Global Demand Spillovers in Corporate Bond Issuance: The Effect of Underwriter Networks*

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Draft: January 14, 2020

ABSTRACT

This paper studies how monetary policy shocks propagate across borders through bond issuance networks of firms, underwriters and investors. Using a difference-in-differences strategy, I find that the European Central Bank's quantitative easing program in 2016 spilled over to the U.S. corporate bond issuance market via an underwriting channel. U.S. firms connected to underwriters with more Eurozone investor clients faced greater orders for their bonds, achieved a lower cost of capital, and ended up issuing more bonds. The underlying mechanism is likely driven by costly search that underwriters face in locating potential investors, which incentivizes maintaining investor relationships for repeated business. As such, investor demand shocks transmitted through underwriters affect issuers heterogeneously based on preexisting issuer-underwriter-investor networks.

*I am deeply grateful for the comments and suggestions of Simona Abis, Charles Calomiris, Kent Daniel, Olivier Darmouni, Xavier Giroud, Wei Jiang, Yiming Ma, Harry Mamaysky, Giorgia Piacentino, Tomasz Piskorski, Tano Santos, Suresh Sundaresan, Kairong Xiao, Neng Wang, and various seminar participants at Columbia Business School.

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Since the financial crisis, the reliance of large corporations on external capital funded through capital markets has been increasing. U.S. corporations issued over $1.6 trillion in bonds in 2017, accounting for 61% of US corporate issuance for the year. This was a 44% increase since 2007.[1] Bond issuance is conducted entirely through bank underwriters. This is a global network, where banks connect U.S. issuers with investors from around the world looking to buy U.S. dollar securities. How do demand shocks propagate through these networks across country borders? What are the mechanisms and magnitudes of potential spillover effects? The prevalence of unconventional monetary easing tools employed by various central banks has made this a more pressing question. While it is well established that demand shocks transmit through bank networks via a balance sheet channel (see, for example, Chodorow-Reich (2014) and Darmouni and Rodnyansky (2017)), other mechanisms through which banks connect global markets are less clear. This paper explores how banks propagate demand shocks via the underwriting of corporate bonds.

Isolating the impact of bank underwriting networks on new issue bonds is difficult for two primary reasons. One, there are many firm-specific characteristics that influence bond issuance outcomes. These characteristics may be observable to potential investors and to firms, but unobservable to the econometrician. Two, institutional relationships may be correlated with these firm characteristics, making it difficult to disentangle firm-specific effects vs. bank relationship-specific effects. I tackle the first problem by using a novel dataset that records the spread between primary and secondary market prices on a near-universe of corporate bonds issuances between 2010-2018. By studying exclusively the difference between primary and secondary markets, I effectively control for any firm characteristics that are observed by market participants and firm managers and unobserved by the econometrician. I tackle the second problem by identifying firms' heterogeneous exposure to a foreign shock, the ECB's increase in demand for corporate bonds. I run a series of robustness checks to

[1] SIFMA 2018; see Appendix for more aggregate data on this market.

ensure that a firm's exposure to the shock is not correlated with firm characteristics.

Given my novel dataset and identification strategy, I am able to identify the impact of bank networks on the corporate bond issuance market. Using novel proprietary bond-issuance-level data, I find that firms respond to bank-specific demand shocks that are unrelated to firm fundamentals. Specifically, I look at how the ECB's corporate bond buying program in June 2016 impacted US firms through the bank underwriting channel. I find that firms that have relationships with banks that are more exposed to the Euro area receive more orders and issue more bonds. I show that this is not related to firm fundamentals or geography. I interpret this as evidence that there are bank-related frictions in the bond issuance market. Banks act as a conduit through which demand shocks spread between countries.

In order to uncover these frictions, I run a Difference-in-Difference analysis using the initiation of the ECB's 2016 QE program as an exogenous shock. Banks are heterogeneously exposed to Europe based on their institutional investor relationships. Firms have heterogeneous relationships with banks. In my empirical methodology, firms are "treated" if they have more relationships with banks that have more investor clients in Europe. I estimate a Diff-in-Diff model with the firm's exposure to Europe via its bank network as a continuous treatment variable. I find that following the start of the ECB's corporate bond purchasing program (CSPP), more "treated" firms had more demand for their bonds, achieved lower costs of capital, and issued more debt. I run a series of robustness checks to ensure that results are not being driven by endogenous firm-bank choice.

Why might demand shocks transmit globally through bank underwriting networks? Unlike the bank lending market, bond underwriting is not directly impacted by bank balance sheets. In the corporate bond underwriting market, banks act as match makers between buyers and sellers. When underwriting bonds, banks incur costs in their search for buyers of securities. Because banks and investors are repeat agents in this market, banks can reduce long-term search costs by maintaining relationships with the same investors. As such, demand shocks transmit through bank underwriting networks. To show that this mechanism is driving my Diff in Diff results, I conduct a series of empirical tests. Using a novel metric of time spent on issuance to proxy for search costs, I find evidence that banks do incur costs when searching beyond their typical network. This suggests that banks derive value from forming long-term relationships with investors.

My paper contributes to three strands of literature. The first is the literature on bank network and bank relationships, which has been studied primarily in the context of bank loans. Gilje et al. (2016) examines spillovers of positive demand shocks through commercial bank networks, while Khwaja and Mian (2008) show evidence of negative liquidity shocks to banks affecting the real economy. For the interbank market, Craig and Ma (2018) use novel methods to explain network formation and map the transmission of systemic risk through these networks. Since the 2008 crisis, there have been many papers that show and explain the spread of credit shocks through syndicated loan markets, including Ivashina and Scharfstein (2010), Darmouni (forthcoming) and Chodorow-Reich (2014). This paper contributes to the existing literature by introducing a novel mechanism through which bank networks matter: through the bond underwriting process.

Secondly, I contribute to the vast literature on underwriting by bringing to bear novel issuance-level data that allows the econometrician to directly observe order book size and issuance dynamics. This allows the potential to empirically test many of the existing theories on underwriting, most of which focuses on equity underwriting. For example, the role of underwriters in equity IPO markets is often described as marketing and producing information about market demand (see Corwin and Schultz (2005), Gao and Ritter (2010)).

Securities underwriters can benefit firms by (1) certifying the issue to uninformed investors (see Booth and Smith (1986), Smith (1986), Carter and Manaster (1990), Fang (2005)), (2) bundling products (see Calomiris and Pornrojnangkool (2009), Schenone (2004)), and (3) gathering market information from investors (Benveniste Spindt (1989), James (1992) and Burch et. al (2005)). The corporate-bond specific corner of bank-firm relationship literature discusses how bank-firm relationships are sticky (Yasuda (2005), Daetz, Dick-Nielsen and Nielsen (2017)), but does not explore the impact of this stickiness on bank networks.

Finally, my paper contributes to the extensive literature on search theory and its applications in the primary capital markets. Search models have been used to assess venture capital markets (see Silveira, Wright (2016)) and real asset markets (see Gavazza (2011) and Gavazza (2016)). Search-based frictions in secondary asset markets are well-documented.[2] Primary markets for equities face frictions as well, due to information asymmetries and signaling effects.[3] Primary markets for corporate bonds, however, are typically considered frictionless. This paper seeks to test the hypothesis of frictionless primary markets, pointing to a particular friction (search).

The outline of this paper is as follows. Section I lays out institutional background and discusses the ECB shock. Section II describes the data used in this study, defines key variables, and gives summary statistics. Identification strategy is described in Section III, and my empirical results and robustness tests are in Section IV. I discuss mechanism in Section V, and I conclude and discuss next steps in Section VI.

