Issuance and Valuation of Corporate Bonds with Quantitative Easing*

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Abstract

After the announcement of the European Central Bank's corporate quantitative easing program, non-financial corporations timed the bond market by shifting their issuance toward bonds eligible for the program. However, issuers of eligible bonds did not increase total issuance compared to other issuers; nor did they experience different economic outcomes. Instead, the announcement produced substantial spillover effects on risk premia. Credit risk premia declined, both in the corporate bond market and in the default swap market, whereas the valuation of eligible bonds did not change relative to comparable ineligible bonds. Firms took advantage of reduced risk premia by issuing riskier bond types. Using a novel and comprehensive dataset of corporate bonds in the euro area, we document how firms substituted across bond characteristics, and we find evidence of their intention to time the market. Our model indicates corporate market timing is instrumental in allowing quantitative easing to produce spillover effects.

Keywords: Quantitative easing, corporate bonds, market timing, risk premia, CSPP.

JEL Classification: G32, G12, E52, E58, E44.

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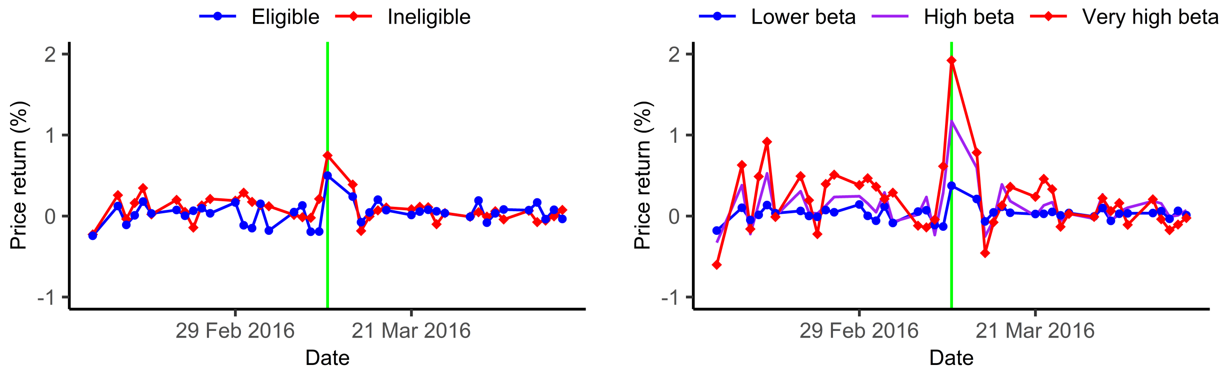
1 Introduction

Starting with the financial crisis of 2008, and continuing through the pandemic of 2020, the traditional tools of monetary policy have been challenged by market segmentation, financial instability, and low interest rates. As a consequence, central banks around the world implemented a series of quantitative easing (QE) programs in an attempt to improve capital market conditions and facilitate the pass-through of monetary policy to markets and the real economy.

As central banks expanded their QE programs to include corporate bonds, non-financial corporations began playing a central role with sovereign issuers in the transmission of monetary policy. Immediately, new puzzles arose. As Figure 1a shows, when the European Central Bank (ECB) announced its corporate QE program, the prices of bonds eligible for the program increased less than the prices of ineligible bonds. This pattern is surprising given our current understanding of the transmission of QE. However, unlike sovereigns, corporations try to time capital markets by adjusting their financing activity in response to market valuations and general market conditions (Baker et al., 2003b; Baker and Wurgler, 2002; Covas and Den Haan, 2011). As a result, QE could affect the issuance activity of corporations, which in turn may affect the transmission of QE to bond prices. So far, the empirical literature has not acknowledged the importance of corporate market timing in the transmission of QE. We document its central role.

We show that non-financial corporations timed their issuance of corporate bonds by altering bond characteristics after the announcement of the Corporate Sector Purchase Program (CSPP) by the ECB. At the same time, the CSPP had major spillover effects on both the valuation of corporate bonds and credit risk. Although the ECB targeted only a set of eligible bonds in its purchases, the program affected the valuation of credit risk, the cost of capital, and the economic activity of non-financial corporations, whether firms issued eligible bonds or not. In order to interpret these findings, we provide a simple model in which the market-timing activity of eligible firms is instrumental in the transmission of QE to the wider market.

We also argue that bond prices increased primarily because risk premia declined. As Figure 1a shows, the prices of eligible bonds increased less than the prices of ineligible bonds when the CSPP was announced. Although this pattern may appear puzzling, we explain it by observing that risk premia declined and that ineligible bonds were more exposed to aggregate risk. Figure 1b shows a substantial price improvement for bonds with high exposure to aggregate credit risk. After controlling for bond and issuer risk, the prices of eligible bonds did not change compared to ineligible bonds. Therefore, QE



(a) Bonds by eligibility

(b) Bonds by aggregate risk exposure

Figure 1: Average price return of euro-denominated corporate bonds around the CSPP announcement. Bonds are sorted according to their eligibility and their exposure to aggregate risk. Price returns are computed as differences in the logarithm of prices. We measure a bond's aggregate risk exposure in terms of its beta before the announcement. The beta is the slope coefficient in a regression of the bond's price return on the price return of the aggregate bond market. Bonds are classified as high beta or very high beta if their beta is, respectively, in the ninth or tenth decile of the cross-sectional distribution of betas. The vertical line marks the first trading day after the announcement of the CSPP.

produced substantial general equilibrium effects on the valuation of corporate bonds and credit risk, and no partial equilibrium effect on eligible bonds.

Earlier studies of the CSPP, such as Grosse-Rueschkamp et al. (2019) and Todorov (2020), document that yields dropped for the group of bonds that are likely to be eligible. We go one step further by using exact information on bond eligibility, as well as information from credit default swaps (CDSs) and default probabilities. We are therefore able to distinguish the direct effect of the CSPP on the valuation of eligible bonds and its spillover effect on risk premia. We find that the effect on risk premia largely outweighs the effect on eligible bonds.

To provide further evidence that risk premia dropped after the announcement, we extend our analysis to include CDS spreads and expected default frequencies (EDFs). We find that CDS spreads narrowed after the announcement, especially for entities with high exposure to aggregate credit risk. However, EDFs did not decline. As a result, credit risk premia, defined as the ratio between CDS spreads and EDFs, declined when the program was announced. Therefore, after the announcement, investors paid less to insure against default risk, indicating that investors' risk appetite increased.

Using a novel and comprehensive dataset of corporate bonds in the euro area, we find that eligible issuers substituted eligible for ineligible bonds after the announcement of the CSPP. However, all issuers changed their total issuance in a similar way, they grew at analogous rates, and their relative productivity remained the same. Therefore, although eligible issuers timed the market, they failed to achieve any relative gain in their cost of capital, which would have induced them to increase their total issuance relative to ineligible issuers. When comparing issuers with non-issuers, we find that issuers increased their leverage and experienced reduced borrowing costs compared to non-issuers, but they generated no higher cash flow for their shareholders.

Whereas many interpretations of the effects of QE tend to abstract from an issuance response – see, for example, Bernanke (2020), Krishnamurthy and Vissing-Jorgensen (2011), and Vayanos and Vila (2009) – our research shows the limits of such abstraction when QE targets corporate securities. The CSPP was met by an increased issuance of eligible bonds rather than an jump in their prices. Eligible firms acted as arbitrageurs in their own debt, and neutralized any direct effect of the CSPP on eligible bond prices. Although we do not identify the effect of QE on aggregate issuance, we estimate firms substituted about €4.5 billion per month of eligible for ineligible bonds. This amount represents 60% of the €7.5 billion monthly purchases that the ECB conducted in the first 12 months of the program.[1]

As firms shifted toward eligible issuance, they changed the characteristics of the bonds they issued in order to meet the ECB's eligibility requirements. In particular, firms increased the issuance of bonds listed on an exchange, bonds deposited with a centralized security depository, and senior bonds. Among other eligibility criteria, the ECB requires an eligible bond to be listed on a regulated exchange, deposited with an eligible centralized security depository, and not subordinated.

Firms also took advantage of the decline in risk premia to increase the issuance of bonds with riskier profiles. Specifically, issuers substituted unsecured bonds and non-guaranteed bonds for secured and guaranteed ones. Our findings therefore indicate that firms choose the type of corporate bonds they issue in response to market conditions, and not only in response to firms' characteristics (Barclay and Smith, 1995; Colla et al., 2013; Rauh and Sufi, 2010).

To provide direct evidence of corporate market timing, we show that, after the announcement of the CSPP, eligible firms revealed a willingness to issue bonds at that moment and at the current rates, rather than wait for future opportunities or needs to arise. In particular, eligible firms shifted toward longer-maturity bonds and moved away from commercial paper; they issued more fixed-coupon bonds; they increasingly issued bonds for general corporate purposes rather than more specific purposes; and they took advantage of their established issuance programs to issue bonds quickly after the announcement of the CSPP.

[1]The shift from ineligible to eligible issuance that we document after the announcement of the CSPP is analogous to the move from jumbo to conforming loans that Di Maggio et al. (2020) find during the first round of mortgage-backed securities purchases by the Federal Reserve.

The paper is organized as follows. In Section 2, we discuss the related literature. In Section 3, we provide a simple model to interpret our empirical results. In Section 4, we discuss the details of the CSPP, the euro area corporate bond market, and our data. In Section 5, we document the effects of the CSPP on corporate bond prices and CDS spreads. In Section 6, we document that firms substituted across bond types after the announcement of the CSPP. In Section 7, we study issuers' real economic activity. Section 8 concludes. Appendix B contains additional figures and tables. Appendix C replicates our analysis on valuation and issuance around the announcement of the ECB's Public Sector Purchase Program. Internet Appendix A provides the proofs for the model, whereas Internet Appendix D considers the announcement of the 2014 Targeted Long-Term Refinancing Operation as a robustness check for the primary role of the CSPP in driving our results.

2 Related Literature

We contribute to the literature that studies how the public sector affects private debt issuance. Whereas existing work focuses on the effect of the supply of government bonds on private debt issuance and yields (Demirci et al., 2019; Greenwood et al., 2010; Greenwood and Vayanos, 2014; Krishnamurthy and Vissing-Jorgensen, 2012, 2015), we study the effect of the central bank's demand for corporate bonds on bond issuance and risk premia.

We show that non-financial corporations timed the market and modified several characteristics of their bond issues in response to the CSPP announcement. Previous market-timing literature has focused variously on equity issuance (Baker and Wurgler, 2000; Dong et al., 2012; Loughran and Ritter, 1995); debt maturity (Baker et al., 2003a); interest rate exposure (Faulkender, 2005); the choice between bank loans and bonds (Becker and Ivashina, 2014); and the joint timing of equity and debt markets (Gao and Lou, 2012; Ma, 2019). We also contribute to the open question of whether market timers are actually successful at reducing their cost of capital (Butler et al., 2006), as we provide suggestive evidence for a negative answer.

We also adopt a different identification approach from the usual market-timing literature. Some authors focused on the correlation between issuance choices and subsequent returns (Baker et al., 2003a; Baker and Wurgler, 2000; Greenwood and Hanson, 2013; Loughran and Ritter, 1995; Ma, 2019). Others exploited variation in non-fundamental investor demand (Becker et al., 2011; Faulkender and Petersen, 2006). We take advantage of the CSPP as a quasi-exogenous change in the demand for eligible corporate bonds. Although the CSPP was certainly endogenous to the aggregate economic conditions of the euro area, the ECB's demand for eligible bonds was not driven by their fundamentals, but only by the ECB's rules.

Compared to existing literature on the CSPP, we improve measurement of the program's effects by using a comprehensive dataset of euro-area corporate bonds and by using exact information on bond eligibility. Abidi and Miquel-Flores (2018), Grosse-Rueschkamp et al. (2019), and Todorov (2020) proxy for eligibility by using credit ratings. They find that the CSPP announcement reduced the yields of investment-grade bonds in the euro area. Bonfim and Capela (2020) and Zaghini (2019) document spillover effects on ineligible bonds. We show, however, that the CSPP announcement had no effects on eligible bond valuation; instead, it had large spillover effects on risk premia. A decline in risk prima was also observed after the announcement of the Federal Reserve's QE programs (Gilchrist and Zakrajšek, 2013; Hattori et al., 2016; Krishnamurthy and Vissing-Jorgensen, 2011).

We also document that firms substituted between bond characteristics after the CSPP announcement, whereas existing work focuses on substitution between bonds and bank loans (Arce et al., 2017; Betz and De Santis, 2019; Ertan et al., 2020; Galema and Lugo, 2019; Grosse-Rueschkamp et al., 2019).

In response to the 2020 pandemic, the Federal Reserve expanded its QE programs to include corporate bonds. Our work, therefore, provides insights for understanding the transmission of corporate QE in the US as well. Ongoing research on the Federal Reserve's Corporate Credit Facility has shown that the Fed's policy reduced risk premia, improved liquidity, and led to increased issuance for both investment-grade and high-yield issuers (Boyarchenko et al., 2020; D'Amico et al., 2020; Haddad et al., 2020; O'Hara and Zhou, 2020).

3 A Model of Market Timing and Spillovers

We provide a framework to interpret our empirical analysis of issuance and valuation of corporate bonds around QE events. With the simple model in this section, we intend to obtain predictions on how issuance and bond valuation change when the monetary authority purchases bonds and affects risk premia.[2]

[2]Although our focus is on the direct demand effect of QE and on its effect on risk premia, there are a number of other channels through which QE may affect asset prices. For example, according to Bhattarai et al. (2015) and Eggertsson and Woodford (2003), asset purchases may serve as a credible commitment for the central bank to maintain low interest rates when the short-term rate has reached its lower bound. With QE, the central bank signals such a commitment, so a QE announcement should flatten the term structure.

3.1 SET-UP

We present a static partial equilibrium model of the corporate bond market and of firm investment. Investors finance firms by purchasing bonds, and they are averse to aggregate risk. In order to overcome the neutrality of asset purchases demonstrated in Wallace (1981), we assume that investors have a preferred habitat demand for eligible bonds and that they face limits to arbitrage.

In this framework, bond purchases by the central bank affect asset prices and issuance. Because of corporate market timing, however, the effects of asset purchases spill over into the entire economy, and eligible issuers do not gain an advantage in terms of cost of capital.

FIRMS Firms can be either safe or risky, depending on their exposure to aggregate risk. With probability q, a downturn happens, and risky firms do not generate any cash flow, but safe firms are unaffected. We assume there is a measure 1 of both safe and risky firms.

Firms finance themselves by issuing bonds. All firms can issue ineligible bonds. A measure η of both safe and risky firms can also issue eligible bonds, and a fraction $1-\eta$ can issue only ineligible bonds. We might think of the difference between eligible and ineligible firms within the same risk group as driven by differences on whether firms are rated or not, or on whether firms are marginally rated more highly or not.

Conditional on producing output, firms operate a decreasing returns to scale technology in their capital. Given total capital K, the firm's output is $AK - \frac{c}{2}K^2$. Safe firms always produce output, whereas risky firms fail to produce output during a downturn, which happens with probability $q \in (0,1)$. In our notation, we say that safe firms produce with probability $(1-q_S)=1$, and risky firms produce with probability $(1-q_R)=(1-q)$.

In order to raise capital to invest, safe firms may issue ineligible bonds at price P_S, whereas risky firms may issue ineligible bonds at price P_R. Moreover, an eligible firm can issue eligible bonds at a premium Δ_S if the firm is safe, or at a premium Δ_R if it is risky. Issuing eligible bonds costs ψ per bond. We may think of this as the cost of obtaining a credit rating and listing the bonds on a regulated market. Each bond pays one unit of consumption good at maturity. If a crisis happen, risky firms default on their bonds.

Moreover, according to Benmelech and Bergman (2012) and Del Negro et al. (2017), the increase in liquidity resulting from QE is crucial to boost output.

We can write the profit function of eligible issuers as

$$T_{jE}(K_{jE}, I_{jE}, f_j; P_j, \Delta_j) = (1 - q_j)\left[AK_{jE} - \frac{c}{2}(K_{jE})^2 - I_{jE}\right] + [P_j + (\Delta_j - \psi)f_j]I_{jE} - K_{jE} \qquad j \in \{S, R\},$$

where K_{jE} is the capital of an eligible firm with risk profile j, I_{jE} is its total bond issuance, and f_j is the fraction of issuance that is eligible. $[P_j + (\Delta_j - \psi)f_j]I_{jE} - K_{jE}$ represents the part of the issuance proceeds that is not invested.

Eligible firms may time the market by adjusting the relative supply of eligible bonds f_j in response to the relative price Δ_j. Here, we assume that firms may supply eligible bonds at constant marginal cost ψ. This assumption is different from models of market timing in Greenwood et al. (2010), and Stein (1996), who assume an increasing marginal cost. The implications of our assumption, however, match the results of our empirical analysis remarkably well.

Ineligible issuers have an analogous profit function, except that they are unable to issue eligible bonds at a cost ψ. Their profit function is

$$T_{jN}(K_{jN}, I_{jN}; P_j) = (1 - q_j)\left[AK_{jN} - \frac{c}{2}K_{jN}^2 - I_{jN}\right] + P_j I_{jN} - K_{jN}, \quad j \in \{S, R\},$$

where K_{jN} is the total capital of ineligible issuers of risk profile j, I_{jN} is their total issuance and, as in the case of eligible issuers, $P_j I_{jN} - K_{jN}$ are the issuance proceeds that are not invested.

