <0.01, ** p<0.05, * p<0.1.

DEPENDENT VARIABLE Δ Yield Spread	(1)	(2)	(3)	(4)	(5)
Outcome mean	-0.147	-0.147	-0.147	-0.147	-0.147
CSPPEligible	0.0385**	0.0612***	0.0883*	0.0602	0.0602
	(0.0174)	(0.0160)	(0.0497)	(0.0488)	(0.0488)
Constant	-0.175***	-0.163***	-0.249***	-0.235***	-0.202***
	(0.00962)	(0.0175)	(0.0245)	(0.0380)	(0.0338)
Control Function	None	None	Linear	Linear	Quadratic
Bandwidth [-0.5; 0.5]	Yes	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes	Yes
R-squared	0.033	0.271	0.059	0.327	0.327
Observations (# Bonds)	82	82	82	82	82
# Bonds $> C_{ECB}$	58	58	58	58	58
# Bonds $\leqslant C_{ECB}$	24	24	24	24	24

*** p<0.01, ** p<0.05, * p<0.1

Table 4: CSPP Effects on Bond Bid-Ask Spreads (March 10, 2016)

Notes: Table (4) presents bond level regressions. The first row in each panel shows the outcome mean for the relevant sample. Columns (1)-(2) are OLS specifications using the entire sample with and without any controls. Specifications in columns (3)-(4), are RD specifications with and without controls. Both these specifications include a linear control for the G (Eq.1) on each side of the discontinuity. The discontinuity is determined by the "BBB- Market" cut-off, defined in Equation 2. In both columns, the sample is restricted to a bandwidth of $\hat{g}$, determined by the Silverman (1986) algorithm. Columns (5)-(7) are alternative RD specifications using the control function and bandwidth pairs: linear and $2\hat{g}$, quadratic and $\hat{g}$, as well as cubic and $\hat{g}$. Covariates include the remaining maturity and the change in market bond returns. Standard errors, clustered by bond, are in parentheses.*** p <0.01, ** p<0.05, * p<0.1.

DEPENDENT VARIABLE Δ Bid-Ask Yield Spread	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome mean	0.021	0.021	0.013	0.013	0.022	0.013	0.013
MIG	-0.00154	-0.00429	0.0164	0.0166	-0.0518**	0.136***	0.122***
	(0.00885)	(0.00851)	(0.0274)	(0.0283)	(0.0227)	(0.0516)	(0.0435)
Constant	0.0221***	0.00868	0.0461**	0.0518**	0.0291	0.0726***	0.0726***
	(0.00822)	(0.0102)	(0.0209)	(0.0229)	(0.0203)	(0.0244)	(0.0244)
Control Function	None	None	Linear	Linear	Linear	Quadratic	Cubic
Bandwidth (g)	-	-	$\hat{g}$	$\hat{g}$	$2\hat{g}$	$\hat{g}$	$\hat{g}$
Covariates	No	Yes	No	Yes	Yes	Yes	Yes
R-squared	0.017	0.075	0.002	0.211	0.161	0.237	0.237
Observations (# Bonds)	1,310	1,310	168	168	442	168	168
# Bonds $> C_{MKT}$	888	888	96	96	304	96	96
# Bonds $\leqslant C_{MKT}$	442	442	72	72	138	72	72

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Bond Issuances, Below vs Above Market Cutoff

Notes: Table (5) presents firm-level regressions for the full sample. This table shows that the CSPP increases corporate bond issuance intensity, especially for firms below the market cut-off. The dependent variable is the seasonally adjusted change in bond issuance of firm i in quarter t_k $(k = 1, \ldots, 4)$ divided by total asset (ratio between 0 and 1). The main regressor is a firm "market investment grade" dummy denoted $(G_{i,t} > C_{MKT})$ and the CSPP announcement dummy $Post_{2016Q1}$. All columns include firm fixed effects. Columns (2) and (5) control for firm specific variables (Tobin'Q , Leverage and Sales's growth). Column (4) includes quarter fixed effects to capture common time effects (the CSPP announcement dummy is absorbed by these fixed effects and therefore omitted). Column (5) includes a full set of quarter*country and firm specific fixed effects to capture any country specific shocks and time-invariant characteristics. All standard errors are two-way clustered at the firm and country*year level. *** p <0.01, ** p<0.05, * p<0.1. Observations are between Q1-2014 and Q2-2017.