[2] See, for example, Duffie, Garleanu and Pedersen (2005), or Lagos and Rocheteau (2009), or Duffie and Garleanu (2007)

[3] See, for example, Darmouni (Forthcoming) for a recent discussion on the role of information asymmetries in bank loan provision; see also Myers and Majluf (1984) for signaling effects of equity issuance

I. Institutional Detail

A. Corporate Bond Market

The corporate bond market is an important source of capital for corporations. Corporate bond issuance is over eight times the volume of common equity issuance.[4] In 2018, 87% of that issuance was Investment Grade (rated above BBB-), and 81% of the issuance was fixed-rate (See Figure 6). The Investment Grade (IG) market is a useful setting to study firm-underwriter-investor networks due to the homogeneity of the securities, particularly within-firm. Unlike equity issuance and bank lending, investment grade corporate bond issuance is subject to less information asymmetry.[5] In addition, corporate bond issuers tend to be larger, more transparent firms.[6]

In a typical corporate bond deal, a potential issuer approaches a median of four banks to underwrite the planned bond. Unlike in the syndicated loan market, there is typically no "lead arranger"; rather, all banks underwriting the bond deal will receive equal fees and league table credit for the issuance.[7] In the investment grade market, the primary services that the bank provides are: (1) searching for investors, collecting orders, setting pricing, and allocating the security to investors and (2) insuring post-issuance price stability.[8] Issuers will approach the syndicate of banks before the intended issuance date. If banks have worked with the issuer in the past, this is commonly part of a longer term conversation that includes banks advising potential issuers on capital structure, market dynamics, and potential M&A

[4]SIFMA 2018: Common Stock issuance (including IPOs and follow-ons issued in the US) was $199.3 bn in 2017; Corporate Debt issuance (including public and private, IG and high yield bonds issued in the US) was $1.637 trillion

[5]See Myers Majluf (1984): bond issuance is higher in the "pecking order" than equity issuance due to less information sensitivity

[6]See Diamond (1991): in the presence of moral hazard, borrowers start out by being monitored by banks, and graduate from bank loans to bond issuance once they have acquired better reputations

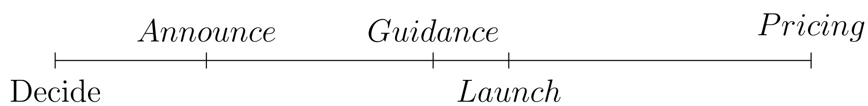
[7]There are exceptions to the equal splitting of fees and league table credit, commonly with M&A related transactions.

[8]Yasuda (2005) discusses another service that underwriting banks provide: insurance for unsold securities. However, this is more likely to be the case for non-investment grade issues. From industry interviews, the probability of unsold securities is so low, that it is not considered a primary service that the bank provides.

targets. Issuance characteristics such as size, tenor, and number of tranches are decided before the actual announcement of a deal, and rarely change after announcement.

B. Deal Day Dynamics

Bonds are typically announced and priced in the same day.[9] The process to issue a bond is as follows. The decision to announce a deal is made prior to market open by the banks and the issuer. Banks "announce" a deal in the morning by sending Bloomberg messages to their investor clients. While I do not directly observe these bank-specific messages, I have headlines from the data aggregator, which according to industry interviews closely matches the timing and messaging of bank news events.[10] See Figure 7 for an example. There are four key news events associated with a bond issuance: *Announcement, Guidance, Launch*, and *Pricing*. Each of these events is communicated by banks to their entire investor base.



Announcement is the first time that the company's intent to issue bonds is publicly announced. This first news event is accompanied by the amount that the firm intends to raise, the tenors of the bonds, and an *Initial Price Target*, usually a 10-20bp range, within which the banks expect the bond to price. Between *Announcement* and *Guidance*, banks take orders from clients. *Guidance* news incorporates initial interest and typically updates the price range to within 5bp. Between *Guidance* and *Launch*, the banks continue to collect feedback from clients. At *Guidance*, the bank has taken orders from potential investors and aggregated the volume of these orders into an *order book*. By the time *Launch* is announced, the price and size of the bond issuance is confirmed. Syndicates usually will not change

[9] 97% of the deals for which I have data on both announcement and pricing were priced within the same calendar day. The median non-financial deal in my sample takes 6.2 hours to complete pricing. See Summary Stats for more details.

[10] While there may be measurement error in the timing of these announcements, I do not believe the error would be correlated with the variables of interest in this study.

the price between *Launch* and *Price*, but it can occasionally happen.[11] The whole process, between initial announcement and pricing, typically takes between 6-7 hours.

C. ECB Quantitative Easing Program

My identification strategy relies on the exogenous increase in demand from Euro-area institutional investors for US corporate bonds. I focus on the European Central Bank's (ECB) implementation of the Corporate Sector Purchase Program (CSPP) between June 8, 2016 and December 19, 2018 as an extension of its expansionary monetary policy efforts. The CSPP was part of a broader ECB asset purchase program (APP) that was designed to stimulate the economy in an environment where key interest rates were hitting their lower bound. The APP included 4 programs introduced between 2014-2016: the Third Covered Bond Purchase Programme (CBPP3), the Asset-backed Securities Purchase Porgramme (ABSPP), the Public Sector Purchase Programme (PSPP), and the CSPP. The decision to add corporate bonds to the assets purchased was released on March 10, 2016, with the stated goal to "further strengthen the pass-through of the Eurosystem's asset purchases to the financing conditions of the real economy."[12]

To implement the CSPP, the ECB coordinated purchases that were carried out by six Eurosystem national central banks. Eligible bonds included euro-denominated bonds issued by Euro-area non-bank corporations with remaining maturity of six months to 30 years. Because bonds purchased needed to be eligible as collateral for Eurosystem credit operations, only investment grade securities were purchased. The ECB deliberately targeted a wide range of ratings, sectors, countries, and issuers in order to remain market-neutral. CSPP purchases were conducted proportionally to the market value of eligible bonds. Following the start of the CSPP, yields for both eligible and non-eligible bonds in the euro-area dropped.

[11]Source: industry interviews

[12]ECB Economic Bbulletin Issue No. 5/2016 (August 2016) https://www.ecb.europa.eu/pub/economic-bulletin/html/eb201605.en.htmlIDofBox1

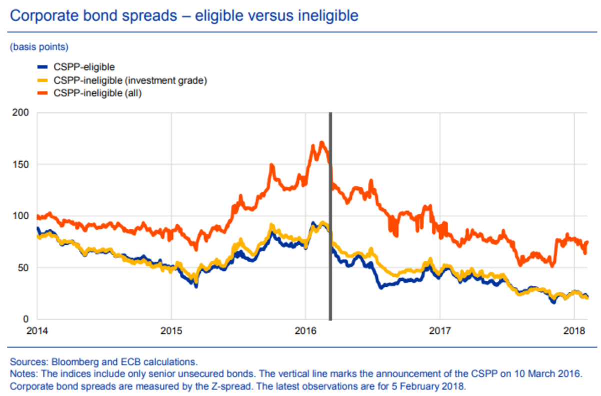


Figure 1. Yields drop across the Euro-area

In response, industry experts advised institutional investors in the Euro-area to invest in USD denominated corporate bonds. In September 2016, the bond fund PIMCO published a report advising European investors to cross the Atlantic, stating "the U.S. corporate bond market still remains the most attractive credit market, even after adjusting for currency hedging costs".[13] The aggregate statistics on Euro-area holdings of USD non-financial corporate bond securities is consistent with this story.