INVESTORS Investors do not discount future payoffs and have a preferred habitat for eligible bonds. They face limits to arbitrage in the form of an increasing marginal cost of bond holdings. Their utility from a portfolio of B_S safe bonds, of which a fraction e_S is eligible, and B_R risky bonds, or which a fraction e_R is eligible, is given by

$$\begin{aligned} &U(B_S, B_R, e_S, e_R; P_S, P_R, \Delta_S, \Delta_R) = \\ &B_S\left[1 - P_S - \Delta_S e_S - \frac{\tau}{2}(e_S - \bar{e})^2\right] + B_R\left[(1-q) - P_R - \pi q - \Delta_R e_R - \frac{\tau}{2}(e_R - \bar{e})^2\right] \\ &\qquad -\frac{\gamma}{2}(B_S + B_R)^2, \end{aligned}$$

where $\tau > 0$ and $\gamma \geq 0$. Investors value the expected net payoff of their bond holdings, and their preferred habitat for eligible bonds is $\bar{e}$. e_j represents the percentage of bonds of risk profile j that are eligible, and investors suffer a disutility when e_j deviates from the target percentage $\bar{e}$. Eligible bonds trade at a premium Δ_j, which reduces their net expected payoff. We assume that the habit demand for eligible bonds is strong enough, that is

$$\bar{e} > \frac{\psi}{2\tau}. \tag{1}$$

Investors face limits to arbitrage. These are captured by the term $-\frac{\gamma}{2}(B_S + B_R)^2$, which introduces an increasing marginal cost of bond holdings. We also assume that investors dislike exposure to aggregate risk, as captured by $\pi > 0$. Although this is a reduced-form formulation, these preferences can be micro-funded as the expected utility of risk-averse investors under the risk neutral measure, where π represents the risk premium.

THE CENTRAL BANK The central bank buys a quantity G_j of eligible bonds in risk category j, and total bond purchases are $G = G_S + G_R$.

MARKET EQUILIBRIUM To close the model, we define a market equilibrium in the usual way.

DEFINITION (Equilibrium)**.** *A market equilibrium is a vector of prices $(P_S^*, \Delta_S^*, P_R^*, \Delta_R^*)$, a vector of bond issues $(I_{SE}^*, f_S^*, I_{RE}^*, f_R^*, I_{SN}^*, I_{RN}^*)$, a vector of firm sizes $(K_{SE}^*, K_{RE}^*, K_{SN}^*, K_{RN}^*)$, and a vector of private bond holdings, $(B_S^*, e_s^*, B_R^*, e_R^*)$, such that issuance, firm size, and holdings are optimal for the private sector, that is:*

$$(K_{jE}^*, I_{jE}^*, f_j^*) = \arg \max_{(K_{jE}, I_{jE}, f_j) \geq 0} T_{jE}(K_{jE}, I_{jE}, f_j; P_j^*, \Delta_j^*), \quad j \in \{S, R\}$$

$$(K_{jN}^*, I_{jN}^*) = \arg \max_{(K_{jN}, I_{jN}) \geq 0} T_{jN}(K_{jN}, I_{jN}; P_j^*), \quad j \in \{S, R\}$$

$$(B_S^*, B_R^*, e_S^*, e_R^*) = \arg \max_{(B_S, B_R, e_S, e_R)} U(B_S, B_R, e_S, e_R; P_S^*, P_R^*, \Delta_S^*, \Delta_R^*);$$

and such that markets clear, that is:

$$\eta f_j^* I_j^* = e_j^* B_j^* + G_j^*, \quad j \in \{S, R\}$$

$$I_j^* = B_j^* + G_j^*, \quad j \in \{S, R\}.$$

In equilibrium, eligible firms compete away any marginal gain from issuing eligible bonds, that is $\Delta_j^* = \psi$. As a consequence, eligible issuers face the same cost of capital as ineligible issuers. Therefore, eligible and ineligible firms of risk type j issue the same total amount of bonds I_j^*, and invest the same amount of capital K_j^*. Moreover, since $P_j^* \leq 1$, all the issuance proceeds are invested, that is $K_j^* = P_j^* I_j^*$.

3.2 Predictions

With the model we have presented, we can obtain predictions about the effects of unconventional monetary policy on bond issuance and valuation. Although we do not provide a full theory for why QE may affect the parameters of the model, we study how parameter changes affect bond issuance and bond prices. In order to identify which parameters may be affected by QE, we appeal to the theoretical literature on scarcity channel and a risk channel of QE.

Scarcity Channel Tobin (1969) and, more recently, Greenwood et al. (2010), Krishnamurthy and Vissing-Jorgensen (2012), and Vayanos and Vila (2009) have noted that investors may have a preferred habitat, that is, a preference for holding a certain portfolio. In our model, the preferred habitat of investors is represented by $\bar{e}$, which is the fraction of eligible bonds that investors would hold if eligible bonds traded at the same price as ineligible bonds.

In such a framework, QE activates a scarcity channel. As the central bank purchases eligible bonds, these bonds become scarce, absent any equilibrium adjustment in supply and prices. Researchers have abstracted from the supply response from issuers and concluded that QE, through a scarcity channel, should lead to an increase in the prices of eligible assets.

In our setting, however, we explicitly take into consideration the supply response of firms. When firms can switch between eligible and ineligible issuance, we obtain the first prediction.

Proposition 1 (Spillover effects)**.** *If the central bank increases the amount of eligible bonds purchased, then the total issuance of eligible firms does not change compared to ineligible firms; the price of eligible bonds does not change compared to ineligible bonds; and the price of safe bonds does not change compared to risky bonds. That is:*

$$\partial_G (I^*_{jE} - I^*_{jN}) = 0, \quad \partial_G \Delta^*_j = 0, \quad \partial_G (P^*_S - P^*_R) = 0, \quad j \in \{S, R\}.$$

Moreover, all firms increase issuance, and all bond prices increase. That is:

$$\partial_G I^*_j > 0, \quad \partial_G P^*_j > 0, \quad j \in \{S, R\}.$$

Because eligible firms can substitute eligible for ineligible bonds, they compete away any partial equilibrium effect that QE may have on eligible bond prices. If $\Delta^*_j > \psi$, eligible firms would gain an arbitrage profit by issuing more eligible bonds. Market equilibrium can be achieved only if eligible firms adjust their issuance to the point that $\Delta_j^* = \psi$. Consequently, the effects of QE fully spill over to the wider market, and lead to a generalized increase in issuance and bond prices, whether firms and bonds are eligible or not.

PROPOSITION 2 (Substitution). *If the central bank increases the amount of eligible bonds purchased, then eligible firms shift their issuance toward eligible bonds, that is*

$$\partial_G \frac{f_S^* I_S^* + f_R^* I_R^*}{I_S^* + I_R^*} > 0, \quad j \in \{S, R\}.$$

This second prediction states that, regardless of the mix of safe and risky bonds in the central bank's purchases, the average eligible firm increases the fraction of eligible bonds that it issues. As the central bank increases purchases of eligible bonds, it crowds out private investors in relative terms, in the sense that the ratio $G/(I_S^* + I_R^*)$ increases. Because the central bank buys only eligible bonds, the aggregate share of eligible bonds must increase. Firms that can supply eligible bonds meet the increase in the demand for eligible bonds by shifting toward them.

RISK CHANNEL QE may affect asset prices also by changing investors' valuation of risk or the amount of economic risk itself. In many intermediary asset-pricing models, such as Brunnermeier and Sannikov (2014), Cúrdia and Woodford (2011), Gertler and Karadi (2011), Gertler and Kiyotaki (2010), and He and Krishnamurthy (2013), QE activates a risk channel if the central bank, by swapping risky assets for riskless assets, relaxes the balance sheet constraints of intermediaries and, hence, reduces their effective risk aversion. In this case, a risk channel works mainly through a decline in risk premia.

Moreover, monetary policy may affect the amount of risk in the economy if, as argued in Brunnermeier and Sannikov (2016), the central bank intervention also mitigates a buildup of endogenous risk.

In our model, these mechanisms translate into a reduction in the risk premium π, or a decline in the probability of a downturn, q. The predictions that we obtain in these two cases are observationally equivalent.

PROPOSITION 3 (Risk). *If quantitative easing reduces risk aversion π, or aggregate risk q, then the prices of risky bonds increase more than the prices of safe bonds and risky firms issue more than safe firms. That is:*

$$-\partial_\pi(P_S^* - P_R^*) < 0, \quad -\partial_\pi(I_S^* - I_R^*) < 0, \quad -\partial_q(P_S^* - P_R^*) < 0, \quad -\partial_q(I_S^* - I_R^*) < 0, \quad j \in \{S, R\}.$$

Therefore, if QE affects either investor aversion to credit risk π, or the amount of credit risk itself q, then the prices of riskier assets should increase relative to safer assets, and riskier issuers must increase issuance compared to safer ones. Yet we must keep in mind that riskier issuers may, in reality, face scale constraints or frictions when they issue bonds, which may affect their ability to increase investments and total issuance.

More generally, if QE increases investors' risk appetite or reduces aggregate risk, firms may respond by issuing larger amounts of risky bond types. They might increase issuance of junior or unsecured bonds, thereby meeting higher investor demand for credit risk.

4 Background Information and Data

Before beginning our analysis of bond issuance and valuation, we first provide a description of the CSPP, the corporate bond market in the euro area, and the relevant data.

4.1 The Corporate Sector Purchase Program

Starting in October 2014, the ECB launched a series of asset purchase programs (APPs) intended to ease monetary and financial conditions for firms and households, and to improve the pass-through of monetary policy to real economic activity and, ultimately, inflation. Initially, these APPs were targeting covered bonds and asset-backed securities and amounted to approximately €10 billion per month. The ECB expanded its QE programs to €60 billion per month in January 2015, by launching its Public Sector Purchase Program (PSPP).

The ECB announced the Corporate Sector Purchase Program (CSPP) on March 10, 2016. Its purpose was to provide additional monetary accommodation and achieve the ECB's inflation target. On April 21, 2016 the ECB released additional technical details on the CSPP, and purchases began on June 8, 2016. In the first 12 months of operation, the CSPP accounted for €7.5 billion in monthly purchases, approximately 85% of which in the secondary market. The initial end date for the CSPP was set at no earlier than March 2017, although it was progressively extended through December 2018. Net purchases under the APPs later resumed in November 2019, although for smaller amounts.

On the same day of the CSPP announcement, the ECB also expanded the total size of the APPs to €80 billion per month, reduced interest rates by 5 basis points, and launched a new round of Targeted Long-Term Refinancing Operations (TLTROs). In Appendix C and Internet Appendix D, we consider previous announcements of analogous policies in the absence of any corporate QE measure. We show these additional policy changes cannot account for the main results of the paper around the March 2016 announcement.[3].

With the CSPP announcement in March 2016, the ECB declared its intention to purchase euro-denominated bonds issued by non-bank corporations established in the euro area, provided that the bonds were eligible to be posted as collateral for the ECB's credit operations.[4] The ECB has always accepted corporate bonds as collateral for its refinancing operations, although in order to be accepted as collateral, a bond needs to satisfy a list of eligibility requirements.[5]

Such requirements include, among others, that a bond be investment-grade rated, listed on an eligible regulated market, deposited with an eligible centralized security depository, and not subordinated. The eligibility requirements also restrict the type of coupon, the conditionality of the principal amount, and the form of the note. The list of eligible securities is published daily on the ECB's website.

4.2 DATA

Our main source of data is the Centralized Security Database (CSDB). The CSDB provides security-level information on every equity, debt, and hybrid instrument issued by residents of the euro area. This dataset is managed by the Eurosystem and is updated monthly, with observations starting in February 2011, although the coverage is limited before the beginning of 2013. The CSDB provides comprehensive information about each security and its issuers. It also specifies whether a bond is eligible as collateral or not.

We then use credit ratings from the four ECB-recognized rating agencies: S&P, Fitch, Moody's, and DBRS. For each bond and for each issuer, we consider their best credit rating at each date. Bonds and issuers are described as investment grade when their best rating is BBB- or above. Otherwise, they are described as speculative.

We obtain daily bond prices and bid-ask spreads from Datastream, CDS spreads from Markit, and expected default frequencies (EDFs) from Moody's KMV. Although price data are not available for all bonds, we obtain data for a sample of 1,987 bonds. Of these

[3]In Appendix C, we show the PSPP announcement brought about a decline in bond risk premia, although to a smaller extent than the March 2016 announcement.

[4]In April 2016, the ECB further specified that it would purchase bonds with maturity between 6 months and 31 years. Our analysis focuses just on a bond's eligibility as collateral and ignores its remaining maturity. We do this for two main reasons. First, the maturity requirement was announced on April 21, whereas the issuance response of firms can be observed starting in March, after the ECB announced its intention to purchase bonds that were eligible as collateral. Second, during the course of 2015, bonds with maturity below 6 months and above 31 years represented only 16% of the outstanding amount for the whole market, and 10% of the collateral-eligible market.

[5]A detailed list of the eligibility requirements may be found in the EU Guideline 2015/510 of the European Central Bank on the implementation of the Eurosystem monetary policy framework (ECB/2014/60): https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX:32014O0060.

Table 1: Summary statistics. The table shows the number of bonds outstanding in the ten months before and after the CSPP announcement and summary statistics for the bonds' issued amount.

	All	Eligible	Ineligible	Elig. issuers	Inelig. issuers	Datastream	Bloomberg
Number of bonds	40, 129	7, 386	33, 341	9, 925	30, 204	12, 554	2, 876
Mean (€mln)	49.34	110.87	32.18	107.11	24.37	80.06	323.84
Median (€mln)	10	25	5	29	4.75	20	190
St. deviation (€mln)	169.09	251.87	132.38	237.92	120.09	197.33	367.02
Decile 1 (€mln)	0.75	5	0.50	5	0.50	3	10
Quartile 1 (€mln)	2	10	1.50	10	1.25	9.91	31.40
Quartile 3 (€mln)	25	50	20	50	14	50	500
Decile 9 (€mln)	75	500	50	300	35	180	750

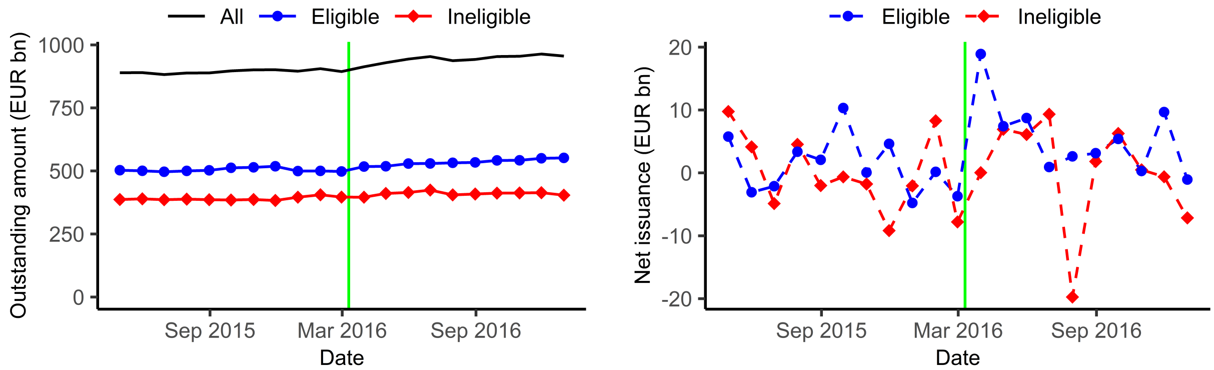
bonds, 1,291 were outstanding for the entire period spanning the three months before and after the CSPP announcement, and they represent 71% of the aggregate outstanding amount in the period. For CDS spreads, we find information on 126 of the issuers in our sample. We then match the Markit data with KMV's, resulting in a sample of 77 issuers for which we observe both CDS spreads and EDFs.

We obtain additional bond information from commercial data providers. Listing and use of proceeds come from both Datastream and Bloomberg; issuance program information comes from Datastream; and dates for bond issuance announcements come from Bloomberg. Finally, we obtain yearly financial statements for all non-financial corporations in the euro area from Bureau van Dijk's Orbis dataset.

We are interested primarily in the period surrounding the announcement of the CSPP. For the ten months before and after the announcement, the CSDB provides information on 40,129 euro-denominated bonds issued by 3,795 non-financial corporations domiciled in the euro area. Of these corporations, 222 had eligible bonds outstanding at some time in 2015.

Table 1 shows summary statistics for the sample of bonds. There are fewer eligible than ineligible bonds (7,386 to 33,341), but eligible bonds were issued in higher amounts.[6] On average, eligible bonds are issued in amounts of €111 million, compared to €32 million for ineligible bonds. Similar differences can be seen for bonds issued by eligible versus ineligible issuers. Here, as in all our analyses of the CSPP, we classify an issuer as eligible if it had eligible bonds outstanding at some time in 2015, which is the year before the announcement of the CSPP.

[6]Bonds can be added to or dropped from the list of eligibility securities. Therefore, some bonds may appear both as eligible and ineligible over time. This is the reason why the sum of the number of eligible and ineligible bonds, when considered separately, exceeds the total number of bonds.



(a) Outstanding amount

(b) Net issuance

Figure 2: Outstanding amount and net issuance of euro-denominated bonds issued by non-financial corporations in the euro area. The vertical line marks the announcement of the CSPP (March 10, 2016).

4.3 The Corporate Bond Market in the Euro Area

In order to gain a more accurate perspective on the size and the relevance of the CSPP, in Figure 2a we plot the aggregate outstanding amount of euro-denominated corporate bonds issued by non-financial corporations domiciled in the euro area. The figure also shows the outstanding amount of eligible and ineligible bonds.

As of February 2016, the total outstanding amount of bonds was €894 billion, of which €498 billion were eligible. Over the course of the first year of the CSPP, the purchases of eligible bonds, averaging €7.5 billion per month, amounted to 18% of the eligible bonds outstanding just before the announcement. The CSPP was therefore a large program relative to the size of the market. It is therefore not surprising that it had substantial effects on the valuation of corporate bonds and on their issuance.

Figure 2a shows that the total outstanding amount of bonds began increasing immediately after the announcement of the CSPP. Note that when we consider eligible and ineligible bonds separately, their outstanding amounts may change merely because bonds are added to or dropped from the list of eligible securities. To properly quantify firm issuance response, we compute the monthly net issuance of each individual bond and plot the aggregate series in Figure 2b. Net issuance of eligible bonds sharply increased immediately after the announcement of the CSPP, and remained above the net issuance of ineligible bonds for most of the subsequent months.

5 Bond Valuation

Before we explore how firms adjusted their issuance in response to the CSPP, we begin by studying the effect of the CSPP on the valuation of corporate bonds and credit risk. We document that the CSPP had no partial equilibrium effect on eligible bond prices. Rather, it increased the valuation of bonds exposed to high levels of systematic credit risk.