DEPENDENT VARIABLE $\Delta B_{i,[t]_k}/TA_{i,[t]_k}$	(1)	(2)	(3)	(4)	(5)
$Post_{2016Q1}$	0.00636***	0.00590***	0.0109***		
	(0.00240)	(0.00193)	(0.00310)		
$Post_{2016Q1} * (G_{i,t} > C_{MKT})$			-0.00815**	-0.00815**	-0.00846**
			(0.00328)	(0.00342)	(0.00353)
Leverage		0.00874	0.0136	0.0151	0.0251
		(0.0409)	(0.0403)	(0.0412)	(0.0405)
Tobin'q		0.0159	0.0161	0.0224	0.0180
		(0.0180)	(0.0178)	(0.0189)	(0.0197)
Sales Growth		-0.0167**	-0.0161**	-0.0160*	-0.0119
		(0.00798)	(0.00794)	(0.00791)	(0.00788)
Firms FEs	YES	YES	YES	YES	YES
Quarters FEs	-	-	-	YES	-
Country*Quarters FEs	-	-	-	-	YES
Observations	2,497	1,741	1,741	1,741	1,741
R-squared	0.003	0.012	0.015	0.040	0.099
Number of NFC	253	178	178	178	178

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Bond Issuances, Across the Three Subsamples

Notes: Table (6) presents firm-level regressions for the full sample. This table shows that the CSPP increases corporate bond issuance intensity, especially for firms below the market cut-off. The dependent variable is the seasonally adjusted change in bond issuance of firm i in quarter t_k ($k = 1, \ldots, 4$) divided by total asset (ratio between 0 and 1). The main regressors are: (i) a firm "market investment grade" dummy denoted ($G_{i,t} > C_{MKT}$) and the CSPP announcement dummy $Post_{2016Q1}$, (ii) a firm "rating wedge" dummy denoted ($C_{MKT} > G_{i,t} \geqslant C_{ECB}$) and $Post_{2016Q1}$. All columns include firm fixed effects. Columns (2) and (5) control for firm specific variables (Tobin'Q , Leverage and Sales's growth). Column (4) includes quarter fixed effects to capture common time effects (the CSPP announcement dummy is absorbed by these fixed effects and therefore omitted). Column (5) includes a full set of quarter*country and firm specific fixed effects to capture any country specific shocks and time-invariant characteristics. All standard errors are two-way clustered at the firm and country*year level. *** p <0.01, ** p<0.05, * p<0.1. Observations are between Q1-2014 and Q2-2017.

DEPENDENT VARIABLE $\Delta B_{i,[t]_k}/TA_{i,[t]_k}$	(1)	(2)	(3)	(4)	(5)
$Post_{2016Q1}$	0.00636***	0.00590***	0.0123***		
	(0.00240)	(0.00193)	(0.00368)		
$Post_{2016Q1} * (G_{i,t} > C_{MKT})$			-0.00960***	-0.00954**	-0.00996**
			(0.00375)	(0.00395)	(0.00425)
$Post_{2016Q1} * (C_{MKT} > G_{i,t} \geqslant C_{ECB})$			-0.00660	-0.00634	-0.00706
			(0.00631)	(0.00638)	(0.00726)
Leverage		0.00874	0.0140	0.0157	0.0253
		(0.0409)	(0.0401)	(0.0411)	(0.0405)
Tobin'q		0.0159	0.0161	0.0224	0.0181
		(0.0180)	(0.0178)	(0.0188)	(0.0197)
Sales Growth		-0.0167**	-0.0159**	-0.0146*	-0.0118
		(0.00798)	(0.00796)	(0.00791)	(0.00786)
Firms FEs	YES	YES	YES	YES	YES
Quarters FEs	-	-	-	YES	-
Country*Quarters FEs	-	-	-	-	YES
Observations	2,497	1,741	1,741	1,741	1,741
R-squared	0.003	0.012	0.015	0.040	0.097
Number of NFC	253	178	178	178	178