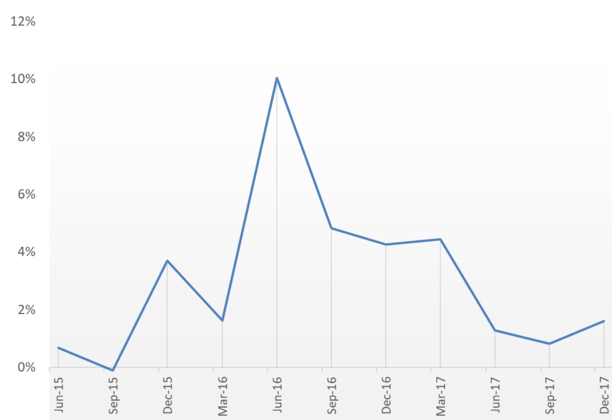


Figure 2. Growth in U.S. non-financial corporate debt securities held by Euro-area residents (ECB SHS)

[13]Kiesel and Dragesic, 2016. "U.S. Corporates: Crossing the Atlantic to Find Value." PIMCO

D. *Bank-firm relationships*

The role of the bank in a bond issuance is to search for investors, educate investors about the issuing firm, collect orders, and allocate the bonds to institutional investors. Because the underwriting process involves familiarity between bank and firm, this relationship tends to be sticky. Banks incur costs in the initial assessment of a firm's management, operations and creditworthiness. If a bank has already worked with a firm, the marginal cost of marketing and selling the firm's securities is lower. James (1992) calls the setup of a bank-firm relationship as investing in "durable transactor-specific assets". Banks not only learn about the firm, but also identify an informed investor base.

It is well established in the literature that firm-bank relationships in the bank loan market are sticky.[14] Theories behind stickiness include market participants trying to avoid adverse selection (Sharpe 1990), costly information acquisition (Sufi 2007b), moral hazard (Holmstrom and Tirole 1997), and costly monitoring (Williamson 1987). Chodorow-Reich (2014) provides empirical evidence for the stickiness of relationships in the syndicated loan market. There is some evidence of similar stickiness in the firm-bank relationship in the bond underwriting market. Yasuda (2005) finds that firms are more likely to choose banks that they have existing relationships than those without.

Since I observe bank-firm relationships in the data, I can directly test the stickiness of underwriting-firm relationships. Table (I) shows the results of the regression below.

$$Pr(i \text{ choose } b)_t = \gamma_1 \mathbf{1}_{\text{past match } b,i} + \gamma_2 \mathbf{1}_{b \text{ lends to } i} + \alpha_{b,q} + \alpha_i + \epsilon_{bit} \quad (1)$$

Each line is a potential firm-underwriter match associated with one bond issuance. I run a linear probability model where the outcome variable is the likelihood that firm i chooses

[14] See Darmouni (forthcoming) or Schwert (2018) for recent discussions

bank b, conditional on issuing. The independent variable of interest is an indicator variable for firm i having hired bank b in the past. Regression (1) shows that there is a statistically significant and positive relationship between previous matching and probability of choosing a bank on a given bond issuance. In regression (2), I also control for whether a firm has a lending relationship with the bank. This coefficient is also statistically significant at the 1% level, suggesting that the existence of a bank lending relationship also increases the probability of a firm-bank match. The coefficient in regression (2) can be interpreted as follows: within firm, within bank-quarter, the probability that a firm i chooses bank b to be an underwriter on a deal issued in time t increases by 26% if there has been a match in the past, controlling for the existence of a bank lending relationship. While there is some level of stickiness for bond-underwriting relationships between firms and banks, it is not nearly as sticky as bank-firm relationships in the bank lending market.[15]

Regressions (3) and (4) run the same specification but for two distinct time periods. First, regression (3) looks at pre-June 2016, while regression (4) looks at post-June 2016. The independent variable of interest, an indicator for "past match", is still measured across the full sample period of 2010-2018. For my identification story to hold, I need to show that firms do not change their bank-selection behavior after the start of the ECB QE program. Indeed, I find that the point estimates are similar in both regressions, suggesting that the stickiness of firm-bank relationships, while not very high, does not decrease following the ECB's QE program.

[15]See Chodorow-Reich (2014), Table 1, for a similar analysis for firm-lender relationship stickiness

Table I Bank-firm relationships

	(1) Bank-firm match	(2) Bank-firm match	(3) Bank-firm match: Pre-QE	(4) Bank-firm match: Post-QE
1 {past match}	0.285***	0.260***	0.251***	0.273***
	(26.55)	(25.07)	(21.03)	(22.32)
1 {b lends to i}		0.0784***	0.0725***	0.0910***
		(18.18)	(15.42)	(14.08)
Firm FE	Yes	Yes	Yes	Yes
Bank-Quarter FE	Yes	Yes	Yes	Yes
r2	0.335	0.344	0.334	0.364
N	312102	312102	208152	103950

Notes. The dependent variable in the regressions is an indicator for whether bank b is an underwriter for firm i in period t. The dataset contains one observation for each potential bank underwriter for each deal (that is, multiple bonds issued on the same day by the same firm are treated as one deal). I include only banks that underwrite for at least one other firm. The independent variables "past match" equals 1 if the bank b has underwritten a deal for firm i previously in the sample. The sample is from September 2010 - June 2018, and includes only deals where the firm has previously issued at least 1 time. Estimation is via OLS. Standard errors are clustered at the issuer level. t-statistics are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

II. Data

A key innovation in this paper is the use of a proprietary industry dataset that has bond-level issuance data starting in 2000. For this paper, I use detailed bond-level data on all US dollar corporate bond issuance that the data aggregator collected from surveying bank underwriters on a daily basis. New variables to the literature include the order book size, oversubscription and new issue discounts of each bond issuance. The dataset also provides the underwriters on each bond deal, descriptions on how the bond was received by the primary market, and bond characteristics (including ratings, tenor, size, coupon, initial yield, and price). I restrict the sample to September 2010 - June 2018. September 2010 is when the variables discussed are consistently collected for all bond issuances. I further restrict the sample to US dollar denominated corporate bonds issued in investment grade market.

To obtain borrower firm characteristics, I merge the bond-level data with Compustat. Because there is no common firm identifier between my dataset and Compustat, I do a combination of fuzzy string merging and manual matches. When a subsidiary issues a bond, I map the observation to the parent company firm characteristics. Issuers that cannot be matched to Compustat are either private, foreign, or sovereign or supra-sovereign entities. To obtain lending information on the bank-firm relationship, I merge my data with the Thomson Reuters Dealscan database of loan-level information on syndicated loans. To complete the Dealscan merge, I use the Chava and Roberts (2008) link table for borrowers and the Schwert (2018) link table for lenders.

My identification strategy relies on the bank-level exposure to the European institutional investor market. To get to this information, I look at the 2010 10-K SEC filing for all bank underwriters that underwrote at least three deals before and after June 2016 (the start of the corporate bond buying program), or the international equivalent of the 10-K. To get at the exposure of a bank's sales and trading business to the Euro-zone, I compute the ratio of "institutional securities revenues" that are earned in the Euro-zone, and call that "euro-exposure".

My sample includes 9,932 bonds issued in 5,793 separate bond deals by 1669 unique corporate issuers. In my primary regression analysis, I further narrow the sample to non-financial issuers, which leaves me with 6,623 bonds issued in 3,705 unique transactions by 1,258 non-European issuers. I have 110 active bank underwriters. To get an idea of my data sample and setting, I lay out the median bond security case. The median bond in my 2010-2018 sample is a 10-year bond, $500 million in size, BBB-rated, with a coupon of 3.6%. It is underwritten along with one more bond in the same deal by 4 banks, at least 3 of which are also lenders. The security takes over 6 hours to price after announcement. It is issued with an average of 3.5bp in new issue concession, has a median book size of $2bn, and is over 3x oversubscribed. See summary statistics for more detail.