Our results challenge conventional wisdom on how QE affects bond prices. According to widely held views, QE should give rise to a scarcity and a rebalancing channel, and thereby increase the prices of purchased bonds and their close substitutes (Bernanke, 2012).

To interpret our findings, we provided a model of corporate market timing in Section 3. In that model, corporations modify their issuance choices in response to QE and to a change in risk premia. We build on existing literature and explore the implications of the scarcity and risk channel of monetary policy when issuers time the market. If we allow for corporate market timing, we obtain the following predictions.

> Scarcity: Because of corporate market timing, the prices of eligible bonds do not change relative to comparable ineligible bonds.
>
> Risk: If risk premia decline, the prices of riskier bonds increase more than the prices of safer bonds.

Note that, after allowing for corporate market timing, the scarcity channel does not imply increased prices. Instead, as we will discuss in Section 6, corporations substitute eligible for ineligible bonds, neutralizing any scarcity effect on eligible bond prices. With this framework in mind, we interpret our results on bond valuation in this section.

5.1 Bond Prices

To identify the channels though which QE affects security prices, we consider all bonds outstanding in the three months before and after the announcement and for which we have daily price data. By doing so, we ensure that our identification strategy relies entirely on the price change of outstanding bonds, and that it is not affected by a change in type of bonds being issued.[7] We also eliminate all bonds whose prices might be stale. In particular, we consider only those bonds that experience price changes in at least 80% of

[7] As we show in Section 6, firms changed the characteristics of the bonds they issued after the announcement of the CSPP. Our approach differs from Grosse-Rueschkamp et al. (2019), who consider yields of new bond issues.

the trading days in the period between December 11, 2015 (three months before the CSPP announcement), and February 25, 2016 (two weeks before the CSPP announcement).

To measure the aggregate risk exposure of a bond, we consider its beta with the aggregate market. First, we build a bond market index by considering the weighted average of bond prices, where the weights are the nominal amounts outstanding three months before the announcement of the CSPP. Then, we compute a bond's beta as the slope coefficient in a regression of the daily change in the bond's log price on the daily change of the index's log price. To estimate the beta, we use trading days from December 11, 2015 (three months before the CSPP announcement), to February 25, 2016 (two weeks before the CSPP announcement). We define bonds in the tenth decile of the cross-sectional distribution of betas as very high-beta bonds, and bonds in the ninth decile as high-beta bonds.

Consistent with our model's predictions, Figure 1a in the Introduction shows that the ECB's demand for eligible bonds did not affect the prices of eligible bonds more than the prices of ineligible bonds. In fact, the prices of ineligible bonds increased more than the prices of eligible bonds. Moreover, Figure 1b shows that bonds with higher betas reacted more to the announcement than lower-beta bonds, in line with the prediction of a risk channel.

Finally, because ineligible bonds and higher-beta bonds may be more illiquid than other bonds, we sort bonds according to their effective bid-ask spreads and control for illiquidity in our empirical analysis. We proxy for illiquidity by considering bonds' average bid-ask spreads (relative to their midpoint) in the days between December 12, 2015, and February 25, 2016. We label bonds in the fifth quintile of the distribution of average bid-ask spreads as illiquid.

To formally test for a transmission of the CSPP to the relative price of eligible bonds and bonds highly exposed to aggregate risk, we run a regression using daily data in the three months before and after the announcement:

$$\begin{aligned} \log P_{it} - \log P_{it-1} = & \\ & (\alpha_0^E \text{Eligible}_i + \alpha_0^{VH} \text{VHighBeta}_i + \alpha_0^H \text{HighBeta}_i + \alpha_0^{Ill} \text{Illiquid}_i) \times \text{EventDay}_t \\ & + (\alpha_1^E \text{Eligible}_i + \alpha_1^{VH} \text{VHighBeta}_i + \alpha_1^H \text{HighBeta}_i + \alpha_1^{Ill} \text{Illiquid}_i) \times \text{DayAfter}_t \quad (2) \\ & + \iota_{f(i)t} + \iota_i + \iota_{c(i)t} + \iota_{m(i)t} + \iota_{r(i)t} + u_{it}, \end{aligned}$$

where i denotes the bond, and t denotes the trading day. P_{it} is the price of bond i on day t; $\text{Eligible}_i = 1$ if bond i is eligible at the beginning of the sample period, 0 otherwise; $\text{VHighBeta}_i = 1$ if bond i's beta is in the tenth decile, 0 otherwise; $\text{HighBeta}_i = 1$ if bond i's beta is in the ninth decile, 0 otherwise; Illiquid$_i$ = 1 if bond i's average bid-ask spread (relative to midpoint) is in the fifth quintile, 0 otherwise; EventDay$_t$ = 1 in the first trading day after the announcement; DayAfter$_t$ = 1 in the second trading day after the announcement; $\iota_{f(i)t}$ is either a country-sector-day fixed effect, or a firm-day fixed effect; ι_i is a bond fixed effect; $\iota_{c(i)t}$ is a coupon type-day fixed effect; $\iota_{m(i)t}$ is a maturity-day fixed effect, where the continuous maturity variable is grouped into eight maturity bins;[8] and $\iota_{r(i)t}$ is a rating-day fixed effect. Standard errors are double-clustered at the country-industry-day and bond level.

In order to obtain a sharper identification of the effects of the CSPP on bond valuation, we restrict the sample to bonds rated between BBB+ and BB. Bonds with very distant credit ratings may have substantially different clienteles (Becker and Ivashina, 2015; Bongaerts et al., 2012; Chen et al., 2014; Ellul et al., 2011), which may be differently affected by the announcement of the CSPP.

Results are reported in Table 2. In odd-numbered columns, we control for country-industry-day fixed effects, whereas in even-numbered columns we control for firm-day fixed effects, thus exploiting heterogeneity across bonds issued by the same corporation. We report coefficients for the EventDay effect, corresponding to the coefficients α_0 in regression (2), and the sum of the EventDay and the DayAfter effects, corresponding to the sums $\alpha_0 + \alpha_1$ in regression (2), which we label the two-day effect.

The results show that the effect of the announcement was strongest for the bonds most exposed to aggregate risk. Bonds with greater exposure to aggregate risk experienced substantial increases in valuations, for both eligible and ineligible firms. Even when compared to lower-beta bonds issued by the same corporations, bonds with very high beta experienced a two-day price increase ranging from 1.536% for eligible firms, to 2.270% for ineligible firms. High-beta bonds also saw an increase in their prices relative to lower-beta bonds, although to less of an extent.

The two-day price change of eligible bonds is statistically indistinguishable from the price change of ineligible bonds issued by the same corporation after we control for bond beta, illiquidity, and firm-day fixed effects. This suggests that the announcement had no effect on the price of eligible bonds relative to the price of comparable ineligible bonds. The negative estimate for eligibility that we obtain when we do not control for firm-day fixed effects may capture the fact that ineligible bonds tend to be issued by marginally riskier firms. Once we control for issuer risk using firm-day fixed effects, eligible and

[8]The maturity bins are: (i) under 6 months, (ii) 6 months to under 1 year, (iii) 1 to under 2 years, (iv) 2 to under 5 years, (v) 5 to under 10 years, (vi) 10 to under 20 years, (vii) 20 to under 30 years, and (viii) 30 years or longer.

Table 2: Effects of the CSPP announcement on bond prices based on bond eligibility, bond market beta, and bid-ask spread. We consider bonds outstanding in the three months before and after the announcement of the CSPP and rated between BBB+ and BB. The dependent variable is the daily change in the logarithm of bond prices. Eligible = 1 if the bond is eligible at the beginning of the sample period. VHighBeta = 1 if the bond's beta with the aggregate bond market is in the tenth decile of the cross-sectional distribution of betas. HighBeta = 1 if the bond's beta is in the ninth decile. Illiquid = 1 if the average bid-ask spread relative to the midpoint is in the fifth quintile of the cross-sectional distribution. Betas and average bid-ask spreads are computed using daily data starting from the beginning of the sample period and ending two weeks before the announcement of the CSPP. EventDay = 1 on the first trading day after the announcement of the CSPP. The two-day effects are the sums of the estimated effects on the first and the second trading day after the announcement. A firm is classified as eligible if it had eligible bonds outstanding at some time during the calendar year before the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-day and bond level.

	Log-return (%)					
	All firms		Eligible firms		Ineligible firms	
	(1)	(2)	(3)	(4)	(5)	(6)
Eligible×EventDay	−0.252**	−0.065	−0.280**	−0.052		
	(0.114)	(0.122)	(0.134)	(0.123)		
VHighBeta×EventDay	1.203***	1.478***	1.254***	1.383***	1.222***	1.755***
	(0.216)	(0.191)	(0.235)	(0.185)	(0.359)	(0.492)
HighBeta×EventDay	0.612***	0.584***	0.455***	0.425***	1.075***	1.094***
	(0.145)	(0.153)	(0.160)	(0.118)	(0.268)	(0.323)
Illiquid×EventDay	0.143	0.238	0.056	0.150	0.232	0.371
	(0.147)	(0.144)	(0.194)	(0.152)	(0.195)	(0.311)
Eligible two-day effect	-0.259**	0.069	-0.352**	0.063		
	(0.126)	(0.139)	(0.151)	(0.141)		
VHighBeta two-day effect	1.437***	1.750***	1.459***	1.536***	1.570***	2.270***
	(0.235)	(0.230)	(0.294)	(0.269)	(0.419)	(0.551)
HighBeta two-day effect	0.870***	0.733***	0.700***	0.600***	1.205***	1.101***
	(0.170)	(0.164)	(0.184)	(0.142)	(0.284)	(0.311)
Illiquid two-day effect	0.277	0.357**	0.289	0.388*	0.168	0.273
	(0.169)	(0.177)	(0.225)	(0.201)	(0.265)	(0.379)
Country-industry-day FE	Yes	No	Yes	No	Yes	No
Firm-day FE	No	Yes	No	Yes	No	Yes
Security FE	Yes	Yes	Yes	Yes	Yes	Yes
CouponType-day FE	Yes	Yes	Yes	Yes	Yes	Yes
Maturity-day FE	Yes	Yes	Yes	Yes	Yes	Yes
Rating-day FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	51,745	46,374	42,706	39,955	9,039	6,419
R^2	0.451	0.652	0.537	0.629	0.707	0.792
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$					

ineligible bonds performed very similarly.

To further corroborate our results, we repeat the analysis for the announcement of the PSPP. In this case, eligible corporate bonds were not subject to a direct demand pressure from the central bank, but the QE announcement may still have produced general equilibrium effects on the valuation of aggregate risk. Table 18 in Appendix C reports the results for the PSPP announcement. The prices of corporate bonds with higher beta increased relative to lower-beta bonds, confirming the effect of QE on the valuation of aggregate credit risk, whereas the prices of eligible corporate bonds did not change relative to ineligible bonds.

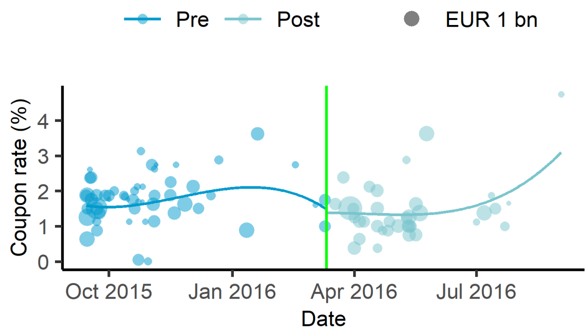
5.2 Coupon Yields at Issuance

So far, we have focused on the valuation of outstanding bonds. We now turn to the valuation of new issues. Grosse-Rueschkamp et al. (2019) observe that the spreads of new issues declined for bonds rated between BBB+ and BBB- in the second quarter after the announcement of the CSPP. However, they do not observe any significant decline in yields in the quarter immediately after the announcement.

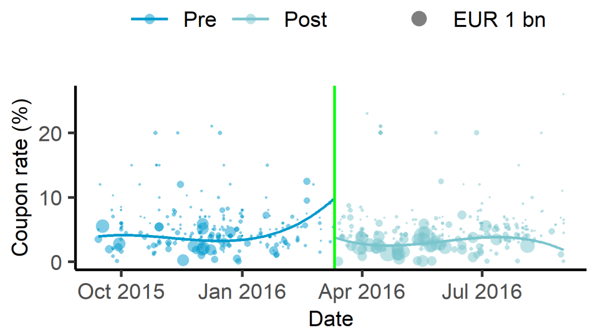
As we will show in Section 6, eligible firms acted quickly to time the market when the CSPP was announced. We therefore ask whether yields at issuance declined shortly after the announcement, especially for eligible bonds. In the same spirit of Grosse-Rueschkamp et al. (2019), we consider the yields of new issues. However, unlike them, we focus on the change in yields in the days immediately following the announcement.

We consider fixed-coupon bonds issued in the six months before and after the CSPP announcement, and we study whether coupon rates declined. We focus on coupon rates for two reasons. First, coupon rates provide a measure of yields at issuance, because corporate bonds are often issued at par, or close to par. Second, our data contain comprehensive information on coupon rates, whereas yields at issuance are available only for a selected sample of bonds and issuers. We therefore chose to use coupon rates in order to cover a large and representative sample of bonds.

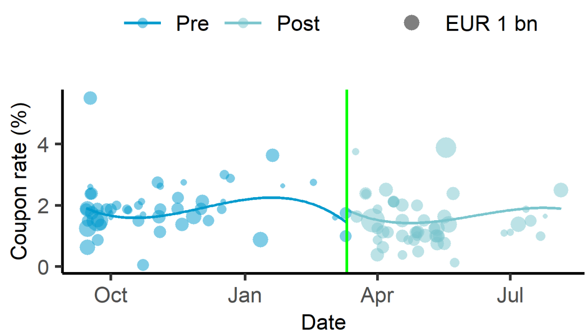
Figure 3 plots fixed-coupon bond issues around the announcement, together with the predicted values using third-degree polynomials for the pre-announcement and the post-announcement period. One can immediately observe two patterns around the CSPP announcement. First, firms increased their issuance activity rapidly after the announcement. Second, the predicted coupon yields appear to decline for ineligible and speculative bonds, but not for eligible and investment-grade bonds. This second pattern is robust even if we consider the spreads of coupon rates relative to the euro-area term structure.



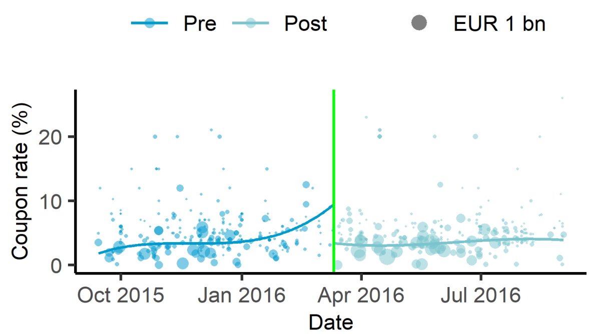
(a) Eligible bonds



(b) Ineligible bonds



(c) Investment-grade bonds



(d) Speculative bonds

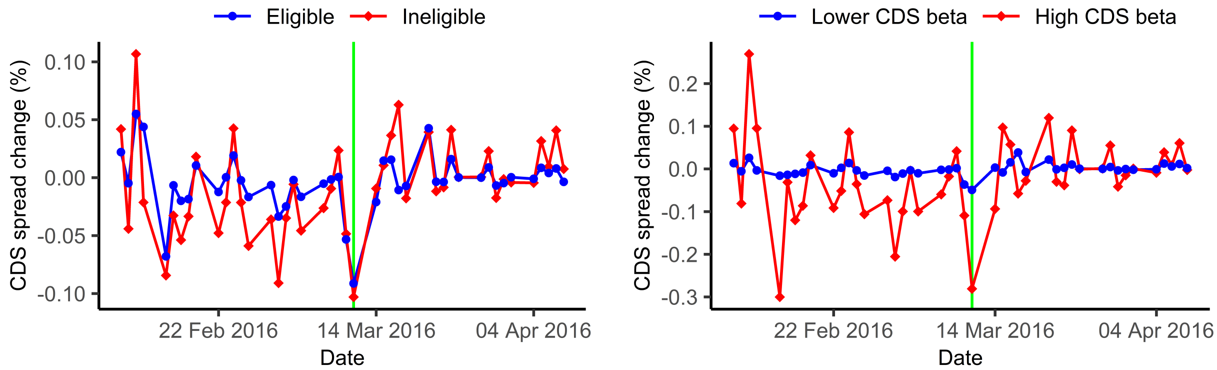
Figure 3: Coupon rates of newly issued fixed-coupon bonds around the CSPP announcement. The dots represent the coupon rates of newly issued bonds, and their area is proportional to the amount issued. The lines represent the predicted value from a third-degree polynomial regression of coupon rates on issue date. Regressions are separately estimated for the six months before and after the announcement, and they are weighted by the issued amounts.

These observations are consistent with our model of Section 3, as well as with our results on the valuation of outstanding bonds in Section 5.1. In equilibrium, firms may increase the issuance of eligible bonds even if their equilibrium yields did not decline. Moreover, as risk premia declined, coupon rates dropped for ineligible and speculative bonds. In Appendix B.2, we econometrically investigate the change in coupon rates using a regression discontinuity design.

5.3 CDS Spreads

We extend our analysis on valuation of credit risk by looking at CDS spreads around the announcement of the CSPP. We again consider daily data for non-financial issuers domiciled in the euro area for the three months before and after the announcement.

Figure 4a plots the average five-year CDS spread of eligible and ineligible issuers,



(a) Entities by eligibility

(b) Entities by aggregate risk exposure

Figure 4: Daily change in five-year CDS spreads of euro-area non-financial issuers around the announcement of the CSPP. Issuers are sorted according to eligibility and exposure to aggregate risk. An issuer is classified as eligible if it had eligible bonds outstanding at some time during the calendar year before the announcement. We measure an issuer's aggregate risk exposure in terms of its CDS beta before the announcement. The CDS beta is the slope coefficient in a regression of the change in the issuer's five-year spread on the change in the average five-year spread of the market. Issuers are classified as high CDS beta if their CDS beta is in the fifth quintile of the cross-sectional distribution of CDS betas. The vertical line marks the first trading day after the announcement of the CSPP.

where an issuer is defined as eligible if it had eligible bonds outstanding in 2015. Consistent with our arguments so far, the spreads of eligible and ineligible issuers declined by a comparable amount when the CSPP was announced.