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Placebo APP Bond Yield Spreads (January 22, 2015)

Notes: Table (7) presents bond level regressions. The first row in each panel shows the outcome mean for the relevant sample. Columns (1)-(2) are OLS specifications using the entire sample with and without any controls. Specifications in columns (3)-(4), are RD specifications with and without controls. Both these specifications include a linear control for the G (Eq.1) on each side of the discontinuity. The discontinuity is determined by the "BBB- Market" cut-off, defined in Equation 2. In both columns, the sample is restricted to a bandwidth of $\hat{g}$, determined by the Silverman (1986) algorithm. Columns (5)-(7) are alternative RD specifications using the control function and bandwidth pairs: linear and $2\hat{g}$, quadratic and $\hat{g}$, as well as cubic and $\hat{g}$. Covariates include the change in bid-ask spreads (lagged it by 1 trading day), the remaining maturity and the change in market bond returns. Standard errors, clustered by bond, are in parentheses.*** p <0.01, ** p<0.05, * p<0.1.

DEPENDENT VARIABLE Δ Yield Spread	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Outcome mean	-0.019	-0.019	-0.024	-0.024	-0.028	-0.024	-0.024
MIG	0.0203***	0.0148**	0.0106	0.0112	-0.0188**	-0.0474	-0.0352
	(0.00700)	(0.00666)	(0.0167)	(0.0142)	(0.00799)	(0.0339)	(0.0297)
Constant	-0.0333***	-0.0528***	-0.0252***	-0.0413***	-0.0301***	-0.0352***	-0.0352***
	(0.00694)	(0.00807)	(0.00454)	(0.00573)	(0.00570)	(0.00498)	(0.00498)
Control Function	None	None	Linear	Linear	Linear	Quadratic	Cubic
Bandwidth (g)	-	-	$\hat{g}$	$\hat{g}$	$2\hat{g}$	$\hat{g}$	$\hat{g}$
Covariates	No	Yes	No	Yes	Yes	Yes	Yes
R-squared	0.017	0.075	0.002	0.211	0.161	0.237	0.237
Observations (# Bonds)	1,029	1,029	135	135	366	135	135
# Bonds $> C_{MKT}$	720	720	75	75	253	75	75
# Bonds $\leqslant C_{MKT}$	309	309	60	72	113	60	60
*** p<0.01, ** p<0.05, * p<0.1							

Table 8: Placebo, "ECB BBB-" cut-off (January 22, 2015)

Notes: Table (8) presents bond level regressions. The first row in each panel shows the outcome mean for the relevant sample. Columns (1)-(2) are OLS specifications using the entire sample with and without any controls. Specifications in columns (3)-(4), are RD specifications with and without controls. Both these specifications include a linear control for the G (Eq.1) on each side of the discontinuity. The discontinuity is determined by the "BBB- Market" cut-off, defined in Equation 2. In both columns, the sample is restricted to a bandwidth of [-0.5; 0.5]. Column (5) is a RD specification with a quadratic control function. Covariates include the change in bid-ask spreads (lagged it by 1 trading day), the remaining maturity and the change in market bond returns. Standard errors, clustered by bond, are in parentheses.*** p <0.01, ** p<0.05, * p<0.1.