A. *Outcome variables of interest*

Book size and oversubscription

The first outcome of interest is the book size relative to the amount issued. Prior to allocating a bond issuance to institutional investors, banks observe an order book that equals the sum of all investors' order volumes. The dataset reports the oversubscription of each bond i as well:

$$Oversubscription_i = \frac{Order\ Book_i}{Amount\ Issued_i} \tag{2}$$

The median book size is $2 billion, while the median bond is 3.2x oversubscribed. From 2010-2018, I find that over 99% of bonds are oversubscribed: that is, there is a great volume of buy orders than the corporate issuer is planning to sell in bonds.

Underpricing

The second outcome of interest is the underpricing of the security, or the New Issue Concession (NIC). The NIC is the difference between the yield to maturity in the primary market and the secondary market for firm i at time t in tenor m for a security of equivalent seniority. The dataset provides a more complete view of underpricing than existing literature. The secondary market for corporate bonds are typically not very liquid, making underpricing inherently difficult to measure. The data overcomes this hurdle by identifying similar securities to the newly issued bond. Similar securities are typically issued by the same corporate entity and have the same covenants and seniority structure. Absent comparable securities by the same issuer, bonds with similar characteristics by same-industry and same-rating issuers are considered. The data aggregator then collects trader quotes from the banks underwriting a given bond prior to the announcement of a new bond, and uses these as a benchmark against which to compute underpricing.

$$Underpricing_{it} = YTM(primary)_{it} - YTM(secondary)_{it} \tag{3}$$

Because the NIC subtracts out the secondary market yield, it controls for aggregate credit market fluctuations, and firm-specific shocks in credit risk and probability of default. It represents the disconnect between the primary and secondary market. When investors have more bargaining power, they can negotiate for a a cheaper price, thus NIC is greater. If NIC is high, the issuer effectively is leaving money on the table.

The NIC is computed by the bank underwriting syndicate as a key input to the ultimate pricing of a new security. The computation is simple if the issuing corporation has liquid outstanding bonds. For example, say McDonald's is issuing a new 10-year bond at T+105. It currently has a liquid 9-year bond outstanding trading at T+90, where the benchmark Treasury against which the bond is trading is the same as for the new 10-year. The 9-year bond spread is then adjusted using the term structure of swap rates. If the 9-year swap rate is 3.00%, and the 10-year swap rate is 3.10%, then the term premium for adjusting from a 9- to 10-year security is 10bps. The NIC would then be $105 - (90 + 10) = 5$bps.

In the absence of a liquid comparison security issued by the same firm, underwriting banks will consider similar liquid securities issued by firms with similar credit ratings, size, industry, and brand recognition. These computations are done by all underwriting banks prior to the issuance of a bond. On the day of the bond issuance, the banks will adjust their NIC computation based on the market that day. The data aggregator collects this information and corroborates it with all of the bank underwriters. See below for average monthly underpricing over time, in basis points. The average bond has 3 basis points of underpricing.

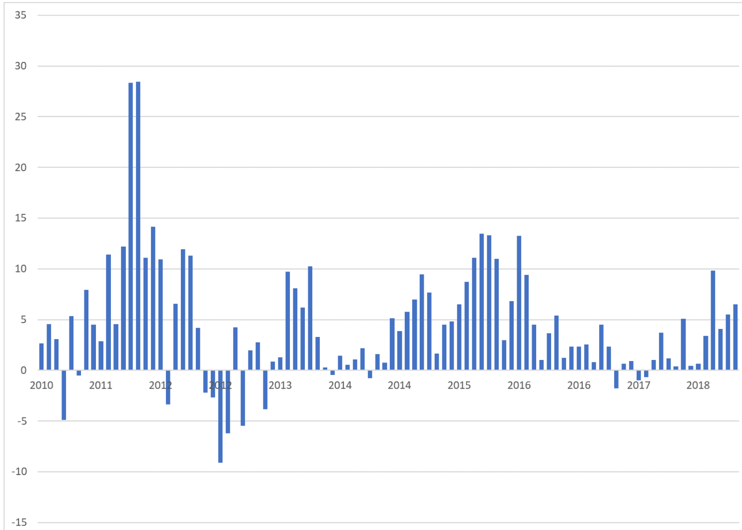


Figure 3. Average underpricing by month (bps)

B. Summary statistics

See below for summary statistics for non-financial, non-European corporate issuers.

Variable	**Min**	**50%**	**Max**	**Mean**
Amount issued ($MM)	25	500	15,000	725
T-spread (bps)	15.0	125.0	501.6	136.4
Underpricing (bps)	-90.0	2.5	100.0	3.5
Book size ($Bn)	0.1	2.0	36.0	2.6
Oversubscription	1.0	3.3	20.0	3.8
Time to price (hours)	0.2	6.6	78.7	7.3
Number of underwriters	1.0	4.0	21.0	4.9

III. Identification

A. Theory

I argue that firms issuing in the U.S. market are heterogeneously exposed to investor demand shocks based on their bank underwriting relationships. Consider the firm's decision on how much to borrow (y_{ibt}). It is a function of firm observable characteristics X_{it} (such as working capital needs and plans for new investment) and firm-specific shocks and unobservable characteristics ϵ_{it} (such as union strikes, shareholder requests for dividends, or unexpected declines in sales). The innovation is in ρ_{ibt}: does a bank-specific shock impact the firm's issuance decisions or outcomes?

$$y_{ibt} = f(X_{it}, \epsilon_{it}, \rho_{ibt}) \tag{4}$$

In the Diff-in-diff exercise, the treatment variable of interest is ρ_{ibt}. To identify a causal link between the bank-specific shock and the firm's issuance outcomes, I need to make the case that (i) $X_{it} \perp \rho_{ibt}$ and (ii) $\epsilon_{it} \perp \rho_{ibt}$. In words, I need the bank-specific shock to be uncorrelated with any firm-level characteristics, observed or otherwise, that affect financing decision or outcome y_{ibt}. If the bank-level shock is correlated with firm fundamentals, then it would be endogenous and thus unable to explain any bank-related impacts on the firm. To show that assumption (i) is reasonable, I plot parallel trends (see the Appendix for parallel trends tests). To show that assumption (ii) is reasonable, I run a series of tests described in the robustness section. With these assumptions satisfied, I can identify a causal effect of a bank-specific shock (in this case, the ECB QE program) on firm issuance outcomes.

B. Constructing the treatment variable

The investor demand shock I focus on is the ECB's CSPP beginning June 8, 2016. Banks are heterogeneously exposed to the Euro-area. Some banks have more physical presence in the Euro-zone that others. I take bank investor networks as given, and assume that they do not change significantly in my sample period. Based on industry interviews, this is a reasonable assumption. Bank-level exposure is measured as follows:

$$Eur\_exp_b = \frac{euro\_IBDrev_{2010}}{total\_IBDrev_{2010}} \tag{5}$$

I collect the data for both numerator and denominator from 2010 bank company filings. The idea is to find out what proportion of a bank's investor relationships is located in the

Euro-zone. The denominator is the bank's revenues from Institutional Securities: that is, any business associated with the trading or underwriting of securities. The numerator is the bank's revenues from Institutional Securities made in the Euro-zone.[16] I collect this metric for all banks that issue at least 3 times pre- and post-QE from 10-Ks, 20-Fs, annual reports, or investor presentations. The average bank-level metric of exposure to the Eurozone is 18%, with a standard deviation of 27%. Bank-level exposure ranges from 0% to 97%, with a median of 4%.