In Figure 4b, we sort reference entities on the basis of the beta of their CDS spread. Again, entities with the highest beta experienced the greatest improvement in the valuation of their credit risk. To compute the CDS beta, first we construct a CDS index as the cross-sectional average of the five-year spreads of non-financial issuers domiciled in the euro area. Then, we compute an entity's CDS beta as the slope coefficient in a regression of the daily change in the entity's five-year spread on the daily change in the index's five-year spread. We define an entity as having high CDS beta if its CDS beta is in the fifth quintile of the cross-sectional distribution of CDS betas.

To study the effects of the CSPP on CDS spreads, we run a regression analogous to (2) using daily data in the three months before and after the announcement:

$$\begin{aligned} s_{it} - s_{it-1} = \\ &(\alpha_0 + \alpha_0^E \text{Eligible}_i + \alpha_0^H \text{HighBeta}_i + \alpha_0^S \text{HighSpread}_i + \alpha_0^R \text{Speculative}_i) \times \text{EventDay}_t \\ &+ (\alpha_1 + \alpha_1^E \text{Eligible}_i + \alpha_1^H \text{HighBeta}_i + \alpha_1^S \text{HighSpread}_i + \alpha_1^R \text{Speculative}_i) \times \text{DayAfter}_t \\ &+ \iota_{f(i)t} + \iota_{r(i)t} + \iota_i + u_{it}, \end{aligned} \tag{3}$$

where s_{it} is the CDS spread of reference entity i on day t; $\text{Eligible}_i = 1$ if the reference

Table 3: Summary statistics for CDS spreads. The table reports the number of entities and summary statistics for the five-year and thirty-year CDS spreads. Summary statistics are separately computed for the three months before and after the announcement of the CSPP using daily data.

	5yr spread (%)			30yr spread (%)		
	All	Eligible	HighBeta	All	Eligible	HighBeta
N entities	126	75	25	114	68	24
Pre-CSPP: Mean (%)	1.565	0.944	3.277	1.973	1.372	3.876
Pre-CSPP: Median (%)	0.907	0.792	2.400	1.396	1.192	3.133
Pre-CSPP: St.Dev. (%)	1.939	0.618	3.031	1.826	0.728	2.565
Post-CSPP: Mean (%)	1.433	0.825	2.532	1.827	1.228	3.221
Post-CSPP: Median (%)	0.834	0.724	1.796	1.258	1.098	2.639
Post-CSPP: St.Dev (%)	1.851	0.463	2.264	1.746	0.570	2.005

entity had eligible bonds outstanding in 2015; HighBeta_i = 1 if the beta of entity i is in the fifth quintile of the cross-sectional distribution of CDS betas; HighSpread_i = 1 if the average five-year spread of entity i up to two weeks before the announcement is in the fifth quintile of the cross-sectional distribution of average spreads; Speculative_i = 1 if the entity is unrated or rated below BBB-; ι_i is the entity fixed effects. Some regressions include country-sector-day fixed effects, $\iota_{f(i)t}$, and rating-day fixed effects, $\iota_{r(i)t}$. Standard errors are double-clustered at the reference entity and country-sector-day level.

The regressions control for the average level of the CDS spread before the announcement in order to better disentangle the effects of QE on aggregate risk and idiosyncratic risk. As we can see in Figure 4b, reference entities with high CDS beta also tend to have high CDS spreads.

As a first approximation, we can interpret the level of a CDS spread as a function of the entity's probability of default and of the correlation of the entity's default with the aggregate market. Entities whose default is more likely to happen during economic downturns will have a higher spread for a given (unconditional) probability of default. The CDS beta measures the co-movement of a change in CDS spreads with a change in the aggregate market's spread, regardless of the level of the spread. The CDS beta therefore captures the entity's exposure to aggregate credit risk only, and not the entity's idiosyncratic risk.

Table 3 shows summary statistics for CDS spreads before and after the announcement for all entities, for eligible entities, and for high-beta entities. We consider daily data for the five-year CDS contract, which is the most actively traded, and the thirty-year CDS contract, which is the longest maturity in our data. Later, in Table 5 we show summary statistics for the one-year contract for the subsample of entities for which we also have data on their probability of default. In general, we notice the same patterns we observed in Figure 4: High-beta entities experience a great decline in CDS spreads after the announcement.

Table 4 shows the results of regression (3) for CDS spreads at different horizons. Similar to bond prices, we report the EventDay effect and the two-day effect, obtained by summing coefficients $\alpha_0 + \alpha_1$ in regression (3).

Consistent with our results on bond prices, entities with the highest aggregate risk exposure experienced the greatest decline in their CDS spreads. The effect lessens along the term structure of the credit spreads, ranging from 42.6 basis points for five-year spreads to 20.2 basis points for 30-year spreads, when we control for daily fixed effects. This pattern possibly reflects a reduction in risk premia in the near term. Moreover, eligible entities did not experience meaningful changes in their CDS spreads compared to ineligible entities, whereas the spreads of speculative-grade entities increased by a small amount relative to investment-grade issuers.

Finally, when looking at the baseline effect of the announcement after controlling for firm eligibility and risk characteristics, we still observe a small, but statistically significant, reduction in credit spreads ranging from 6.4 basis points to 9.5 basis points across the various horizons.

5.4 Risk Premia

We conclude this section by studying the effect of the CSPP announcement on risk premia. In particular, we show that risk premia declined after the announcement of the CSPP.

To obtain a measure of risk premia, we consider the ratio between the CDS spread and the expected default frequency (EDF) of bond issuers. We find EDF data for 77 of the 126 issuers in the CDS sample. The ratio between the CDS spread and the entity's EDF represents, approximately, the ratio between the risk-neutral expected default frequency and the default frequency under the physical probability measure. The ratio, therefore, captures a default risk premium. We focus on one-year EDFs and CDS spreads because we can directly interpret these quantities as annualized arrival rates of defaults under the physical and risk-neutral measure, respectively. We use weekly data in order reduce microstructure noise in the daily estimates of the EDFs.

Table 5 shows summary statistics for EDFs, one-year spreads, and risk premia before and after the announcement. Although the average one-year spread narrowed after the announcement, the average EDF actually increased. Moreover, after the announcement,

Table 4: Effects of the CSPP announcement on CDS spreads based on entity eligibility, CDS beta, CDS spread level, and credit rating. We consider CDS spreads in the three months before and after the CSPP announcement. The dependent variable is the daily change in CDS spreads at various maturities. Eligible = 1 if the entity had eligible bonds outstanding in the calendar year before the announcement of the CSPP. HighBeta = 1 if the beta of the entity's five-year CDS spread with the average five-year spread of euro area issuers is in the fifth quintile of the cross-sectional distribution of CDS betas. HighSpread = 1 if the average level of the entity's five-year spread before the announcement is in the fifth quintile of the cross-sectional distribution of average five-year spread levels. Speculative = 1 if the entity is unrated or rated below BBB- at the beginning of the sample period. CDS beta and average spread level are calculated using daily data starting from the beginning of the sample period and ending two weeks before the announcement of the CSPP. EventDay = 1 on the first trading day after the announcement of the CSPP. The two-day effects are the sums of the estimated effects on the first and the second trading day after the announcement. Standard errors are in parentheses and double-clustered at the country-industry-day and entity level.

	5yr spread (%)		10yr spread (%)		20yr spread (%)		30yr spread (%)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EventDay	-0.056^{***}		-0.062^{***}		-0.084^{***}		-0.076^{***}	
	(0.016)		(0.018)		(0.025)		(0.026)	
Eligible×EventDay	-0.008	-0.035	-0.012	-0.058^{**}	-0.001	-0.042	-0.004	-0.058^{*}
	(0.016)	(0.029)	(0.018)	(0.023)	(0.025)	(0.028)	(0.026)	(0.033)
HighBeta×EventDay	-0.229^{***}	-0.302^{***}	-0.205^{***}	-0.252^{***}	-0.139^{***}	-0.185^{***}	-0.126^{***}	-0.176^{***}
	(0.041)	(0.077)	(0.031)	(0.052)	(0.029)	(0.054)	(0.029)	(0.050)
HighSpread×EventDay	-0.046	-0.046	-0.052	-0.083	-0.094^{*}	-0.129	-0.071	-0.083
	(0.059)	(0.072)	(0.049)	(0.055)	(0.054)	(0.090)	(0.054)	(0.096)
Speculative×EventDay	0.050^{***}		0.045^{**}		0.069^{**}		0.060^{*}	
	(0.019)		(0.018)		(0.029)		(0.031)	
Baseline two-day effect	-0.064^{***}		-0.069^{***}		-0.095^{***}		-0.092^{***}	
	(0.019)		(0.021)		(0.025)		(0.021)	
Eligible two-day effect	-0.010	-0.035	-0.017	-0.058^{*}	-0.003	-0.050	-0.005	-0.061^{*}
	(0.021)	(0.039)	(0.022)	(0.034)	(0.025)	(0.032)	(0.026)	(0.034)
HighBeta two-day effect	-0.334^{***}	-0.426^{***}	-0.301^{***}	-0.350^{***}	-0.206^{***}	-0.232^{***}	-0.189^{***}	-0.202^{***}
	(0.065)	(0.118)	(0.050)	(0.084)	(0.034)	(0.064)	(0.032)	(0.060)
HighSpread two-day effect	-0.065	-0.071	-0.082	-0.138	-0.103^{*}	-0.186^{*}	-0.063	-0.134
	(0.087)	(0.114)	(0.070)	(0.086)	(0.057)	(0.107)	(0.055)	(0.103)
Speculative two-day effect	0.095^{***}		0.096^{***}		0.070^{**}		0.069^{**}	
	(0.024)		(0.025)		(0.028)		(0.031)	
Country-industry-day FE	No	Yes	No	Yes	No	Yes	No	Yes
Rating-day FE	No	Yes	No	Yes	No	Yes	No	Yes
Entity FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,225	16,225	15,662	15,662	13,246	13,246	13,789	13,789
R^2	0.017	0.550	0.017	0.559	0.014	0.584	0.012	0.580

Notes: $^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$

Table 5: Summary statistics for EDFs, one-year spreads, and risk premia. The table reports the number of entities and summary statistics for entities with EDF and CDS data available. Summary statistics are separately computed for the three months before and after the announcement of the CSPP using daily data.

	1yr EDF (%)			1yr spread (%)			Risk premium		
	All	Eligible	HighBeta	All	Eligible	HighBeta	All	Eligible	HighBeta
N entities	77	47	17	77	47	17	77	47	17
Pre-CSPP: Mean (%)	0.182	0.182	0.384	0.611	0.376	1.640	8.972	8.874	10.260
Pre-CSPP: Median (%)	0.040	0.040	0.120	0.283	0.246	0.730	5.897	5.444	6.623
Pre-CSPP: St.Dev. (%)	0.430	0.471	0.590	1.371	0.468	2.523	15.412	16.025	18.145
Post-CSPP: Mean (%)	0.191	0.181	0.403	0.493	0.272	1.197	8.147	7.240	10.914
Post-CSPP: Median (%	0.050	0.040	0.090	0.213	0.185	0.426	4.850	4.436	4.918
Post-CSPP: St.Dev (%)	0.494	0.496	0.702	1.147	0.365	2.119	17.749	15.835	25.996

risk premia are below their pre-announcement average. One can also see in Figure 5 in Appendix B.3 that the announcement brought about a great decline in risk premia.

We test whether default risk premia dropped in the week of the CSPP announcement. If investors' risk appetite increased, we should expect to see a generalized reduction in default risk premia. Table 6 shows that risk premia dropped across all bond issuers. For the average issuer, the risk premium declined by an amount corresponding to 29% of its pre-announcement average. When we control for issuer eligibility and risk characteristics, we notice that risk premia declined less for eligible issuers. Although the differential effects associated with other risk characteristics may appear substantial, the estimates are either statistically insignificant or only barely significant.

Interestingly, the effect of the CSPP on risk premia does not simply mimic the effect on the one-year spreads. For one-year spreads, we see no generalized reduction after controlling for entities' risk characteristics, but we do see a reduction in the spreads of high-beta entities compared to lower-beta entities. For risk premia, we observe a generalized reduction even after controlling for entities' risk characteristics, but we do not find evidence that risk premia dropped more for entities with higher beta.

We therefore conclude that the announcement of the CSPP was associated with a reduction in credit risk premia. Because of the reduction in risk premia, entities with the greatest exposure to aggregate risk experienced the greatest declines in their spreads. Although our tests do not allow us to precisely quantify the change in risk premia and in the amount of risk, they nevertheless allow us to conclude that risk premia declined.[9]

[9]One could more clearly disentangle the effects of monetary policy on risk premia and the amount of risk by developing a fully structural pricing model (Berndt et al., 2005; Huang and Huang, 2012). However, such a test is beyond the scope of this paper.

Table 6: Effects of the CSPP announcement on one-year expected default frequencies (EDFs), one-year CDS spreads, and one-year risk premia. We consider weekly EDFs and CDS spreads in the three months before and after the CSPP announcement. The risk premium is the ratio between the CDS spread and the EDF. The dependent variable is the weekly change in the issuers' EDFs, CDS spreads, and risk premia. Eligible = 1 if the entity had eligible bonds outstanding in the calendar year before the announcement of the CSPP. HighBeta = 1 if the beta of the entity's five-year CDS spread with the average five-year spread of euro area issuers is in the fifth quintile of the cross-sectional distribution of CDS betas. HighSpread = 1 if the average level of the entity's five-year spread before the announcement is in the fifth quintile of the cross-sectional distribution of average five-year spread levels. Speculative = 1 if the entity is unrated or rated below BBB- at the beginning of the sample period. CDS beta and average spread level are calculated using daily data starting from the beginning of the sample period and ending two weeks before the announcement of the CSPP. EventWeek = 1 on the week of the CSPP announcement. Standard errors are in parentheses and double-clustered at the country-industry-week and entity level.

	1yr EDF (%)		1yr spread (%)		Risk premium	
	(1)	(2)	(3)	(4)	(5)	(6)
EventWeek	0.021**	0.009**	−0.101***	−0.040	−2.582***	−3.388***
	(0.008)	(0.004)	(0.036)	(0.029)	(0.680)	(0.613)
Eligible×EventWeek		0.006		−0.042		1.821**
		(0.012)		(0.041)		(0.853)
HighBeta×EventWeek		0.005		−0.093**		−0.847
		(0.018)		(0.043)		(1.122)
HighSpread×EventWeek		0.026		−0.099		−3.499
		(0.022)		(0.161)		(2.934)
Speculative×EventWeek		0.007		0.014		1.669*
		(0.008)		(0.034)		(0.874)
Entity FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,913	1,913	1,656	1,656	1,656	1,656
R^2	0.033	0.035	0.031	0.034	0.034	0.040
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$					

6 ISSUANCE

We now explore whether and how non-financial corporations modified their bond issuance after the announcement of the CSPP. We again consider the implications of the scarcity and risk channel in our model of corporate market timing in Section 3. We then obtain the following predictions on firm issuance.

> Scarcity: Eligible firms substitute eligible for ineligible bonds, but their total issuance does not increase relative to ineligible firms.

Risk: If risk premia decline, the issuance of riskier bonds increases relative to safer bonds.

In this section, we empirically document these patterns, and we also provide more direct evidence that firms attempted to time the market.

6.1 Substitution of Eligible for Ineligible Bonds

We focus on the monthly net issuance of bonds. Net issuance is defined as change in the outstanding amount of bonds, including new issues, redemptions, and bonds reaching maturity. We aggregate net issuance at the firm-eligibility level, so that, for each firm i and for each month t, we obtain the net issuance of eligible bonds I_{it}^{E} and ineligible bonds I_{it}^{I}.[10]

One concern is that some firms may become able to issue eligible bonds because of the CSPP itself. For example, rating agencies may provide more favorable ratings after the announcement. To overcome this endogeneity problem, we define an issuer as eligible if the issuer had eligible bonds outstanding in 2015, the year before the announcement of the CSPP. For eligible issuers, we consider both the eligible net issuance, I_{it}^{E}, and ineligible net issuance, I_{it}^{E}. For other issuers, which we label as ineligible, we consider only their ineligible net issuance, I_{it}^{E}.

We investigate both the short-term and the longer-term issuance response. For the short-term response, we compare issuance during three months before the CSPP announcement with issuance in the subsequent three months. For the longer-term response, we compare the ten months before and after the announcement.

To conduct our empirical tests, we scale each firm's net issuance by the outstanding amount of the firm's bonds at the beginning of the sample period under consideration, B_i. That is, for the short-term response, we divide I_{it}^{E} and I_{it}^{I} by the notional value of all of firm i's bonds that were outstanding on November 30, 2015. For the longer-term response, we divide the net issuance variables by the notional value of all of firm i's bonds that were outstanding on April 30, 2015.

Table 7 reports the summary statistics for the scaled net issuance in the ten months before and after the announcement. This sample represents 2,658 issuers, of which 198 had

[10]It is important to first compute net issuance at the individual bond level and then aggregate at firm-eligibility level, rather than simply compute changes in the outstanding amounts of eligible and ineligible bonds. Bonds may be included in, or excluded from, the list of eligible assets, and changes in the total outstanding amounts of eligible and ineligible bonds may reflect these inclusions and exclusions. By computing net issuance at the bond level, we make sure that our measure of net issuance at the firm-eligibility level measures only the actual issuance choices of the firm.

Table 7: Summary statistics. The table shows the number of firms, the distribution of the initial outstanding amount of bonds ten months before the announcement of the CSPP, as well as the distribution of net issuance in the ten months before and after the announcement of the CSPP. Net issuance is scaled by the initial outstanding amount of all the firm's bonds ten months before the announcement. Wt.Avg. is the weighted average where weights are given by the initial outstanding amount of all the firm's bonds ten months before the announcement.