DEPENDENT VARIABLE Δ Yield Spread	(1)	(2)	(3)	(4)	(5)
Outcome mean	-0.023	-0.023	-0.023	-0.023	-0.023
CSPPEligible	-0.00706	-0.0137**	-0.0114	-0.0256	-0.0256
	(0.00695)	(0.00606)	(0.0232)	(0.0188)	(0.0188)
Constant	-0.0183***	-0.0319***	-0.0232	-0.0356**	-0.0314**
	(0.00569)	(0.00623)	(0.0196)	(0.0161)	(0.0133)
Control Function	None	None	Linear	Linear	Quadratic
Bandwidth [-0.5; 0.5]	Yes	Yes	Yes	Yes	Yes
Covariates	No	Yes	No	Yes	Yes
R-squared	0.015	0.278	0.026	0.302	0.302
Observations (# Bonds)	70	70	70	70	70
# Bonds $> C_{ECB}$	48	48	48	48	48
# Bonds $\leqslant C_{ECB}$	22	22	22	22	22

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Placebo Tests, Liquidity Dynamics

Notes: Table 9 presents bond-level regressions. This table shows the main results of Eq.8. The reference date (Week= 0) of the dependent variable is stated in the head of each column. This table compares the bid-ask spreads of CSPP-eligible and CSPP-non-eligible bonds in every week between: January 28, 2016 and April 22, 2016 for the first column, and April 22, 2016 to July 15, 2016 for the second column. CSPPEligible$_{i,t}$ (=1 if the bond is eligible to the CSPP) and a set of dummy variables that indicate the specified relative week t, (Week=t). All columns include full sets of firm fixed effects. Standard errors, clustered by bond are in parentheses. *** p <0.01, ** p<0.05, * p<0.1.

DEPENDENT VARIABLE Bid-Ask Spread	(1) At Announcement	(2) At Effective Purchase
(Week= -6)*CSPPEligible$_{i,t}$	0.00183	-0.00497
	(0.00918)	(0.00736)
(Week= -5)*CSPPEligible$_{i,t}$	-0.0205*	0.00326
	(0.0112)	(0.0171)
(Week= -4)*CSPPEligible$_{i,t}$	-0.0455***	0.0153
	(0.0142)	(0.00973)
(Week= -3)*CSPPEligible$_{i,t}$	-0.0528***	0.0293***
	(0.0172)	(0.0111)
(Week= -2)*CSPPEligible$_{i,t}$	-0.0374**	0.0435***
	(0.0166)	(0.0148)
(Week= -1)*CSPPEligible$_{i,t}$	-0.0204	0.0320**
	(0.0145)	(0.0126)
(Week= 0)*CSPPEligible$_{i,t}$	-0.0172	0.0204
	(0.0157)	(0.0142)
(Week= 1)*CSPPEligible$_{i,t}$	0.0138	0.00162
	(0.0156)	(0.0146)
(Week= 2)*CSPPEligible$_{i,t}$	0.0179	-0.0225
	(0.0158)	(0.0143)
(Week= 3)*CSPPEligible$_{i,t}$	0.0440***	-0.211***
	(0.0166)	(0.0169)
(Week= 4)*CSPPEligible$_{i,t}$	0.0576***	-0.140***
	(0.0164)	(0.0185)
(Week= 5)*CSPPEligible$_{i,t}$	0.137***	-0.103***
	(0.0177)	(0.0196)
(Week= 6)*CSPPEligible$_{i,t}$	0.171***	-0.0817***
	(0.0201)	(0.0204)
Firms FEs	YES	YES
R-squared	0.045	0.069
Observations	18,202	18,241
# Bonds	1,310	1,308
Events	March 10, 2016 (Week= 0)	June 8, 2016 (Week= 0)

*** p<0.01, ** p<0.05, * p<0.1

Appendix A. Harmonised Rating Scale

Notes: This table maps the ratings of S&P, Moodys, Fitch and DBRS into seventeen numerical values, with 10 corresponding to the highest rating (AAA/Prime High Grade) and -6 to the lowest (CCC+/substantial risks). The horizontal dashed-line separate assets from "High Yield" to "Investment Grade".