To get to firm-level *Eurexp*, I compute a weighted average of the firm's bank relationships based on all firm-bank underwriting interactions between 2009-2011. I first compute the average exposure across all underwriters for a given bond to compute a bond-specific Euro-exposure. Then, I compute the average bond exposure across all bonds for a given firm to compute a firm-specific Euro-exposure. It is reasonable to average across all of the underwriters for a given bond because the bond allocation is split evenly across all underwriters. Across non-financial corporate issuers that are not located in the Eurozone, the average euro-exposure at the firm level is 22%, with a standard deviation of 11%. Firm-level exposure ranges from 0% to 79%. The inter-quartile range is 14%.

$$Eur\_exp_f = \frac{1}{N_{d,f}} \sum_{\forall d \in D_f} \frac{\sum_{\forall b \in B_{d,f}} Eur\_exp_b}{N_{b,d,f}} \tag{6}$$

A key assumption of my identification strategy is that the geographic distribution of a bank's investor network is not correlated with the geographic footprint of the same bank's corporate clients. It is not immediately obvious if there would be a correlation in either direction. It is possible that banks have geographic specialties in both investor and corporate clientele. On the other hand, it may benefit corporate issuers to work with banks that are more geographically diverse than themselves. On net, it is unclear which effect, if any, would

[16]Not all banks report revenues segmented into geographies and business lines. In the absence of revenue numbers, I use assets (excluding assets associated with retail or mortgage lending). In the absence of revenue *and* asset numbers, I use employee headcount.

dominate. Given my data, however, I can test whether there is a correlation empirically. In the next section, I run a series of robustness tests to ensure that a bank's exposure to the Eurozone is not correlated with the European footprint of that bank's corporate clients.

IV. Results

In this section, I present my primary results for the effect of bank relationships on bond issuance outcomes. Overall, I find that the aggregate demand shock introduced by the ECB's QE program impacts US firms' capital raising decisions and outcomes heterogeneously based on their bank relationships. Conditional on issuing bonds, 'treated' firms receive more orders and have less underpricing per bond. In addition, 'treated' firms issue more bonds.

A. More treated issuers receive more orders

$$Y_{it} = \beta_{DID} Eurexp_i Post_t + \beta_1 Post_t + \beta_2 Eurexp_i + X'_{it}\gamma + \alpha_{FE} + \epsilon_{it} \tag{7}$$

Table II Increase in interest for treated firms' bonds

	(1) Oversubscription	(2) Oversubscription	(3) Oversubscription	(4) Book size ($Bn)
Diff-in-diff	2.388**	2.627**	2.883***	1.416*
	(2.30)	(2.37)	(2.62)	(1.78)
amtmm_std		-0.0467	-0.0486	-0.0470
		(-0.98)	(-1.02)	(-1.59)
Deal controls	No	Yes	Yes	Yes
Firm controls	No	Yes	Yes	Yes
Lev x Post controls	No	No	Yes	Yes
Size x Post controls	No	No	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Industry x Post FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
r2	0.490	0.501	0.506	0.766
N	3044	3044	3044	3044

Notes. Includes non-Eurozone USD non-financial corporate issuance, September 2010-June 2018. Post is after June 8, 2016. t-statistics in parentheses. Estimation is via OLS. Controls are normalized to variance 1 and include rating, tenor, amount, revenue, the dollar amount issued on day t other than firm i, and the number of underwriting banks. Standard errors, in parentheses, are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

Table II show the first results from my main specification. The dependent variable for the regressions (1)-(3) is *Oversubscription*, a metric of the ratio of the order book size and the amount ultimately issued. On average, that ratio is around 3. The dependent variable of regression (4) is just the size of the order book, controlling for the amount issued. The coefficient on β_{DID} indicates that "treated" firms achieve bigger order books after the ECB's CSPP begins. An increase from the 25th to 75th percentile of *Eurexp* at the firm level will increase the oversubscription by nearly 0.40. The point estimates are statistically significant at the 5% level. This means that for the median $500 million bond issuance, if the book had median oversubscription of 3x, increasing treatment level from 25th to 75th percentile would lead to an increase in the orderbook of $200 million. This is consistent with the coefficient of Book size ($1.42 \times 0.137 = 0.194$, in billions).

The richness of the dataset allows me to estimate within-firm effects, thus controlling for all time-invariant firm characteristics. Within my sample period, non-financial, non-Eurozone corporate issuers issue on average 6 bonds. I also include quarter fixed effects to account for business cycle variation and shifts in overall credit and macro conditions throughout the sample period. To absorb any significant sector-wide changes from the pre-2016 to post-2016 periods, I include industry x post fixed effects in all of my main specifications. To control for variations in investor behavior due to day-to-day changes in how busy the primary bond markets are, I control for the total dollar amount issued in the corporate bond market on day t. There may still be characteristics that contribute to how complex or difficult a bond issuance is that are observable to firms and investors but unobservable to the econometrician. To account for unobservable potential complexity of a bond issuance, I control for the number of banks underwriting the deal.

In Column (2), I add firm and deal controls. This absorbs key firm characteristics that can vary over time, such as size, revenue, and rating. It also ensures that any firm decisions to change tenor or size of the bond issuance does not bias my results. The addition of these controls increases my point estimate to $\hat{\beta}_{DID} = 2.627$. One potential source of bias in Column (1) is that an increase in the size of the bond mechanically decreases oversubscription. As I will discuss below, I find that treated firms issue more after the ECB shock, so this could have biased my coefficient downward. In specification (3), I add Leverage x Post and Size x Post controls, which absorbs any significant level changes in the firm's size or leverage post 2016.

B. *More treated issuers have less underpricing*

In this section, I focus on the impact of the ECB QE program on pricing of new securities. The dependent variable in Table III is the level of underpricing, in basis points. The primary specification is the same as Table II, as detailed in the previous section. For regressions (2)-(3), the $\hat{\beta}_{DID}$ is negative and statistically significant to the 1% level, indicating that the ECB QE program had a positive impact on "treated" firms. Corporate issuers that had relationships with banks that have greater exposure to the Eurozone through their institutional investor relationships faced lower discounts on new securities, and thus a lower cost of capital, relative to similar firms issuing similar bonds. The magnitude of this effect is also economically significnat. The coefficient for regression (3) of -21.73 can be interpreted as follows: if a firm moves from the 25th to the 75th percentile of the *Eurexp* treatment variable, it will face a 3bp lower new issue concession. This is over half of the average discount on a new security. For the median 10-year bond of $500 million, that is over $1.2 million in additional present value coupon cost.

$$Y_{it} = \beta_{DID} Eurexp_i Post_t + \beta_1 Post_t + X'_{it}\gamma + \alpha_{FE} + \epsilon_{it} \tag{8}$$

Table III Decrease in underpricing

	(1) Underpricing (NICs)	(2) Underpricing (NICs)	(3) Underpricing (NICs)
Diff-in-diff	-20.33**	-22.71***	-21.73***
	(-2.46)	(-2.96)	(-2.93)
amtmm_std		0.0988	0.116
		(0.35)	(0.41)
Deal controls	No	Yes	Yes
Firm controls	No	Yes	Yes
Lev x Post controls	No	No	Yes
Size x Post controls	No	No	Yes
Firm FE	Yes	Yes	Yes
Industry x Post FE	No	Yes	Yes
Quarter FE	Yes	Yes	Yes
r2	0.501	0.524	0.528
N	3044	3044	3044

Notes. Includes non-Eurozone USD non-financial corporate issuance, September 2010-June 2018. Post is after June 8, 2016. t-statistics in parentheses. Estimation is via OLS. Controls are normalized to variance 1 and include rating, tenor, amount, revenue, and number of underwriting banks. Standard errors, in parentheses, are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

C. More treated firms issue more

In this section I focus on changes in the firm issuance decision as a result of treatment. The outcome variable for regressions (1)-(3) is the amount issued in billions of USD at the firm-quarter level. In this difference-in-difference specification, "Post" refers to after Q1 2016. For all of the specifications, I find an economically significant uptick in issuance by treated firms after the ECB shock. Column (3) of Table IV includes firm fixed effects to isolate within-firm variation in issuance volume, industry-quarter fixed effects to absorb any industry specific shocks, and controls for firm revenue, size, and credit rating. I also account for any changes in size pre- and post-QE with size x post controls. I interpret the coefficient 0.67 as follows: if a firm moves from the 25th percentile to the 75th percentile of firm exposure, it increases its issuance volume by nearly $100 million.