Firms:	All	Eligible			Ineligible
Bonds:	All	All	Eligible	Ineligible	Ineligible
N firms	2,658	198	198	198	2,460
Initial amount: Mean (€mln)	334.69	3,202.47	2,539.74	662.73	103.86
Initial amount: Median (€mln)	10	1,575	1,199.91	13.19	7.61
Initial amount: St.Dev. (€mln)	1,514.00	4,488.59	3,860.06	1,493.28	383.60
Initial amount: Decile 1 (€mln)	0.90	170.61	33.50	0	0.80
Initial amount: Quartile 1 (€mln)	2.18	607.50	500	0	2
Initial amount: Quartile 3 (€mln)	65.44	3,864.70	2,842.38	628.12	40
Initial amount: Decile 9 (€mln)	526.50	7,900.20	6,360.02	1,817.50	254.42
Pre-CSPP net issuance: Mean (%)	-0.07	0.98	0.64	0.33	-0.15
Pre-CSPP net issuance: Median (%)	0	0	0	0	0
Pre-CSPP net issuance: Wt.Avg. (%)	-0.25	-0.01	0.04	-0.06	-0.83
Pre-CSPP net issuance: St.Dev. (%)	65.81	21.10	18.91	9.41	68.15
Post-CSPP net issuance: Mean (%)	0.68	2.47	0.86	1.61	0.54
Post-CSPP net issuance: Median (%)	0	0	0	0	0
Post-CSPP net issuance: Wt.Avg. (%)	0.32	0.56	0.74	-0.18	-0.25
Post-CSPP net issuance: St.Dev. (%)	210.42	64.26	20.29	61.02	217.97

eligible bonds outstanding at some time in the calendar year before the announcement of the CSPP.

We then run a regression using monthly data:

$$\frac{I^x_{it}}{B_i} = \alpha_P \text{Eligible}^x \times \text{Post}_t + \alpha_M \text{Eligible}^x \times \text{FirstMonth}_t + \iota_{f(i)t} + \iota_{ix} + u_{it}, \tag{4}$$

where x denotes whether the issuance is eligible or not, i denotes the firm, and t denotes the month. Eligible_i = 1 if the issuance is eligible , i.e. $x = E$; Post_t = 1 if the month is after the announcement of the CSPP; FirstMonth_t = 1 for March 2016, which is the month the CSPP was announced; $\iota_{f(i)t}$ is either a country-sector-month fixed effect, or a firm-month fixed effect; ι_{ix} is a firm-eligibility fixed effect (one fixed effect for any i, x pairs).[11]

[11] We control for the first-month effect for two reasons. First, the CSPP was announced on the 10th day of the month, after some issuance activity had already taken place. It would therefore be incorrect to attribute the whole month's net issuance to the CSPP. Second, as we see in Figure 2b, net issuance of eligible bonds increased sharply during the month of March 2016. We therefore choose to control for the first-month effect in order to obtain a more accurate estimate of the change in net issuance that persisted after the announcement.

Table 8: Net issuance of eligible and ineligible bonds around the CSPP announcement. The dependent variable is the monthly net issuance of eligible and ineligible bonds, scaled by the firm's outstanding amount of bonds at the beginning of the sample period. Eligible = 1 if the net issuance is eligible. Post = 1 after the announcement of the CSPP. FirstMonth = 1 for the month in which the CSPP was announced. A firm is eligible if it had eligible bonds outstanding in the calendar year before the CSPP announcement. Odd-numbered columns consider the three months before and after the announcement; even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

	Net Issuance (%)			
	All firms		Eligible firms	
	(1)	(2)	(3)	(4)
Eligible×Post	1.113*	0.506**	1.521***	0.638**
	(0.573)	(0.253)	(0.548)	(0.262)
Eligible×FirstMonth	2.054	2.027	1.793	1.867
	(2.296)	(2.294)	(2.223)	(2.210)
Country-industry-month FE	Yes	Yes	No	No
Firm-month FE	No	No	Yes	Yes
Firm-eligibility FE	Yes	Yes	Yes	Yes
Observations	17,118	56,320	2,412	7,920
R^2	0.278	0.245	0.392	0.525
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$			

Standard errors are double-clustered at the country-sector-month and firm level. Since issuance is very lumpy and a small denominator B_i could introduce a large amount of noise in the firm i's series, we weight regressions by B_i, in order to correct for the noise. By doing so, we also obtain estimates that are more informative of the aggregate issuance patterns.

Table 8 reports our results. Eligible issuance increased relative to ineligible issuance after the announcement of the program. In the entire sample, the longer-term change of eligible issuance was 0.506% higher than the change of ineligible issuance. The short-term response is higher at 1.113%, although it is barely statistically significant.

To put these numbers into perspective, at the end of February 2016 the total outstanding amount of euro-denominated bonds issued by non-financial corporations domiciled in the euro area was €894 billion. Multiplying this amount by the longer-term effect on eligible issuance, we estimate a €4.5 billion monthly substitution of eligible for ineligible bonds in the ten months following the announcement of the CSPP. This number accounts only for the relative increase in eligible issuance compared to ineligible issuance and does not account for the change in aggregate issuance. Yet, this relative increase alone represents 60% of the €7.5 billion monthly purchases that the ECB made over the course of the first year of the program.

We then explore whether the relative increase in eligible issuance occurred because eligible firms substituted eligible for ineligible bonds, or because eligible firms issued more than ineligible firms. Our results show a clear pattern of within-firm substitutions. In the last two columns of Table 8, we consider only eligible firms and control for firm-month fixed effects. Thanks to this identification strategy, we control for all the time-varying firm characteristics, including investment opportunities, financing needs, and cost of issuance. These regressions therefore focus on the choice of issuing eligible or ineligible bonds conditional on these characteristics.

Eligible firms shifted toward eligible issuance, at a rate of 1.521% in the short term, and a rate of 0.638% in the longer term. Both substitution effects are stronger than the estimates obtained in the full sample of firms. Because the estimates are higher when we control for firm-month fixed-effects, we conclude, following the reasoning in Jiménez et al. (2020) and Khwaja and Mian (2008), that there is a positive correlation between the firm-level monetary policy shock and the firm-level shock to demand for financing. Therefore, we can be reasonably confident that a firm-level analysis will not overestimate the impact of the CSPP announcement.

In Table 9, we conduct a firm-level analysis of the total issuance of firms. Although eligible firms substituted eligible for ineligible bonds, they did not increase their total issuance compared to ineligible firms. The point estimates for the increase in total issuance of eligible firms versus ineligible firms are high and positive in the first month, but negative afterward, although always statistically insignificant. This suggests that the cost of capital changed in the same way for eligible and ineligible firms, because they changed total issuance in the same way.

Table 9 also shows whether riskier firms increased their issuance. To test this, we restrict the sample to the CDS reference entities in Section 5.3 and examine whether firms with high CDS beta issued more than firms with lower beta. Within this restricted sample, we find that high CDS beta firms, as well as eligible firms, increased their issuance in the first month, but reduced issuance afterward, although the estimates are either statistically insignificant or only barely significant.

In a placebo test, we run the same regressions on issuance by eligibility and total issuance in the periods around the announcement of the PSPP. Since the PSPP did not involve purchases of corporate bonds, we would not expect to observe any substitution toward eligible issuance, nor an increase in total issuance by eligible firms. Tables 21 and 22 in Appendix C confirm our expectations.

Table 9: Total net issuance around the CSPP announcement. The dependent variable is the total monthly net issuance of bonds by each firm, scaled by the firm's outstanding amount of bonds at the beginning of the sample period. EligibleFirm = 1 if the firm had eligible bonds outstanding in the calendar year before the CSPP announcement. Post = 1 after the announcement of the CSPP. FirstMonth = 1 for the month in which the CSPP was announced. HighBeta = 1 if the firm is a CDS reference entity and the beta of its five-year CDS spread lies in the fifth quintile of the CDS beta distribution. Odd-numbered columns consider the three months before and after the announcement; even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

	Net Issuance (%)			
	All firms		CDS entities	
	(1)	(2)	(3)	(4)
EligibleFirm×Post	−0.708	−0.393	−5.576*	−2.115
	(1.418)	(0.601)	(2.823)	(1.396)
HighBetaFirm×Post			−1.609	−0.986
			(2.281)	(0.780)
EligibleFirm×FirstMonth	3.470	3.861	9.770	8.793
	(3.350)	(3.347)	(6.720)	(6.474)
HighBetaFirm×FirstMonth			6.912*	5.663*
			(3.679)	(3.068)
Country-industry-month FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	15,858	52,180	588	2,000
R^2	0.343	0.271	0.568	0.318
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$			

6.2 How Quickly Can Firms Issue Bonds?

Our analysis suggests that eligible firms acted quickly in order to shift their issuance toward eligible bonds. So how quickly can firms issue bonds? To answer this question, we collect some anecdotal evidence by manually searching information of eligible issuers issuing bonds in the second half of March 2016. Most of the issuers had long-term issuance agreements already in place with major banks. These agreements allow firms to issue bonds of a predetermined type "from time to time," thus giving firms substantial flexibility to act quickly.

In order to conduct a more systematic analysis, in Appendix B.4 we consider bonds' issue dates, as well as the dates of the issues' public announcements. For the available sample of bonds, the median time lag between the announcement of the bond issue and the actual issue date is only seven days. We therefore conclude that large and established issuers are able to issue bonds quickly enough to take advantage of a change in market conditions.

6.3 HOW DID FIRMS SUBSTITUTE?

So how are firms able to ensure that their bonds are eligible? That is, across which bond characteristics did firms substitute in order to time the market?

As we mentioned in Section 4.1, a corporate bond needs to satisfy an extensive set of requirements in order to be eligible as collateral at the ECB. Although a corporation has limited control over some of the requirements, such as a bond's credit rating, it can easily substitute across some other bond characteristics that matter for the bond's eligibility.

Among other requirements, in order to be eligible, a bond must be (i) listed on an eligible regulated exchange, (ii) deposited with an eligible centralized security depository (CSD), (iii) non-subordinated, and (iv) investment-grade rated. A firm can choose to list its bonds on an exchange and for clearing in a CSD, possibly at a cost. A firm may also have some flexibility in deciding the seniority of new issues. Moreover, although ratings are assigned by external agencies, a firm may be able to provide collateral for a bond or obtain a credit guarantee from a third party.

However, changing the seniority, collateral, and guarantees of a bond, also changes the risk profile of the bond. As we have seen in Section 5, the announcement of the CSPP resulted in a substantial re-pricing of riskier bonds. This suggests an increased risk appetite among investors. As a result, firms may have been tempted to shift toward junior, unsecured or non-guaranteed bonds, in order to take advantage of lower risk premia.

Similar to our study of the substitution between eligible and ineligible issuance, we now study substitution across bond characteristics. In particular, we separately consider the substitution between the net issuance of listed versus non-listed bonds, CSD-deposited versus non-CSD-deposited bonds, senior versus junior bonds, secured versus unsecured bonds, and guaranteed versus non-guaranteed bonds.

Using monthly bond issuance data, we run five separate regressions in the form

$$\frac{I_{it}^T}{B_i} = \alpha_P \text{IssuanceType}^T \times \text{Post}_t + \alpha_M \text{IssuanceType}^T \times \text{FirstMonth}_t + \iota_{f(i)t} + \iota_{ix} + u_{it}, \quad (5)$$

where T denotes the characteristic of the bond issuance, i denotes the firm, and t denotes the month. We consider different characteristics in five separate regressions, and IssuanceType is an indicator variable for whether the bond issuance has the characteristic under consideration. In the first regression, IssuanceType indicates whether the bonds are listed or not (IssuanceType = Listed). In the second, it indicates whether they are CSD-deposited or not (IssuanceType = InCSD). In the third, it indicates whether they are

Table 10: Net issuance by characteristics related to eligibility and riskiness around the CSPP announcement. We run separate regressions of net issuance of bonds with and without a certain characteristic on the interaction IssuanceType×Post and report the coefficients on this interaction. IssuanceType = 1 if the issuance has the characteristic being considered. Post = 1 after the announcement of the CSPP. We control for an IssuanceType×FirstMonth interaction, firm-month fixed effects, and firm-IssuanceType fixed effects. For each row, we report the coefficients on the interaction IssuanceType×Post for a different issuance type: Listed = 1 if the issuance is listed (row 1); InCSD = 1 if the issuance is deposited with a CSD (row 2); Senior = 1 if the issuance is senior (row 3); Secured = 1 if the issuance is secured (row 4); Guaranteed = 1 if the issuance is guaranteed (row 5). A firm is eligible if it had eligible bonds outstanding in the calendar year before the CSPP announcement. Odd-numbered columns consider the three months before and after the announcement. Even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

	Net Issuance (%)					
	All firms		Eligible firms		Ineligible firms	
	3M	10M	3M	10M	3M	10M
Listed×Post	1.649***	0.671***	1.990***	0.857***	0.791	0.210
	(0.477)	(0.224)	(0.610)	(0.273)	(0.713)	(0.331)
InCSD×Post	1.231**	1.678***	1.468**	1.851***	0.637	1.248*
	(0.519)	(0.332)	(0.660)	(0.379)	(0.775)	(0.666)
Senior×Post	1.630***	0.069	2.162***	0.260	0.296	−0.406
	(0.501)	(0.291)	(0.602)	(0.322)	(0.837)	(0.574)
Secured×Post	−1.875***	−0.393	−1.849***	−0.303	−1.940**	−0.619
	(0.509)	(0.286)	(0.624)	(0.312)	(0.867)	(0.599)
Guaranteed×Post	−1.096**	−0.254	−0.984	−0.247	−1.379*	−0.271
	(0.478)	(0.284)	(0.645)	(0.316)	(0.777)	(0.597)
IssuanceType×FirstMonth	Yes	Yes	Yes	Yes	Yes	Yes
Firm-month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-IssuanceType FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,220	106,320	2,412	7,920	29,808	98,400

Notes: $^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$

senior or not (IssuanceType = Senior). In the fourth, it indicates whether they are secured or not (IssuanceType = Secured). In the fifth, it indicates whether they are guaranteed or not (IssuanceType = Guaranteed). $\iota_{f(i)t}$ is a firm-month fixed effect, and ι_{ix} is a firm-type fixed effect. Regressions are weighted by the outstanding amount of the firm's bonds at the beginning of the sample period under consideration, B_i. Standard errors are double-clustered at the country-sector-month and firm level.

Table 10 shows estimates of the coefficients on the IssuanceType×Post interaction in the five regressions. One can clearly see that firms shifted their issuance toward exchange-listed and CSD-deposited bonds after the announcement of the CSPP. This kind of substitution can be attributed primarily to eligible firms, as ineligible firms display a much weaker substitution pattern in terms of the listing or CSD-clearing status of their net issuance.

Eligible firms increased their issuance of senior bonds in the short run, but the effect faded over a longer period. This may reflect firms' limited capacity to increase the share of senior bonds beyond a certain level. It may also be due to firms' incentive to time risk premia. Although firms may have wanted to shift toward senior bonds because seniority is a necessary requirement for eligibility, they were also tempted to shift toward junior bonds in order to take advantage of lower risk premia.

Finally, we find that firms did not increase the issuance of secured or guaranteed bonds. Instead, in the short run, firms actually shifted toward unsecured and non-guaranteed bonds. Moreover, the substitution was economically stronger among ineligible firms. This suggests that firms took advantage of investors' higher risk appetite and increased their issuance of riskier bonds, at least in the short run.

We repeat the same analysis for the PSPP. With the announcement of that program, there was no market-timing incentive that would lead firms to issue more listed, CSD-cleared, or senior bonds. However, the PSPP announcement still reduced corporate bond risk premia, as we show in Appendix C. Therefore, firms may have timed their issuance of junior, unsecured, and non-guaranteed bonds. The empirical evidence, reported in Table 23 in Appendix C, generally aligns with our predictions. We do not see any pattern of substitution in favor of listed or CSD-cleared bonds, but firms did shift toward riskier forms of issuance.

6.4 Did Firms Try to Time the Market?

To conclude our analysis of firms' issuance response, we look for more direct evidence on whether firms tried to time the market after the announcement of the CSPP. Although we cannot observe managers' intentions, here we take a revealed preference approach. We look for hints suggesting that issuers preferred to seize the moment and issue bonds after the announcement rather than to wait for future needs and investment opportunities to arise.

We consider four bond characteristics that may reveal a firm's preferences regarding the timing of its issuance. We study whether firms issued less commercial paper and fewer short-maturity bonds, thus indicating an intention to collect funds to be used over a longer period. We also explore if firms issued more fixed-coupon bonds, thus suggesting firms intended to lock in current borrowing rates. Then, we check whether firms increased the net issuance of bonds whose prospectus mentions "general corporate purposes" as the sole use of proceeds. We consider an increase in this lack of specificity as

Table 11: Net issuance by characteristics related to a willingness to time the market after the CSPP announcement. We run separate regressions of net issuance of bonds with and without a certain characteristic on the interaction IssuanceType×Post and report the coefficients on this interaction. IssuanceType = 1 if the issuance has the characteristic being considered. Post = 1 after the announcement of the CSPP. We control for an IssuanceType×FirstMonth interaction, firm-month fixed effects, and firm-IssuanceType fixed effects. For each row, we report the coefficients on the interaction IssuanceType×Post for a different issuance type: CommPaper = 1 if the issuance is commercial paper (row 1); ShortMaturity = 1 if the issuance's maturity is shorter than one year (row 2); FixedCoupon = 1 if the issuance has a fixed coupon rate (row 3); GeneralPurpose = 1 if the issuance prospectus indicates general corporate purposes as the only use of proceeds (row 4); IssuanceProgram = 1 if the issue is part of an issuance program (row 5). A firm is eligible if it had eligible bonds outstanding in the calendar year before the CSPP announcement. Odd-numbered columns consider the three months before and after the announcement. Even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

	Net Issuance (%)					
	All firms		Eligible firms		Ineligible firms	
	3M	10M	3M	10M	3M	10M
CommPaper×Post	-1.676^{***}	-0.712^{**}	-1.785^{***}	-0.752^{**}	-1.404^{*}	-0.613
	(0.538)	(0.301)	(0.655)	(0.333)	(0.839)	(0.594)
ShortMaturity×Post	-1.452^{***}	-0.560^{*}	-1.494^{**}	-0.528	-1.345	-0.639
	(0.548)	(0.300)	(0.667)	(0.335)	(0.874)	(0.617)
FixedCoupon×Post	1.825^{***}	0.690^{**}	2.084^{***}	0.809^{***}	1.174	0.396
	(0.507)	(0.277)	(0.617)	(0.300)	(0.827)	(0.570)
GeneralPurpose×Post	0.906^{*}	0.648^{***}	1.408^{**}	0.957^{***}	-0.354	-0.121
	(0.475)	(0.238)	(0.561)	(0.301)	(0.837)	(0.342)
IssuanceProgram×Post	1.065^{**}	0.140	1.225^{**}	0.225	0.662	-0.072
	(0.414)	(0.180)	(0.499)	(0.216)	(0.742)	(0.337)
IssuanceType×FirstMonth	Yes	Yes	Yes	Yes	Yes	Yes
Firm-month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-IssuanceType FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,220	106,320	2,412	7,920	29,808	98,400
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$					

a hint that firms were seizing an opportunity, possibly in the absence of specific investment projects or financing needs. Finally, we assess whether firms took advantage of their issuance programs to issue bonds quickly after the CSPP announcement.