DBRS	Moody's	S&P	Fitch	Rating Description	Ranking
AAAu	Aaa	AAA	AAA	Prime	10
AAH	Aa1	AA+	AA+	High grade	9
AA	Aa2	AA	AA		8
AAL	Aa3	AA-	AA-		7
AH	A1	A+	A+	Upper medium grade	6
A	A2	A	A		5
AL	A3	A-	A-		4
BBBH	Baa1	BBB+	BBB+	Lower medium grade	3
BBB	Baa2	BBB	BBB		2
BBBL	Baa3	BBB-	BBB-		1
BBH	Ba1	BB+	BB+	Non-investment grade	0
BB	Ba2	BB	BB	speculative	-1
BBL	Ba3	BB-	BB-		-2
CCCH	B1	B+	B+	Highly speculative	-3
CCC	B2	B	B		-4
CCCL	B3	B-	B-		-5
CCH	Caa1	CCC+	CCC+	Substantial risks	-6

Appendix B. Investors Credit Risk Assessment

Notes: This table shows the stricter qualifying rules of investors regarding "investment grade" classification. The column "Stricter?" tells us whether the credit risk management framework of investors is tighter than the ECB's first best rule approach.

Risk Mangement Framework		
Market Participant	Function/Type	Stricter?
Bank of America Merrill Lynch	Investment Strategies	YES
S&P Dow Jones Indices	Benchmarking	YES
Markit iBoxx Rating	Benchmarking	YES
UBS	Asset management	YES
STOXX	Benchmarking	YES
Bloomberg Barclays	Benchmarking	YES
J.P. Morgan	Research Indices	YES
Barclays	Investment Strategies	YES

Internet Links ("BBB-" Threshold")

- Bank of America Merrill Lynch (The average of Moody's, S&P and Fitch is Baa3/BBB-/BBB- or higher):
  `http://www.mlindex.ml.com/gispublic/bin/indexrules.asp`

- S&P Dow Jones Indices (The lowest rating of Moody's, S&P and Fitch is Baa3/BBB-/BBB- or higher)
  `https://us.spindices.com/indices/fixed-income/sp-500-bond-index`

- Markit iBoxx Rating (The average of Moody's, S&P and Fitch)
  `https://products.markit.com/indices/download/products/guides/Markit_iBoxx_Rating_Methodology.pdf`

- UBS (The median/the average or the lowest rating of Moody's, S&P and Fitch is Baa3/BBB-/BBB- or higher)
  `https://www.ubs.com/ch/en/asset-management/etf-institutional/investment-themes/corporate-bond-investing.html`

- STOXX (The lowest rating of Moody's, S&P and Fitch is Baa3/BBB-/BBB- or higher)

https://www.stoxx.com/document/Indices/Common/Indexguide/bond_index_guide.pdf

- Bloomberg Barclays (The average rating of Moody's, S&P and Fitch is Baa3/BBB-/BBB- or higher)
  https://www.bbhub.io/indices/sites/2/2017/03/Index-Methodology-2017-03-17-FINAL-FINAL.pdf

- J.P. Morgan (At least 2 ratings of Moody's, S&P and Fitch are Baa3/BBB-/BBB- or higher)
  https://www.jpmorgan.com/country/US/EN/jpmorgan/investbk/solutions/research/indices/product

- Barclay's (The average rating of Moody's, S&P and Fitch is Baa3/BBB-/BBB- or higher)
  https://indices.barclays/IM/12/en/indices/welcome.app