Regression (4) is a linear probability model that includes all of the fixed effects of regression (3). The coefficient is positive and statistically significant at the 5% level, suggesting that treated firms have a higher probability of issuing. In regression (5), the dependent variable is the number of bonds issued. I find an economically meaningful and statistically significant positive coefficient on the number of bonds, suggesting that treated firms not only issue more in volume, but they also choose to issue more bonds.

$$Y_{iq} = \beta_{DID} Eurexp_i Post_q + X'_{iq}\gamma + \alpha_i + \alpha_{ind,q} + \epsilon_{iq} \tag{9}$$

Table IV Increase in issuance at firm level

	(1) Amount ($Bn)	(2) Amount ($Bn)	(3) Amount ($Bn)	(4) Pr(Issue)	(5) # Bonds
Diff-in-diff	0.784**	0.839***	0.667***	0.248**	0.721***
	(2.54)	(3.13)	(2.68)	(2.13)	(2.86)
Firm controls	No	No	Yes	Yes	Yes
Size x Post controls	No	No	Yes	Yes	Yes
Firm FE	No	Yes	Yes	Yes	Yes
Industry x Quarter FE	Yes	Yes	Yes	Yes	Yes
r2	0.101	0.211	0.294	0.361	0.356
N	8798	8692	8692	8692	8692

Notes. Includes non-Eurozone USD corporate issuance, by firm-quarter. Post is after Q1 2016. t-statistics in parentheses. Controls for firm revenue, assets, rating. Estimation is via OLS. Standard errors, in parentheses, are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

Is this increase in bond issuance a substitution away from loans, or is it a secular increase in leverage? To address this question, I replace the left-hand-side variable with the number of loans and total volume lent. I find that the Diff-in-diff coefficients in both regressions are not statistically different from zero. I interpret this as evidence that there was not a substitution away from loans. Rather, there was an increase in bond issuance. This could be substituting away from future issuance or increasing debt burden overall.

D. *Robustness check: endogenous bank-firm relationships*

The primary endogeneity concern is that the bank-firm relationship is endogenous. Firms do not select banks randomly. In the syndicated loan market, Chen and Song (2013) have found that firms and banks match by size, and Schwert (2018) find that bank-dependent firms match with well-capitalized lead arrangers.[17] It is quite plausible that banks that are more exposed to the Euro-area market match with firms that are also more exposed to the Euro-area. This would invalidate my identification strategy, because the ECB's QE program could them impact firms with Euro-area operations through a demand-side channel. For example, a U.S. firm with retail branches in the Euro-area may experience an increase in demand for its products sold in Europe following the QE program, and thus raise more debt.

To shut down this channel of firm-bank endogenous choice, I run two tests. First, I check how much the stock market returns of each firm i in my sample are correlated with the Euro-area stock market returns. In order for my identification strategy to hold, I want the correlations to not correlate with my bank-level measure of $Eurexp_i$. To run this test, because the Euro-area stock markets is strongly correlated with the U.S. stock market index, I first run a regression of Euro-area stock market returns on the S&P index returns, and recover the residuals. I then find the correlation between the stock return of each of the firms in my sample with the stock market residuals over the period 2010-2016, and plot these according to *Eurexp*.

$$r_t^{€} = \beta r_t^{\$} + \epsilon_t \tag{10}$$

$$corr_{i,t} = corr(\epsilon_t, r_{i,t}) \tag{11}$$

See Figure 4 for the robustness check. On the x-axis is how exposed firms are by my bank-relationship metric, from the least exposed to the most exposed. On the y-axis is the

[17]See Schwert (2018) for recent survey of ways firms and banks match in the bank lending market

$corr_{i,t}$ computed as described above. Each dot on the graph is one firm's correlation of stock returns with the Euro-market return residual. Firms with higher *Eurexp* do not appear to have greater correlation with the Euro-zone stock market. I consider this sufficient variation in correlation with the Euro-area market within each bucket of my bank-relationship Euro-exposure metric to make it unlikely that firms with higher *Eurexp* are systematically operating more in the Euro-zone in a way that would invalidate my identification strategy.

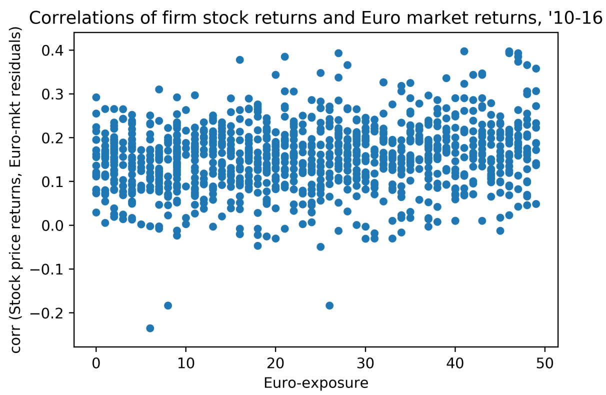


Figure 4. Correlations of firm stock returns and Euro market returns, 2010-2016

The second check of firm-bank endogenous choice involves exploring in more detail the operations side of firms in my sample. I pull the 2010 10-K (or 20-F) of each firm in my sample. I scrape the text of each file and count (1) the number of times the word "Euro", "euro", or "Europe" occurs in each text; and (2) the number of times each country in the Euro-zone is mentioned in each text, weighted by the GDP of the respective country to account for the relative economic importance of "Germany" occurring in a text versus "Malta". I weight both metrics by the number of total words in each company filing in order to avoid arbitrarily over-weighting firms with longer documents. As I did in the first check, I plot these metrics along an x-axis of 50 bins of *Eurexp*. Again, I find no systematic correlation between a firm having operations in Europe according to its company filings and the *Eurexp* I measure via its bank. In my robustness checks (discussed below), I use these metrics again to ensure that the firm's operational exposure to the Euro-zone does not drive my results.

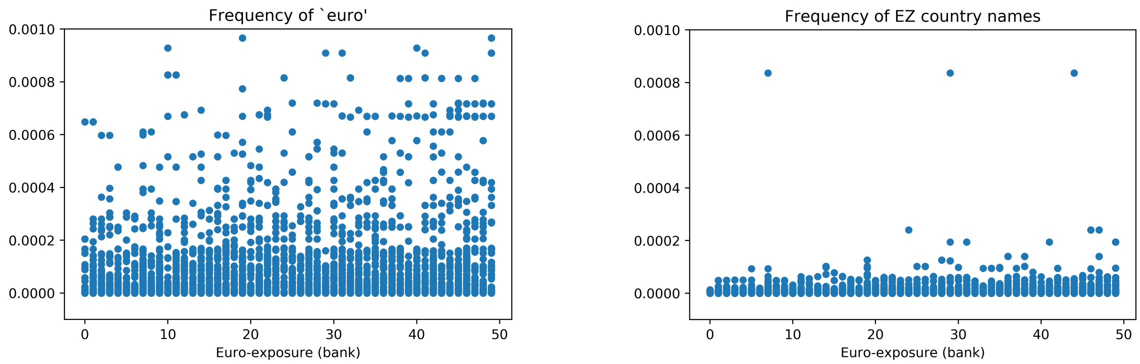


Figure 5. Frequency of Euro-zone words in SEC filing texts, 2010

A reasonable concern is that the increase in amount issued is due to a shift in treated firms' operations. Firms that are exposed to Europe through their bank relationships may simply be exposed to Europe via their operations. To address this issue, I employ the core Diff-in-Diff specification using the two alternative, operations-based measure of firm-level exposure to the Euro-zone constructed above. As a robustness check, I use these alternative measures in my main specification in place of my measure of *Eurexp*. The Diff-in-Diff coefficients are not statistically different from 0. This suggests that the spillover from ECB QE purchases in June 2016 were channeled through the bank underwriting network, and not through firm operations.