We run five separate regressions in the same form of (5). Here, in the first regression IssuanceType indicates whether the issuance is of commercial paper or not (IssuanceType = CommPaper). In the second, it indicates whether it has maturity shorter than 1 year or not (IssuanceType = ShortMaturity). In the third, it indicates whether is has a fixed coupon or not (IssuanceType = FixedCoupon). In the fourth, it indicates whether it is described to be solely for general corporate purposes or not (IssuanceType = GeneralPurpose). In the fifth, it indicates whether it is part of an issuance program or not (IssuanceType = IssuanceProgram).

Table 11 reports the estimated coefficients on the IssuanceType×Post interaction in the five regressions. In all five cases, we find hints of market-timing behavior, especially in the case of eligible firms. Eligible firms moved away from commercial paper and short-maturity bonds, shifted toward fixed-coupon bonds, and increased their issuance of bonds for general corporate purposes. In the short run, they relied more heavily on issuance programs, with effect lessening in the longer run, when firms may have sufficient time to issue bonds through other channels.

In a placebo test, we repeat the analysis for the announcement of the PSPP. Table 24 in Appendix C reports the results. As expected, we find no relative change in the issuance of bonds linked to issuance programs, or in the issuance motivated by general corporate purposes only. We do observe, in the longer run, an increase in the issuance of commercial paper and of bonds with maturities shorter than one year. This observation is consistent with a rebalancing effect: Issuers supplied more liquid corporate bonds after the PSPP reduced the residual supply of government bonds, which are typically more liquid than corporate ones.

7 Real Economic Activity

Finally, we investigate whether bond issuers – eligible issuers in particular – experienced different real economic outcomes after the announcement of the CSPP compared to firms that did not issue bonds. We intentionally restrict our analysis to the differential effect of the CSPP on issuers compared to non-issuers, while controlling for aggregate economic conditions. We leave the identification of the aggregate effect of the CSPP for future research.

In Sections 5 and 6, we showed that credit premia declined after the CSPP announcement and that firms timed the bond market. We therefore ask whether issuers enjoyed longer-term economic benefits following the CSPP announcement.

Grosse-Rueschkamp et al. (2019) and Ertan et al. (2020) show that eligible issuers substituted bank loans for bond issues. Banks, in turn, increased the supply of bank loans to ineligible firms, which used the loans to expand investment and employment. However, these papers do not investigate whether eligible firms, or bond issuers more generally, gained significant economic benefits compared to non-issuers. In this section, we fill this gap.

We document that bond issuers did not experience higher rates of growth compared to non-issuers, and that eligible firms did not experience significantly different economic outcomes compared to ineligible issuers. Although issuers paid lower interest rates compared to non-issuers, their shareholders did not enjoy larger cash flows.

We run regressions using end-of-the-year financial statements from Orbis for the two years before and after the CSPP announcement. We separately consider the sample of all firms and the sample of bond issuers. For the sample of all firms, we run regressions in this form:

$$y_{it} = \alpha^I \text{Issuer}_i \times \text{Post}_t + \delta_1 y_{it-1} + \delta_2 y_{it-2} + \iota_{css(i)t} + \iota_i + u_{it};$$

whereas for the sample of bond issuers, we run regressions as the following:

$$y_{it} = \alpha^E \text{EligIssuer}_i \times \text{Post}_t + \delta_1 y_{it-1} + \delta_2 y_{it-2} + \iota_{css(i)t} + \iota_i + u_{it}.$$

In the regressions, y_{it} is the outcome of interest, i indicates the firm, and t indicates the year; Issuer_i = 1 if the firm issues corporate bonds; EligIssuer_i = 1 if the firm is an issuer and had eligible bonds outstanding in 2015; Post_t = 1 in 2016 and 2017; $\iota_{css(i)t}$ is a country-sector-size-year fixed effect; and ι_i is a firm fixed effect.[12] Standard errors are double-clustered at the country-industry-year and firm level. To reduce the impact of outliers and data-entry mistakes, we retain only observations for which the dependent variable lies between the first and the 99th percentile. We restrict the sample to medium and larger firms.[13]

7.1 Did (Eligible) Issuers Benefit from the Program?

In Section 5, we showed that bond valuation increased after the CSPP announcement, whereas in Section 6, we showed that eligible issuers timed the bond market by adjusting the characteristics of their bond issues. We therefore ask: Did issuers, and eligible issuers in particular, experience a reduction in their cost of borrowing compared to non-issuers? Did their shareholders enjoy larger cash flows?

We consider the division of surplus between debt holders and equity holders in terms of leverage, interest expenses per liabilities, and cash flow per book equity. Given our previous results, we do not expect to find significant changes in the leverage and interest expenses of eligible issuers compared to ineligible issuers. However, bond-issuing firms

[12]Size is one of the four size categories in Orbis: small, medium, large, and very large.

[13]These are firms that satisfy at least one of the following criteria: operating revenue above €1 million, total assets above €20 million, or number of employees above 15. Results are similar if we consider the entire sample of firms in the euro area.

may increase their leverage or pay lower interests compared to non-issuers if the latter face constraints in the credit market. Moreover, issuers' cash flow may either increase or decreases relative to non-issuers, because of the combined effects of a change in borrowing costs, issuance expenses, and spillover effects on non-issuers as those documented by Grosse-Rueschkamp et al. (2019) and Ertan et al. (2020).

Table 12a shows that, in the two years following the CSPP announcement, bond issuers enjoyed a drop of 13 basis points in their interest expenses compared to non-issuers. However, issuers did not increase their leverage by any economically significant amount. When comparing eligible and ineligible issuers in Table 12b, we observe that both experienced similar changes in their leverage and cost of borrowing.

Although one may expect the shareholders of bond-issuing firms to enjoy higher cash flows as a result of their market-timing activity, our results in Table 12 offer a different picture. If we do not control for firm size, bond issuers appear to generate higher cash flows for their shareholders. However, bond issuers tend to be large firms. After controlling for firm size, we do not observe a statistically significant change in shareholder cash flow for bond issuers compared to non-issuers. Moreover, we find no statistically significant change in the cash flow of eligible issuers relative to ineligible ones, although the point estimates are positive.

Taken together, these results suggest that, after taking into account spillover effects and the cost of bond issuance, the shareholders of eligible and ineligible issuers did not capture significant private benefits after the CSPP announcement.

7.2 Growth Rates

To conclude, we consider the growth rates of euro-area firms in the years around the CSPP announcement. In particular we ask whether issuers, and eligible issuers in particular, increased their size relative to non-issuers. We consider firm growth in terms of total assets, number of employees, and tangible fixed assets.

Table 13 shows that issuers did not grow faster than non-issuers. In fact, non-issuers expanded their size more than issuers in the two years following the CSPP announcement, especially when we consider total asset and fixed asset growth. Although eligible issuers appear to grow more than ineligible issuers in terms of total assets and employment, the differences in outcomes are not statistically significant.

Grosse-Rueschkamp et al. (2019) and Ertan et al. (2020) document that banks extended more credit to ineligible firms after the CSPP. These firms were therefore able to expand investments. However, they do not investigate the differential real economic outcomes

Table 12: Leverage, borrowing costs, and cash flow. The dependent variables are liabilities over total assets (columns 1 and 2), interest expenses over liabilities (columns 3 and 4), and cash flow per book equity (column 5 and 6). Issuer = 1 if the firms had bonds outstanding in 2015. EligIssuer = 1 if the firm is an issuer and it had eligible bonds outstanding at some point during 2015. Post = 1 for the 2016 and 2017 financial statements. The sample includes firms of medium, large, and very large size. Standard errors are in parentheses and are double-clustered at the country-industry-year and firm level.

(a) All firms

	$\frac{\text{Liab}_t}{\text{A}_t}$ (%)		$\frac{\text{Inte}_t}{\text{Liab}_{t-1}}$ (%)		$\frac{\text{CF}_t}{\text{BE}_{t-1}}$ (%)	
	(1)	(2)	(3)	(4)	(5)	(6)
Issuer∗Post	0.509^{**}	0.229	-0.129^{***}	-0.133^{***}	2.910^{***}	0.444
	(0.208)	(0.220)	(0.040)	(0.038)	(0.935)	(0.938)
1- and 2-year lag. dep. var.	Yes	Yes	Yes	Yes	Yes	Yes
Country-industry-year FE	Yes	No	Yes	No	Yes	No
Country-industry-year-size FE	No	Yes	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,407,196	2,407,164	1,312,244	1,312,228	1,560,896	1,560,860
R^2	0.937	0.937	0.779	0.780	0.611	0.611

(b) Bond issuers

	$\frac{\text{Liab}_t}{\text{A}_t}$ (%)		$\frac{\text{Inte}_t}{\text{Liab}_{t-1}}$ (%)		$\frac{\text{CF}_t}{\text{BE}_{t-1}}$ (%)	
	(1)	(2)	(3)	(4)	(5)	(6)
EligFirm∗Post	0.214	−0.126	−0.063	−0.059	1.913	1.478
	(0.718)	(0.736)	(0.127)	(0.133)	(3.085)	(3.193)
1- and 2-year lag. dep. var.	Yes	Yes	Yes	Yes	Yes	Yes
Country-industry-year FE	Yes	No	Yes	No	Yes	No
Country-industry-year-size FE	No	Yes	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,868	5,868	4,348	4,348	5,440	5,436
R^2	0.932	0.937	0.761	0.777	0.632	0.662

Notes: $^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$

Table 13: Firm growth. The dependent variables are total asset growth (columns 1 and 2), employment growth (columns 3 and 4), and tangible fixed asset growth (column 5 and 6). Issuer = 1 if the firms had bonds outstanding in 2015. EligIssuer = 1 if the firm is an issuer and it had eligible bonds outstanding at some point during 2015. Post = 1 for the 2016 and 2017 financial statements. The sample includes firms of medium, large, and very large size. Standard errors are in parentheses and are double-clustered at the country-industry-year and firm level.

(a) All firms

	$\frac{A_t}{A_{t-1}}$ (%)		$\frac{Empl_t}{Empl_{t-1}}$ (%)		$\frac{TFA_t}{TFA_{t-1}}$ (%)	
	(1)	(2)	(3)	(4)	(5)	(6)
Issuer∗Post	-2.348^{***}	-2.947^{***}	-0.864	-1.198^{*}	-4.325^{***}	-2.969^{*}
	(0.683)	(0.711)	(0.629)	(0.635)	(1.644)	(1.741)
1- and 2-year lag. dep. var.	Yes	Yes	Yes	Yes	Yes	Yes
Country-industry-year FE	Yes	No	Yes	No	Yes	No
Country-industry-year-size FE	No	Yes	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,517,512	2,517,492	1,331,164	1,331,136	2,199,764	2,199,736
R^2	0.375	0.375	0.364	0.365	0.335	0.335

(b) Bond issuers

	$\frac{A_t}{A_{t-1}}$ (%)		$\frac{Empl_t}{Empl_{t-1}}$ (%)		$\frac{TFA_t}{TFA_{t-1}}$ (%)	
	(1)	(2)	(3)	(4)	(5)	(6)
EligFirm∗Post	2.295	2.715	1.460	1.153	1.199	-0.381
	(2.007)	(2.071)	(2.518)	(2.604)	(8.335)	(8.832)
1- and 2-year lag. dep. var.	Yes	Yes	Yes	Yes	Yes	Yes
Country-industry-year FE	Yes	No	Yes	No	Yes	No
Country-industry-year-size FE	No	Yes	No	Yes	No	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,980	5,980	4,668	4,668	5,112	5,112
R^2	0.485	0.530	0.457	0.482	0.393	0.430
Notes:	$^{*}p \leq .10$; $^{**}p \leq .05$; $^{***}p \leq .01$					

between issuers and non-issuers. We therefore provide suggestive evidence that the spillover effects might have been strong enough that non-issuers grew more than bond-issuing firms.

8 Conclusions

The CSPP announcement in March 2016 produced considerable spillover effects on the issuance and valuation of corporate bonds. The prices of eligible bonds did not increase relative to ineligible bonds; eligible firms did not increase their total issuance relative to ineligible issuers, nor did they experience a relative change in their growth and productivity. Although issuers enjoyed a reduced cost of borrowing compared to non-issuers, they did not show signs of different economic performance.

After the announcement of the CSPP, eligible issuers timed the market by substituting eligible for ineligible bonds. To do this, eligible issuers increased the issuance of bonds listed on exchanges and cleared in centralized security depositories. In the short run, they also increased the issuance of senior bonds.

The CSPP increased investors' appetite for aggregate risk, which we observe in the reduced risk premia in both corporate bond markets and CDS markets. Firms met the increase in investor risk appetite by issuing more unsecured and non-guaranteed bonds.

Firms displayed eagerness to time the market after the announcement. They issued less in short-term bonds and commercial paper, but more in fixed-coupon bonds, possibly in an attempt to take advantage of what were perceived as favorable market conditions. They also issued more bonds that were not tied to specific business needs or opportunities, and they exploited their issuance programs to issue bonds quickly after the announcement.

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Appendix A Proofs

A.1 Investors' First-Order Conditions

The first-order conditions for investors are

$$e_j = \bar{e} - \frac{\Delta_j}{\tau} \tag{6}$$

$$1 - P_S - \bar{e}\Delta_S + \frac{\Delta_S^2}{2\tau} = \gamma(B_S + B_R) \tag{7}$$

$$(1-q) - P_R - \pi q - \bar{e}\Delta_R + \frac{\Delta_R^2}{2\tau} = \gamma(B_S + B_R). \tag{8}$$

Equation (6) expresses the demand for eligible bonds as a decreasing function of their price premium. Equations (7) and (8) establish that the net marginal benefit of holding ineligible bonds must equal the marginal cost of increasing bond holdings.

A.2 Equilibrium Characterization

In order to ensure that markets for eligible bonds clear, the equilibrium is characterized by $\Delta_j^* \leq \psi$. Otherwise, eligible firms would be able to realize unbounded profits by issuing an unbounded amount of bonds. However, if $\Delta^* < \psi$, investors would have a positive demand for eligible bonds because of assumption (1) and demand function (6), but eligible issuers would be unwilling to supply them. Hence, in equilibrium the price premium of eligible bonds must match the cost of issuing them. That is:

$$\Delta_j^* = \psi.$$

Moreover, if $\Delta_j^* = \psi$, then eligible issuers have no advantage over ineligible issuers in terms of cost of capital, and therefore

$$I_{jE}^* = I_{jN}^* \quad \text{and} \quad K_{jE}^* = K_{jN}^*,$$

so that we can simply define I_j^* and K_j^* as the total issuance and investments of issuers of risk type j.

Furthermore, assumption (1) implies that $P_S^* < 1$ and $P_R^* < (1-q)$ and, therefore, firms do not have any arbitrage gain from issuing bonds. Therefore, all the issuance proceeds are invested, that is $K_j^* = P_j^* I_j^*$, and the first-order condition for issuance is simply

$$A - cI_j^* = \frac{1}{P_j^*}, \tag{9}$$

which shows that firms increase their bond issuance if bond prices increase.

A.3 Proof of Proposition 1

Proof. Since $\Delta_j^* = \psi$ and $I_{jE}^* = I_{jN}^*$, then it must be the case that $\partial_G(I_{jE}^* - I_{jN}^*) = 0$ and $\partial_G \Delta_j^* = 0$.

Combining investors' first-order conditions (7) and (8), we obtain an expression of the price difference between safe and risky bonds:

$$P_S^* - P_R^* = q + \pi q > 0. \tag{10}$$

From this equation, it follows that $\partial_G(P_S^* - P_R^*) = 0$.