Appendix C. List of Variables

Bloomberg Sample

- Bond i's Yield-to-Maturity in day t
- Bond i's Amount Outstanding
- Bond i's Bid-Ask Spreads (i.e. measure of liquidity)
- Bond i's Maturity to Redemption
- Bond i's Coupon Rate
- Bond i's Type (i.e. callable, at maturity)
- Bond i's Issuer (and Ultimate parent)
- Bond i's Currency
- Bond i's Industry (and Sector)
- Bond i's Country of Incorportation
- Bond i's Rating Vector (S&P, Moody's, Fitch and DBRS)
- Risk Free rate= German sovereign bond yields (adjusted via linear interpolation to construct corporate yield spreads)
- European Market rate= BofA Merrill Lynch Eurozone Bond Index (i.e. market benchmark).
- European volatility benchmark= VSTOXX

Dealogic Sample

- Deal Total Value (i.e. amount issued)
- Issuer Nationality
- Rating at launch

Other Variables (from Bloomberg and Datastream)

- Bond Debt to Assets= Ratio of bond debt (senior bonds, subordinated bonds and commercial paper) to total assets
- Size= ln(Total Assets) (expressed in Million) : Natural logarithm of firm total asset
- Tobin's q= the market value of equity, minus the book value of equity, plus the book value of assets, all scaled by the book value of assets
- Leverage= Ratio of debt to total assets
- Sales Growth= ln(Sales$_{t+1}$)- ln(Sales$_t$)
- MIG= A dummy variable that equals one for "market investment grade" bonds (firms), and zero otherwise.
- CSPPEligible= A dummy variable that equals one for "ECB investment grade" (i.e CSPP eligible) bonds (firms), and zero otherwise .

Appendix D. CSPP-eligibility at a Firm Level

Notes: We provide anecdotal evidences on the difficulty to extrapolate any inferences from bonds to companies. In Section III.C, we tried to mitigate the issue arising from the discrepancies between credit rating of firms and bonds. If a rating of a specific credit rating agency is not available through bloomberg, we complete the rating vector (at the bond and firm level), with DEALOGIC. The following table presents a set of examples where the rating of an issuer differs from (some) of its outstanding bonds. We will only focus on the case of firms and bonds that are located around the BBB- cutoff.

CSPP-eligibility at a Firm Level						
	Firm Level			Bond Level		
Date	Firm Name	S&P/Moodys/Fitch/DBRS	Elig.	Bond ISIN	S&P/Moodys/Fitch/DBRS	Elig.
29Nov16	Lanxess AG	BBB-/Baa3/NA/NA	Yes	XS1405763019	BB/Ba2/NA/NA	No
12Mar15	Repsol SA	BBB-/Baa3/BBB/NA	Yes	XS1207054666	BB/Ba1/BB+/NA	No
12Mar15	Repsol SA	BBB-/Baa3/BBB/NA	Yes	XS1207058733	BB/Ba1/BB+/NA	No
28Feb15	ThyssenKrupp AG	BB/Baa3/BB+/NA	Yes	DE000A14J579	BB/Ba1/NA/NA	No
28Feb15	ThyssenKrupp AG	BB/Baa3/BB+/NA	Yes	DE000A14J587	BB/Ba1/NA/NA	No
23Jun14	Accor SA	BBB-/NA/BBB-/NA	Yes	FR0012005924	BB/NA/BB/NA	No
31Oct13	CasinoGuichardPerrachonSA	BBB-/NA/BBB-/NA	Yes	FR0011606169	BB/NA/BB/NA	No
30Sep13	Lafarge SA	BBB/Ba1/BBB/NA	Yes	XS097513498	BB+/Ba1/NA/NA	No
31Jul13	Continental AG	BB/Baa2/BBB/NA	Yes	XS0953199634	BB/Ba2/BB/NA	No
30Mar13	Telecom Italia SpA	BBB/Baa3/BBB/NA	Yes	XS0906837645	BB+/Ba2/BB+/NA	No
31Mar13	Koninklijke KPN NV	BBB-/Baa3/BBB-/NA	Yes	XS0903872355	BB/Ba1/BB/NA	No
31Mar13	Koninklijke KPN NV	BBB-/Baa3/BBB-/NA	Yes	XS0903872603	BB/Ba1/BB/NA	No

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