Table V Robustness Check: Increase in issuance at firm level on operational exposure to Euro-zone

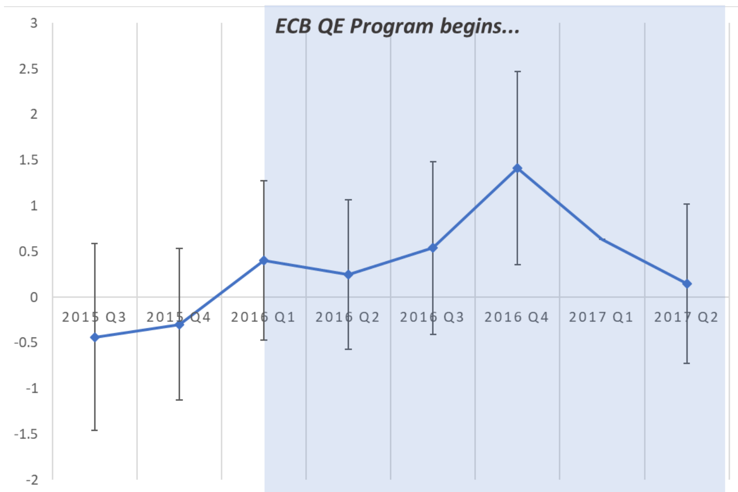
	(1) Amount ($Bn)	(2) Pr(Issue)	(3) # Bonds	(4) Amount ($Bn)	(5) Pr(Issue)	(6) # Bonds
NumEuro x Post	0.00263	0.00118	-0.00334			
	(0.14)	(0.28)	(-0.26)			
WtdCountry x Post				-0.0237	-0.00570	-0.0260
				(-0.88)	(-0.54)	(-1.04)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Size x Post controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
r2	0.299	0.347	0.337	0.299	0.347	0.337
N	9522	9522	9522	9522	9522	9522

Notes. Includes non-Eurozone USD corporate issuance, by firm-quarter. Post is after Q1 2016. t-statistics in parentheses. Controls for firm revenue, assets, rating. Estimation is via OLS. Standard errors are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

E. Robustness Check: Timing

A reasonable concern is the timing of the effects. It is possible that results are driven by pre-existing trends. For example, perhaps treated firms had already begun to issue more prior to the ECB's program, and the effect is unrelated to bank influence. To ensure that the findings are not driven by pre-existing trends, I run the Granger (1969) causality test, and plot the coefficients with standard error bars as per Autor (2003). The dependent variable in this test is the amount issued by firm i in quarter q. The coefficient of interest is positive in the periods following the start of the QE program, with the greatest impact in 2016 Q4. It is plausible that the effect took a few quarters to fully set in. The fact that coefficient is not significantly different from the zero in the periods prior to the start of the program suggests that firms were not anticipating the program through their issuance activity.

$$Y_{iq} = \alpha_q + \alpha_i + \sum_{\tau=0}^{m} \beta_{-\tau} Eurexp_i \times D_{t-\tau} + \sum_{\tau=1}^{q} \beta_{+\tau} Eurexp_i \times D_{t+\tau} + X'_{iq}\gamma + \epsilon_{iq} \qquad (12)$$



Notes: Vertical bands represent ±1.96 times the standard error of each point estimate, as per Autor (2003). Here, Q1 2017 is omitted because of collinearity

F. *Robustness Check: Switching Banks*

Sophisticated firms may anticipate that banks more exposed to the Eurozone would be better at underwriting bonds following the start of the ECB QE program. If firms are more likely to switch banks following the start of QE, this would invalidate my identification strategy which assumes firms take bank-specific shocks as given. My results could then be picking up firms switching to banks with greater European exposure in anticipation of better pricing following June 2016. Industry interview suggest this is unlikely to happen, due to the confidential nature of institutional investor lists and the multi-dimensional selection criteria of firms when selecting bank underwriters. To be sure, though, I can test this hypothesis directly in the data.

To address this concern, I compare how frequently firms switch banks over the whole sample period vs. after the start of QE. Specifically, I compute the percentage of firm-bank choices in which firms choose a bank that they have worked with in the past i deals ($i = 1, ..., 5$), conditional on having i past deals in the sample period. I find that firms are no less likely to choose a bank they have an existing relationship with following QE. Moreover, firms are actually slightly *more* likely to choose a bank they have previously hired post the start of QE. This refutes the potential confounding hypothesis that firms strategically switch banks in anticipation of benefits from the ECB QE program.

Table VI Pr(i choose b that was in one of the X past deals$|i$ having had X deals)

	2010-2018	**Post-QE**
1 deal	36%	41%
2 deals	55%	59%
3 deals	66%	68%
4 deals	72%	73%
5 deals	76%	76%

V. Mechanism

In this section, I explore potential mechanisms that drive the results. The ECB QE program was public information. What is preventing every bank underwriter from selling to institutional investors in Europe in order to take advantage of these positive demand shocks? One plausible mechanism is the following: banks could face search costs to find investors. Since the search for incremental investors beyond the bank's usual investor base is costly, a bank has an incentive to sustain relationship capital with its existing investor relationships. As such, the ECB QE program would first impact those underwriters that have already cultivated relationships in Europe.

If it is the case that banks incur search costs to find incremental investors beyond their relationship investor base, I would expect the following to occur: (1) when a bank's existing institutional investor base puts in more orders for bonds, search costs are lower; and (2) when banks have more bonds to issue than usual, they incur greater costs to sell those bonds than on days with fewer bonds to underwrite.

I first would like to test hypothesis (1), whether an increase in the intensive margin of orders from a bank's existing investors will decrease search costs. There are two empirical difficulties with trying to run this test. First, I do not observe the bank's existing institutional investor relationships in the data. Second, search costs are unobserved and thus difficult to measure. In order to tackle the first empirical challenge, I will use the same ECB treatment effect described above. Because the cross-sectional heterogeneity across banks in exposure the ECB QE program is constructed using the banks' reported capital markets presence in the Euro-zone, it can serve as a proxy for the existing investor relationships. I can thus interpret the increase in orders from European investors as an increase in the intensive margin of orders from existing investor relationships. In order to tackle the second empirical challenge, I use the time it takes to sell a bond, from announcement to pricing, as a proxy for search costs.