After combining investors' demand for safe bonds (7) with the market clearing conditions and differentiating, we obtain

$$-\partial_G P_S^* = \gamma \partial_G (I_S^* + I_R^*) - \gamma,$$

whereas after combining firms' demand for capital (9) with $\partial_G(P_S^* - P_R^*) = 0$, we obtain

$$\partial_G(I_S^* + I_R^*) = \frac{1}{c} \partial_G P_S^* \left(\frac{1}{(P_S^*)^2} + \frac{1}{(P_R^*)^2} \right).$$

Together, these equations imply that $\partial_G P_S^* > 0$. Since $\partial_G(P_S^* - P_R^*) = 0$, firms' first-order conditions imply that

$$\partial_G I_j^* = \frac{1}{c} \frac{\partial_G P_j^*}{(P_j^*)^2} > 0.$$

□

A.4 Proof of Proposition 2

Proof. Combining the market clearing conditions for safe and risky eligible bonds and dividing by the total amount issued, we obtain

$$\frac{f_S^* I_S^* + f_R^* I_R^*}{I_S^* + I_R^*} = e^* + (1 - e^*) \frac{G}{I_S^* + I_R^*}.$$

Because e^* does not change with G, it suffices to show that the ratio $\frac{G}{I_S^*+I_R^*}$ increases when G increases. Let us consider equation (7) and the equilibrium price premium $\Delta_j^* = \psi$, thus obtaining

$$1 - P_S^* - \bar{e}\psi + \frac{\psi^2}{2\tau} = \gamma(B_S^* + B_R^*).$$

According to Proposition 1, P_S increases when G increases, which implies that $B_S^* + B_R^*$ must decline. Because $I_S^* + I_R^* = B_S^* + B_R^* + G$, then $\frac{G}{I_S^*+I_R^*}$ increases when G increases. □

A.5 PROOF OF PROPOSITION 3

Proof. Consider a change in risk aversion π. From equation (10), it follows that $\partial_\pi(P_S^* - P_R^*) > 0$. Taking the difference in the firms' demand for capital and differentiating, we obtain

$$\partial_\pi(I_S^* - I_R^*) = \frac{1}{c}\left(\frac{\partial_\pi P_S^*}{(P_S^*)^2} - \frac{\partial_\pi P_R^*}{(P_R^*)^2}\right).$$

Using $\partial_\pi(P_S^* - P_R^*) > 0$, we obtain that

$$\partial_\pi(I_S^* - I_R^*) > \frac{1}{c}\left(\frac{1}{(P_S^*)^2} - \frac{1}{(P_R^*)^2}\right)\partial_\pi P_R^*,$$

where $\frac{1}{(P_S^*)^2} - \frac{1}{(P_R^*)^2} < 0$ because of equation (10). It therefore suffices to show that $\partial_\pi P_R^* < 0$. Assume, by way of contradiction, that $\partial_\pi P_R^* \geq 0$. Considering the firms' first-order conditions (9) and $\partial_\pi(P_S^* - P_R^*) > 0$, the assumption would imply

$$\partial_G(I_S^* + I_R^*) > \frac{1}{c}\partial_G P_R^*\left(\frac{1}{(P_S^*)^2} + \frac{1}{(P_R^*)^2}\right) \geq 0.$$

Because of investors' demand for risky bonds (8), this last inequality would imply that

$$\partial_\pi P_R^* = -(1-q) - \gamma\partial_\pi(I_S^* + I_R^*) < 0,$$

which contradicts $\partial_\pi P_R^* \geq 0$. Therefore $\partial_\pi P_R^* < 0$ and $\partial_\pi(I_S^* - I_R^*) > 0$.

The proof for $\partial_q(P_S^* - P_R^*) > 0$ and $\partial_q(I_S^* - I_R^*) > 0$ is identical. □

Appendix B Additional Figures and Tables

B.1 Correlation Tables

Table 14: Correlation table between indicators of bond characteristics. The bonds are outstanding in the three months before and after the announcement of the CSPP, and rated between BBB+ and BB.

	Eligible	InvestmentGrade	VHighBeta	HighBeta	Illiquid
Eligible	1	0.551	-0.359	-0.104	-0.284
InvestmentGrade	0.551	1	-0.195	-0.019	-0.293
VHighBeta	-0.359	-0.195	1	-0.112	0.392
HighBeta	-0.104	-0.019	-0.112	1	0.172
Illiquid	-0.284	-0.293	0.392	0.172	1

Table 15: Correlation table between indicators of CDS characteristics.

	Eligible	Speculative	HighBeta	HighSpread
Eligible	1	-0.803	-0.238	-0.401
Speculative	-0.803	1	0.335	0.501
HighBeta	-0.238	0.335	1	0.551
HighSpread	-0.401	0.501	0.551	1

B.2 Regression Discontinuity Design for Coupon Rates

Table 16: Estimates of the discontinuity in a regression of coupon rates on issue date. In the first row, we control for a third-degree polynomial; in the second row, we control for a fourth-degree polynomial. We also control for rating, maturity, country, and sector fixed effects. Odd column show the results from unweighted regressions, whereas even columns show the results for regressions weighted by the amount issued. Standard errors are clustered at the country-sector level.

	Coupon rate (%)									
	Eligible		Ineligible		Investment grade		Speculative		BBB+ to BBB-	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
3rd degree poly.	0.754	0.440	-1.696	-5.150	0.626	0.427	-1.816	-6.752^{**}	0.420	0.187
	(0.583)	(0.682)	(1.220)	(3.149)	(0.482)	(0.596)	(1.208)	(3.052)	(0.818)	(0.872)
4th degree poly.	0.297	-0.422	-3.465^{**}	-6.965^{*}	-0.007	-0.436	-3.486^{**}	-5.750	0.122	-0.160
	(0.854)	(0.679)	(1.496)	(3.813)	(0.620)	(0.654)	(1.504)	(3.647)	(1.083)	(0.897)
Weighted	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Rating FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maturity FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$									

We provide additional analyses for the change in coupon rates after the announcement of the CSPP. We adopt a regression discontinuity design using new bond issues in the six months before and after the announcement of the CSPP.

Although Gelman and Imbens (2019) encourage the use of local linear or quadratic regressions instead of higher-order polynomials, our data do not allow us to follow their suggested approach. As Figure 3 shows, firms issued very few bonds in the days immediately before the CSPP announcement. As a result, we cannot exploit local data. We therefore use higher-order polynomials over a longer period of time, but we are cautious with the interpretation of our results. In particular, we view our discontinuity estimates as illustrations of a pattern, rather than as precise measures of a causal effect of the CSPP on coupon rates.

We consider a regression the following form:

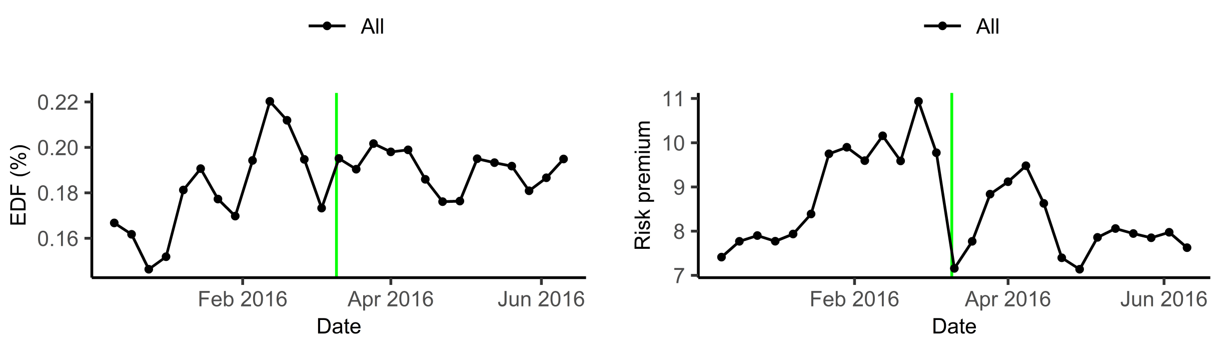
$$c_{it} = a_0^0 + a_0^1 x^1 + \cdots + a_0^p x^p + \text{Post}_t \times (a_1^0 + a_1^1 x^1 + \cdots + a_1^p x^p) + \iota_{r(i)} + \iota_{m(i)} + \iota_{c(i)} + \iota_{s(i)} + u_{it}, \quad (11)$$

where c_{it} is the coupon rate of issue i at date t, and x_{it} is the time difference in days between t and the first trading day after the announcement of the CSPP; $\iota_{r(i)}$ is a rating fixed effect, $\iota_{m(i)}$ is a maturity-bin fixed effect, $\iota_{c(i)}$ is a country fixed effect, and $\iota_{s(i)}$ is a sector fixed effect.

The coefficient a_1^0 provides an estimate of the change in coupons immediately after the announcement. We report estimates in Table 16. Here, we consider polynomials of third and fourth degree. We include estimates obtained with and without weighting observations by the issued amount.

It appears the CSPP announcement was followed by a decline of the coupon rates of ineligible and speculative bonds, although the statistical significance of the estimates depends on the choice of the econometric model. We do not observe a drop in the coupon rate of eligible bonds, whereas the sign of the discontinuity for investment grade bonds depend on the polynomial specification. For bonds rated between BBB+ and BBB-, we find no indication that coupon rates dropped immediately after the announcement.

B.3 EDFs and Risk Premia



(a) Expected default frequency

(b) Risk premium

Figure 5: Average one-year EDF and risk premium of euro-area non-financial issuers in the three months before and after the announcement of the CSPP. The vertical line marks the first trading day after the announcement of the CSPP.

B.4 Bond Issuance Announcements

We consider all the bonds issued after January 1, 2014, and available on Bloomberg. Bloomberg provides the date of issue, as well as the date of its public announcement. Table 17 provides summary statistics. In particular, note that the median time lag from the announcement of the bond issuance to the issue date is only seven days.

We then plot the weekly time series of bond issuance announcements. We consider bonds announced in the three months before and after the announcement of the CSPP. As Figure 6 reveals, firms substantially increased announcement of new issues after the ECB unveiled its intentions to purchase eligible corporate bonds.

Table 17: Summary statistics of issue amounts and announcement-to-issuance lag of bonds available on Bloomberg. The sample includes all euro-denominated bonds issued between January 1, 2014, and December 31, 2017, by non-financial corporations domiciled in the euro area.

	All bonds	Eligible bonds	Ineligible bonds
Number of issues	1350	374	976
Avg. issued amount (€mln)	228.74	387.67	167.47
Median issued amount (€mln)	100.00	500.00	54.97
Std. of issued amount (€mln)	258.84	287.43	218.05
Mean announcement-to-issuance lag (days)	8.64	7.97	8.89
Median announcement-to-issuance lag (days)	7.00	7.00	7.00
Std. of announcement-to-issuance lag (days)	9.38	2.82	10.89

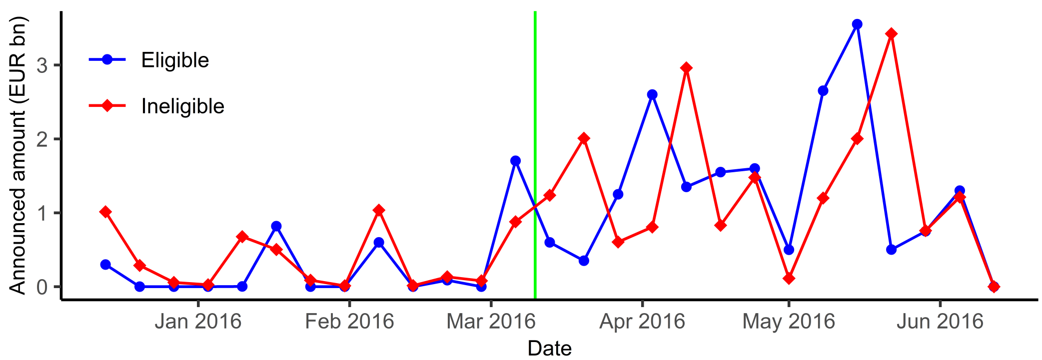
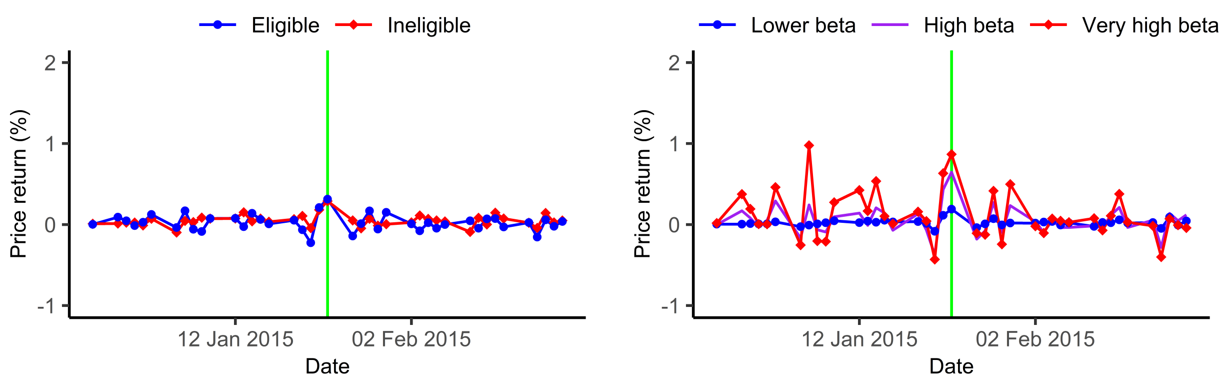


Figure 6: Weekly announced bond issuance for the three months before and after the CSPP. All bonds are euro-denominated and issued by non-financial corporations domiciled in the euro area. The vertical line marks the announcement of the CSPP.

Although bonds in Bloomberg are biased toward the largest issuers, eligible firms tend to be large and established issuers themselves, as we saw in Table 1. Therefore, these data provide valuable information on how quickly eligible firms can time the market and perform the substitution we have documented. Yet, one would not want to interpret these numbers as representative of the entire bond market. New and smaller issuers may have to present themselves to investors by roadshow, which might extend the time needed to issue bonds.

Appendix C The Public Sector Purchase Program



(a) Bonds by eligibility

(b) Bonds by aggregate risk exposure

Figure 7: Average price return of euro-denominated corporate bonds around the PSPP announcement when bonds are sorted according to their eligibility and their exposure to aggregate risk. Price returns are computed as differences in the logarithm of prices. We measure a bond's aggregate risk exposure by using its beta before the announcement. The beta is the slope coefficient in a regression of the bond's price return on the price return of the aggregate bond market. Bonds are classified as high beta or very high beta if their beta is, respectively, in the ninth or tenth decile of the cross-sectional distribution of betas. The vertical line marks the first trading day after the announcement of the PSPP.

Table 18: Effects of the PSPP announcement on bond prices based on bond eligibility, bond market beta, and bid-ask spread. We consider bonds outstanding in the three months before and after the announcement of the PSPP and rated between BBB+ and BB. The dependent variable is the daily change in the logarithm of bond prices. Eligible = 1 if the bond is eligible at the beginning of the sample period. VHighBeta = 1 if the bond's beta with the aggregate bond market is in the tenth decile of the cross-sectional distribution of betas. HighBeta = 1 if the bond's beta is in the ninth decile. Illiquid = 1 if the average bid-ask spread relative to the midpoint is in the fifth quintile of the cross-sectional distribution. Betas and average bid-ask spreads are computed using daily data starting from the beginning of the sample period and ending two weeks before the announcement of the PSPP. EventDay = 1 on the first trading day after the announcement of the PSPP. The two-day effects are the sums of the estimated effects on the first and the second trading day after the announcement. A firm is classified as eligible if it had eligible bonds outstanding at some time during the calendar year before the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-day and bond level.

	Log-return (%)					
	All firms		Eligible firms		Ineligible firms	
	(1)	(2)	(3)	(4)	(5)	(6)
Eligible×EventDay	0.073*	0.072**	0.108**	0.069**		
	(0.039)	(0.031)	(0.048)	(0.027)		
VHighBeta×EventDay	0.586***	0.468***	0.473***	0.377***	1.236*	1.048
	(0.150)	(0.120)	(0.081)	(0.055)	(0.643)	(0.673)
HighBeta×EventDay	0.284***	0.261***	0.267***	0.240***		
	(0.049)	(0.047)	(0.046)	(0.042)		
Illiquid×EventDay	−0.015	−0.004	0.043	−0.014	−0.000	0.089*
	(0.054)	(0.049)	(0.067)	(0.068)	(0.088)	(0.046)
Eligible two-day effect	0.077	0.048	0.161*	0.045		
	(0.076)	(0.070)	(0.094)	(0.070)		
VHighBeta two-day effect	0.765***	0.570***	0.689***	0.476***	1.412**	1.204*
	(0.231)	(0.141)	(0.197)	(0.100)	(0.625)	(0.662)
HighBeta two-day effect	0.151***	0.095*	0.150***	0.082*		
	(0.050)	(0.053)	(0.054)	(0.048)		
Illiquid two-day effect	0.040	0.023	0.131	0.007	0.026	0.105
	(0.099)	(0.085)	(0.140)	(0.111)	(0.090)	(0.080)
Country-industry-day FE	Yes	No	Yes	No	Yes	No
Firm-day FE	No	Yes	No	Yes	No	Yes
Security FE	Yes	Yes	Yes	Yes	Yes	Yes
CouponType-day FE	Yes	Yes	Yes	Yes	Yes	Yes
Maturity-day FE	Yes	Yes	Yes	Yes	Yes	Yes
Rating-day FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	44,330	39,650	37,180	34,710	7,150	4,940
R^2	0.444	0.631	0.534	0.650	0.456	0.606
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$					

Table 19: Effects of the PSPP announcement on CDS spreads based on entity eligibility, CDS beta, CDS spread level, and credit rating. We consider CDS spreads in the three months before and after the PSPP announcement. The dependent variable is the daily change in CDS spreads at various maturities. Eligible = 1 if the entity had eligible bonds outstanding in the calendar year before the announcement of the PSPP. HighBeta = 1 if the beta of the entity's five-year CDS spread with the average five-year spread of euro area issuers is in the fifth quintile of the cross-sectional distribution of CDS betas. HighSpread = 1 if the average level of the entity's five-year spread before the announcement is in the fifth quintile of the cross-sectional distribution of average five-year spread levels. Speculative = 1 if the entity is unrated or rated below BBB- at the beginning of the sample period. CDS beta and average spread level are calculated using daily data starting from the beginning of the sample period and ending two weeks before the announcement of the PSPP. EventDay = 1 on the first trading day after the announcement of the PSPP. The two-day effects are the sums of the estimated effects on the first and the second trading day after the announcement. Standard errors are in parentheses and double-clustered at the country-industry-day and entity level.

	5yr spread (%)		10yr spread (%)		20yr spread (%)		30yr spread (%)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EventDay	-0.008		-0.006		-0.036^{**}		-0.049^{***}	
	(0.005)		(0.009)		(0.015)		(0.017)	
Eligible×EventDay	-0.006	0.002	-0.009	0.007	0.019	0.028	0.036^{**}	0.029
	(0.005)	(0.009)	(0.009)	(0.011)	(0.015)	(0.023)	(0.017)	(0.019)
HighBeta×EventDay	-0.055^{***}	-0.048^{***}	-0.045^{***}	-0.030^{**}	-0.035	0.028	-0.042^{**}	-0.018
	(0.010)	(0.015)	(0.013)	(0.014)	(0.026)	(0.035)	(0.021)	(0.030)
HighSpread×EventDay	0.004	0.021^{**}	0.009	0.023^{**}	0.044	0.027	0.047^{*}	0.028
	(0.009)	(0.011)	(0.009)	(0.010)	(0.044)	(0.057)	(0.025)	(0.030)
Speculative×EventDay	-0.002		-0.009		-0.001		0.024	
	(0.006)		(0.009)		(0.017)		(0.016)	
Baseline two-day effect	-0.010		-0.016		-0.028		-0.033	
	(0.008)		(0.011)		(0.021)		(0.011)	
Eligible two-day effect	-0.008	0.000	0.000	0.009	0.011	0.021	0.020	0.036^{*}
	(0.008)	(0.016)	(0.011)	(0.023)	(0.021)	(0.027)	(0.021)	(0.020)
HighBeta two-day effect	-0.066^{***}	-0.050^{**}	-0.065^{***}	-0.056^{***}	-0.058^{**}	0.018	-0.093^{***}	-0.070^{***}
	(0.014)	(0.023)	(0.016)	(0.015)	(0.025)	(0.027)	(0.017)	(0.012)
HighSpread two-day effect	0.000	0.027	0.018	0.034^{**}	0.036	-0.021	0.045^{**}	0.046
	(0.013)	(0.017)	(0.013)	(0.014)	(0.038)	(0.099)	(0.021)	(0.033)
Speculative two-day effect	-0.005		-0.009		-0.016		-0.006	
	(0.009)		(0.011)		(0.026)		(0.023)	
Country-industry-day FE	No	Yes	No	Yes	No	Yes	No	Yes
Rating-day FE	No	Yes	No	Yes	No	Yes	No	Yes
Entity FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,833	15,833	15,515	15,515	12,310	12,310	14,031	14,031
R^2	0.004	0.666	0.004	0.714	0.003	0.730	0.009	0.679

Notes: $^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$

Table 20: Effects of the PSPP announcement on one-year expected default frequencies (EDFs), one-year CDS spreads, and one-year risk premia. We consider weekly EDFs and CDS spreads in the three months before and after the PSPP announcement. The risk premium is the ratio between the CDS spread and the EDF. The dependent variable is the weekly change in the issuers' EDFs, CDS spreads, and risk premia. Eligible = 1 if the entity had eligible bonds outstanding in the calendar year before the announcement of the PSPP. HighBeta = 1 if the beta of the entity's five-year CDS spread with the average five-year spread of euro area issuers is in the fifth quintile of the cross-sectional distribution of CDS betas. HighSpread = 1 if the average level of the entity's five-year spread before the announcement is in the fifth quintile of the cross-sectional distribution of average five-year spread levels. Speculative = 1 if the entity is unrated or rated below BBB- at the beginning of the sample period. CDS beta and average spread level are calculated using daily data starting from the beginning of the sample period and ending two weeks before the announcement of the PSPP. EventWeek = 1 on the week of the PSPP announcement. Standard errors are in parentheses and double-clustered at the country-industry-week and entity level.

	1yr EDF (%)		1yr spread (%)		Risk premium	
	(1)	(2)	(3)	(4)	(5)	(6)
EventWeek	−0.008	−0.011	−0.049***	−0.005	−0.477	0.023
	(0.009)	(0.057)	(0.013)	(0.011)	(0.308)	(0.263)
Eligible×EventWeek		0.010		−0.016		−0.410
		(0.057)		(0.011)		(0.410)
HighBeta×EventWeek		−0.013		−0.140***		−0.577
		(0.017)		(0.038)		(0.820)
HighSpread×EventWeek		−0.032		−0.106		−1.534
		(0.030)		(0.075)		(1.465)
Speculative×EventWeek		0.008		0.010		0.089
		(0.060)		(0.013)		(0.432)
Entity FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,316	1,316	1,026	1,026	1,026	1,026
R^2	0.042	0.043	0.017	0.018	0.083	0.083
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$					

Table 21: Net issuance of eligible and ineligible bonds around the PSPP announcement. The dependent variable is the monthly net issuance of eligible and ineligible bonds, scaled by the firm's outstanding amount of bonds at the beginning of the sample period. Eligible = 1 if the net issuance is eligible. Post = 1 after the announcement of the PSPP. FirstMonth = 1 for the month in which the PSPP was announced. A firm is eligible if it had eligible bonds outstanding in the calendar year before the PSPP announcement. Odd-numbered columns consider the three months before and after the announcement; even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

	Net Issuance (%)			
	All firms		Eligible firms	
	(1)	(2)	(3)	(4)
Eligible×Post	0.109	0.159	0.377	0.185
	(0.605)	(0.254)	(0.583)	(0.245)
Eligible×FirstMonth	0.510	−0.585	0.684	−0.646
	(0.852)	(0.707)	(0.882)	(0.727)
Country-industry-month FE	Yes	Yes	No	No
Firm-month FE	No	No	Yes	Yes
Firm-eligibility FE	Yes	Yes	Yes	Yes
Observations	15,768	51,520	2,388	7,800
R^2	0.228	0.052	0.320	0.510
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$			

Table 22: Total net issuance around the PSPP announcement. The dependent variable is the total monthly net issuance of bonds by each firm, scaled by the firm's outstanding amount of bonds at the beginning of the sample period. EligibleFirm = 1 if the firm had eligible bonds outstanding in the calendar year before the PSPP announcement. Post = 1 after the announcement of the PSPP. FirstMonth = 1 for the month in which the PSPP was announced. HighBeta = 1 if the firm is a CDS reference entity and the beta of its five-year CDS spread lies in the fifth quintile of the CDS beta distribution. Odd-numbered columns consider the three months before and after the announcement; even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

	Net Issuance (%)			
	All firms		CDS entities	
	(1)	(2)	(3)	(4)
EligibleFirm×Post	0.220	0.005	−1.138	0.467
	(2.000)	(0.691)	(2.458)	(1.134)
HighBetaFirm×Post			−0.507	0.964
			(3.124)	(1.195)
EligibleFirm×FirstMonth	−0.678	0.149	3.705	2.805
	(2.723)	(1.856)	(3.249)	(3.396)
HighBetaFirm×FirstMonth			1.852	4.088
			(5.155)	(4.816)
Country-industry-month FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	14,520	47,480	588	1,860
R^2	0.225	0.053	0.191	0.270
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$			

Table 23: Net issuance by characteristics related to eligibility and riskiness around the PSPP announcement. We run separate regressions of net issuance of bonds with and without a certain characteristic on the interaction IssuanceType×Post and report the coefficients on this interaction. IssuanceType = 1 if the issuance has the characteristic being considered. Post = 1 after the announcement of the PSPP. We control for an IssuanceType×FirstMonth interaction, firm-month fixed effects, and firm-IssuanceType fixed effects. For each row, we report the coefficients on the interaction IssuanceType×Post for a different issuance type: Listed = 1 if the issuance is listed (row 1); InCSD = 1 if the issuance is deposited with a CSD (row 2); Senior = 1 if the issuance is senior (row 3); Secured = 1 if the issuance is secured (row 4); Guaranteed = 1 if the issuance is guaranteed (row 5). A firm is eligible if it had eligible bonds outstanding in the calendar year before the PSPP announcement. Odd-numbered columns consider the three months before and after the announcement. Even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

	Net Issuance (%)					
	All firms		Eligible firms		Ineligible firms	
	3M	10M	3M	10M	3M	10M
Listed×Post	0.655	0.163	0.166	0.018	1.873***	0.566
	(0.478)	(0.191)	(0.603)	(0.222)	(0.601)	(0.348)
InCSD×Post	−0.320	−0.336	−0.835	−0.470*	0.964	0.037
	(0.537)	(0.234)	(0.661)	(0.281)	(1.316)	(0.407)
Senior×Post	−2.834***	−2.327***	−2.667***	−2.084***	−3.249**	−3.005***
	(0.603)	(0.243)	(0.666)	(0.263)	(1.517)	(0.431)
Secured×Post	−0.877*	−0.328	−1.225**	−0.309	−0.010	−0.380
	(0.493)	(0.231)	(0.583)	(0.273)	(1.268)	(0.395)
Guaranteed×Post	−1.362***	−0.512**	−1.838***	−0.466*	−0.175	−0.640
	(0.500)	(0.226)	(0.579)	(0.264)	(1.281)	(0.399)
IssuanceType×FirstMonth	Yes	Yes	Yes	Yes	Yes	Yes
Firm-month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-IssuanceType FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,580	96,600	2,388	7,800	27,192	88,800

Notes: $^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$

Table 24: Net issuance by characteristics related to a willingness to time the market after the PSPP announcement. We run separate regressions of net issuance of bonds with and without a certain characteristic on the interaction IssuanceType×Post and report the coefficients on this interaction. IssuanceType = 1 if the issuance has the characteristic being considered. Post = 1 after the announcement of the PSPP. We control for an IssuanceType×FirstMonth interaction, firm-month fixed effects, and firm-IssuanceType fixed effects. For each row, we report the coefficients on the interaction IssuanceType×Post for a different issuance type: CommPaper = 1 if the issuance is commercial paper (row 1); ShortMaturity = 1 if the issuance's maturity is shorter than one year (row 2); FixedCoupon = 1 if the issuance has a fixed coupon rate (row 3); GeneralPurpose = 1 if the issuance prospectus indicates general corporate purposes as the only use of proceeds (row 4); IssuanceProgram = 1 if the issue is part of an issuance program (row 5). A firm is eligible if it had eligible bonds outstanding in the calendar year before the PSPP announcement. Odd-numbered columns consider the three months before and after the announcement. Even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

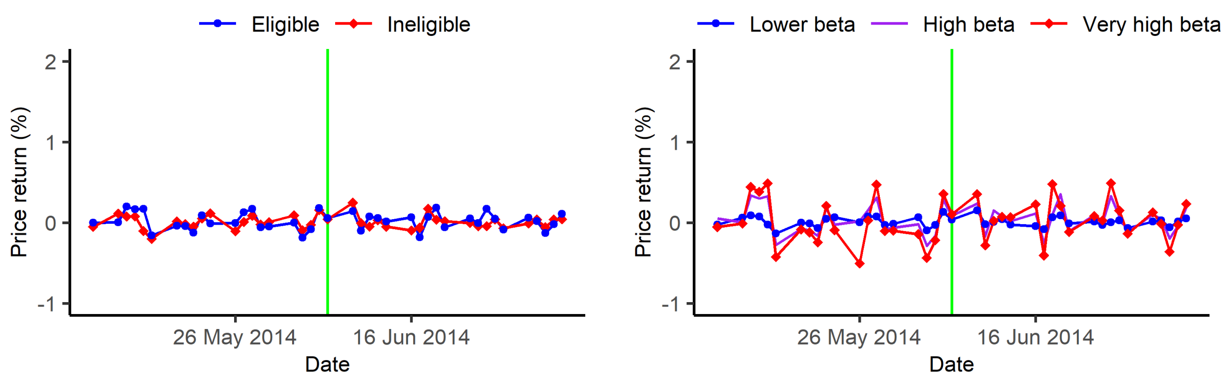
	Net Issuance (%)					
	All firms		Eligible firms		Ineligible firms	
	3M	10M	3M	10M	3M	10M
CommPaper×Post	0.076	0.896***	0.699	0.891***	−1.476	0.910**
	(0.534)	(0.195)	(0.601)	(0.231)	(1.509)	(0.370)
ShortMaturity×Post	−0.125	0.396*	0.631	0.606**	−2.009	−0.189
	(0.509)	(0.215)	(0.602)	(0.255)	(1.382)	(0.388)
FixedCoupon×Post	0.246	−0.091	−0.336	−0.349	1.695	0.626*
	(0.489)	(0.194)	(0.627)	(0.234)	(1.238)	(0.347)
GeneralPurpose×Post	0.044	0.142	0.104	0.102	−0.104	0.252
	(0.409)	(0.224)	(0.519)	(0.282)	(0.753)	(0.360)
IssuanceProgram×Post	0.505	0.007	0.573	−0.034	0.335	0.122
	(0.421)	(0.200)	(0.499)	(0.249)	(0.742)	(0.312)
IssuanceType×FirstMonth	Yes	Yes	Yes	Yes	Yes	Yes
Firm-month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-IssuanceType FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,580	96,600	2,388	7,800	27,192	88,800

Notes: $^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$

Appendix D Prices and Issuance Around the 2014 TLTRO Announcement

On the same day of the CSPP announcement, the ECB also announced a 5-basis point reduction in interest rates, as well as a Targeted Long-Term Refinancing Operation (TLTRO). In this Appendix, we show these policy measures were likely irrelevant for our results on bond prices and issuance.

We exploit the announcement of analogous measures on June 5, 2014. On that day, the ECB announced its first TLTRO program, as well as an interest rate cut of 10 basis points. Figure 8 shows the 2014 TLTRO and rate reduction announcement produced no effect on bond prices, not even on higher-beta bonds. Tables 25 and 26 show that there was barely any issuance substitution and, if any, they were in the opposite direction of the substitutions we observe after the announcement of the CSPP.



(a) Bonds by eligibility

(b) Bonds by aggregate risk exposure

Figure 8: Average price return of euro-denominated corporate bonds around the 2014 TLTRO announcement when bonds are sorted according to their eligibility and their exposure to aggregate risk. Price returns are computed as differences in the logarithm of prices. We measure a bond's aggregate risk exposure by using its beta before the announcement. The beta is the slope coefficient in a regression of the bond's price return on the price return of the aggregate bond market. Bonds are classified as high beta or very high beta if their beta is, respectively, in the ninth or tenth decile of the cross-sectional distribution of betas. The vertical line marks the first trading day after the announcement of the TLTRO.

Table 25: Net issuance by characteristics related to eligibility and riskiness around the 2014 TLTRO announcement. We run separate regressions of net issuance of bonds with and without a certain characteristic on the interaction IssuanceType×Post and report the coefficients on this interaction. IssuanceType = 1 if the issuance has the characteristic being considered. Post = 1 after the announcement of the 2014 TLTRO. We control for an IssuanceType×FirstMonth interaction, firm-month fixed effects, and firm-IssuanceType fixed effects. For each row, we report the coefficients on the interaction IssuanceType×Post for a different issuance type: Eligible = 1 if the issuance is eligible (row 1); Listed = 1 if the issuance is listed (row 2); InCSD = 1 if the issuance is deposited with a CSD (row 3); Senior = 1 if the issuance is senior (row 4); Secured = 1 if the issuance is secured (row 5); Guaranteed = 1 if the issuance is guaranteed (row 6). A firm is eligible if it had eligible bonds outstanding in the calendar year before the 2014 TLTRO announcement. Odd-numbered columns consider the three months before and after the announcement. Even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

	Net Issuance (%)					
	All firms		Eligible firms		Ineligible firms	
	3M	10M	3M	10M	3M	10M
Eligible× Post			0.255	−0.601**		
			(0.587)	(0.300)		
Listed×Post	−0.317	−0.049	−0.293	−0.101	−0.383	0.085
	(0.584)	(0.265)	(0.740)	(0.317)	(0.846)	(0.443)
InCSD×Post	−0.624	−0.166	−0.736	−0.509*	−0.323	0.724
	(0.528)	(0.251)	(0.660)	(0.306)	(0.730)	(0.540)
Senior×Post	−0.876**	0.117	−1.135**	−0.182	−0.178	0.892
	(0.441)	(0.295)	(0.546)	(0.353)	(0.706)	(0.558)
Secured×Post	0.165	0.071	0.056	−0.054	0.460	0.396
	(0.500)	(0.267)	(0.640)	(0.315)	(0.825)	(0.543)
Guaranteed×Post	−0.385	−0.272	−0.766	−0.509	0.640	0.347
	(0.492)	(0.278)	(0.636)	(0.340)	(0.725)	(0.526)
IssuanceType×FirstMonth	Yes	Yes	Yes	Yes	Yes	Yes
Firm-month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-IssuanceType FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,560	96,240	2,280	7,560	26,280	88,680

Notes: $^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$

Table 26: Net issuance by characteristics related to a willingness to time the market after the 2014 TLTRO announcement. We run separate regressions of net issuance of bonds with and without a certain characteristic on the interaction IssuanceType×Post and report the coefficients on this interaction. IssuanceType = 1 if the issuance has the characteristic being considered. Post = 1 after the announcement of the 2014 TLTRO. We control for an IssuanceType×FirstMonth interaction, firm-month fixed effects, and firm-IssuanceType fixed effects. For each row, we report the coefficients on the interaction IssuanceType×Post for a different issuance type: CommPaper = 1 if the issuance is commercial paper (row 1); ShortMaturity = 1 if the issuance's maturity is shorter than one year (row 2); FixedCoupon = 1 if the issuance has a fixed coupon rate (row 3); GeneralPurpose = 1 if the issuance prospectus indicates general corporate purposes as the only use of proceeds (row 4); IssuanceProgram = 1 if the issue is part of an issuance program (row 5). A firm is eligible if it had eligible bonds outstanding in the calendar year before the 2014 TLTRO announcement. Odd-numbered columns consider the three months before and after the announcement. Even-numbered columns consider the ten months before and after the announcement. Standard errors are in parentheses and are double-clustered at the country-industry-month and firm level.

	Net Issuance (%)					
	All firms		Eligible firms		Ineligible firms	
	3M	10M	3M	10M	3M	10M
CommPaper×Post	0.441	1.044***	0.430	1.113***	0.468	0.863**
	(0.387)	(0.198)	(0.503)	(0.242)	(0.475)	(0.407)
ShortMaturity×Post	0.767	0.155	1.120	0.514*	−0.183	−0.781
	(0.569)	(0.259)	(0.707)	(0.303)	(0.838)	(0.532)
FixedCoupon×Post	−0.411	0.139	−0.591	0.059	0.074	0.345
	(0.475)	(0.268)	(0.596)	(0.317)	(0.902)	(0.536)
GeneralPurpose×Post	−0.329	−0.081	−0.291	−0.009	−0.433	−0.269
	(0.437)	(0.220)	(0.549)	(0.271)	(0.762)	(0.375)
IssuanceProgram×Post	0.017	0.097	0.125	0.283	−0.272	−0.385
	(0.352)	(0.200)	(0.448)	(0.246)	(0.544)	(0.295)
IssuanceType×FirstMonth	Yes	Yes	Yes	Yes	Yes	Yes
Firm-month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-IssuanceType FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,560	96,240	2,280	7,560	26,280	88,680
Notes:	$^{*}p \leq 0.10$; $^{**}p \leq 0.05$; $^{***}p \leq 0.01$					