I hypothesize that treated banks experience lower search costs following the ECB CSPP for a similar kind of bond. To check if the cost of banks placing bonds for a given firm goes down with the ECB shock, I run the following regression:

$$time_{bit} = \beta_{DID} Eurexp_b \times Post_t + \beta_1 \times Post_t + X'_{it}\gamma_1 + \alpha_{b,q} + \alpha_i + \epsilon_{bit} \qquad (13)$$

Table VII More buyers, less time spent on placement

	(1) Time (hours: ann. to price)	(2) Time (hours: ann. to price)	(3) Time (hours: ann. to price)
Diff-in-Diff	-3.743** (-2.35)	-3.721** (-2.32)	-3.603** (-2.31)
Post	0.0934 (0.29)	-0.412 (-1.25)	-0.141 (-0.42)
# of bonds (t)			0.0531*** (8.86)
Firm controls	No	Yes	Yes
Deal controls	No	Yes	Yes
Bank x Quarter FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
r2	0.813	0.820	0.823
N	10496	10496	10496

Notes. Dataset includes one observation per deal for each bank. I exclude financial issuance. Standard errors are clustered at the bank level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

Column (3) controls for the total number of bonds that were issued on day t. The coefficient in Column (3) of -3.603 indicates that moving from the 25th to the 75th percentile of bank exposure decreases the time it takes to price the bond by over 1 hour. I include bank-quarter fixed effects which control for time-varying bank characteristics, while the firm fixed effects makes this a within-firm comparison. This is economically significant, since the median time to issue a bond is 6.7 hours.

Next, I test hypothesis (2): when banks have more bonds to issue than usual, they incur greater costs to sell those bonds, controlling for bond characteristics. Indeed, I find the opposite is true as well. If there are more sellers than buyers on a given day, banks will take *more* time to place the bond. I interpret this finding to mean that the relative mass of buyers and sellers for any given bank is relatively persistent. When firms happen to issue on days that their bank is busier, the deal takes longer and they have more underpricing.

This is true even when I control for the size of the deal, total issuance on that day, firm and bank-quarter fixed effects, and time-varying firm and deal characteristics. Because I include bank-quarter fixed effects, I am holding fixed the size of the bank's investor base (as long as the investor base does not change significantly within a quarter). The magnitude of this finding is not huge. It takes an extra 8 minutes for every 1% increase in the bank's issuance on a given day. However, it is strongly significant, suggesting that there is an increase in cost to the bank's placement of bonds in the primary market when there are more sellers than usual.

Table VIII More sellers, more time spent on placement

	(1) Time	(2) Time
logamt_bank	0.236***	0.130***
	(8.81)	(5.45)
logamt_t	0.176***	0.147***
	(3.70)	(3.27)
amtmm_std		0.641***
		(9.40)
Firm controls	No	Yes
Deal controls	No	Yes
Bank x Quarter FE	Yes	Yes
Firm FE	Yes	Yes
r2	0.816	0.821
N	10479	10479

Notes. Dataset includes one observation per deal for each bank. I exclude financial issuance. Standard errors are clustered at the bank level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

I interpret these results to support the hypothesis that banks incur search costs to find incremental investors beyond their typical investor base. This is consistent with a story in which banks prefer to maintain the same investor base. For the bond underwriting market as a whole, this suggests that local demand shocks can propagate through the bank-investor network to impact the issuing decisions of firms.

VI. Concluding Remarks

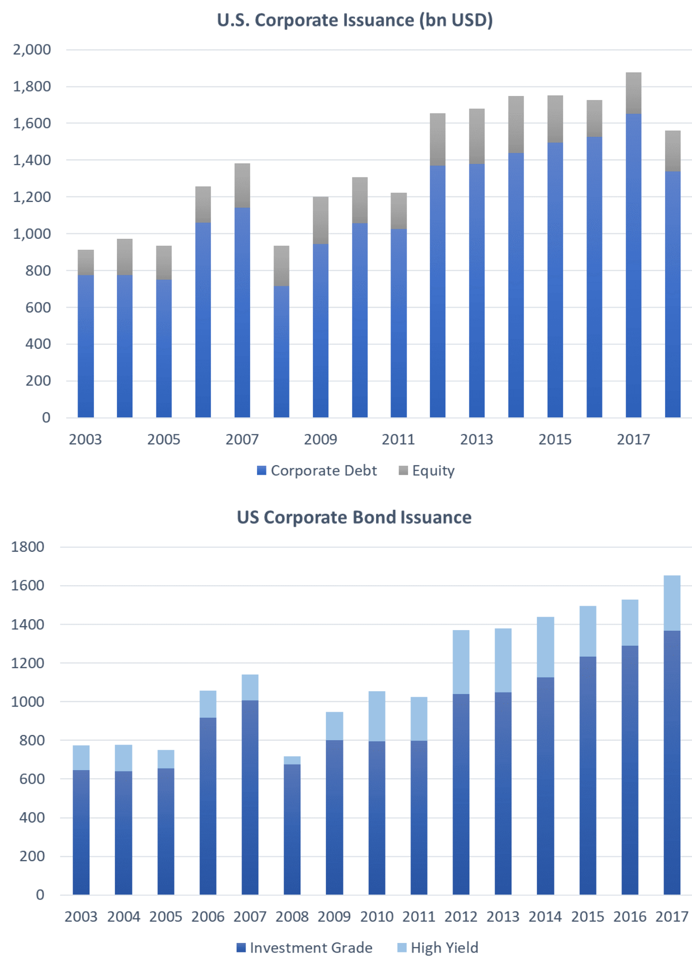
In this paper I have identified how monetary policy-driven demand shocks propagated from the Eurozone to the US corporate issuer market through the pre-existing network of firms, underwriters and investors. Using data that is novel to the literature on bond underwriting, I find that firms are differentially impacted by European demand shocks due to their bank relationships. Firms that are more "treated" have larger order books and achieve lower underpricing. Moreover, they issue more bonds. I interpret this as evidence that bank-investor relationships are reasonably sticky. This suggests a bank-related friction that is unrelated to the balance sheet channel. I hypothesize the mechanism is through banks facing costly search to sell to incremental investors. I find evidence supporting this hypothesis, consistent with the story of banks and investors having sticky relationships.

I have implemented a number of robustness checks to ensure that the results do not arise from endogenous firm-bank selection. In addition, I ensure that the results are not driven by firms switching bank relationships in order to benefit from the shock. The inability of firm-level exposure to the Eurozone to explain the effect supports the identifying assumption that banks' relationships with institutional investors are uncorrelated with corporate issuers' geographic presence.

The findings detailed above pave the way for three additional topics for further study on bank intermediaries and their role in underwriting bonds. First, what causes search frictions in the primary markets? Second, what are the implications to these networks when banks merge or split? Finally, what are policy implications of this result? Do bank networks magnify or attenuate the propagation of demand shocks caused by monetary policy shifts? How does this affect the way banks should be regulated?

Appendix A. Market Overview

Figure 6. Total Corporate Issuance



Source: SIFMA 2018

Figure 7. Headline examples for a MCD issuance

NEW ISSUE: [McDonald's] US$ benchmark 5s/10s/30s 3-part

By Chris Reich   August 13 at 9:06 AM

[NEW ISSUE] $tbd [McDonald's Corp] (MCD) Baa1/BBB+/BBB (s/s/s) SEC registered 3-part sr notes (tap of 3.35% 4/1/23 5y - $500m o/s (CUSIP: 58013MFE9), tap of 3.80% 4/1/28 10y - $500m o/s (CUSIP: 58013MFF6), and new 30y due 9/1/48). MWC (+15 on 5y and +15 on 10y; tbd on 30y) then 1mo par call on 5y, 3mos on 10y and 6mos on 30y. BAML (B&D on 5y tap)/JPM (B&D on 30y)/GS/Miz (B&D on 10y tap) joint active books. UOP: gcp, including, but not limited to, refi of debt, capex, payment of dividends, purchase of cmn stock, investments in or extensions of credit to subs, or business expansion. Pricing today. Settle 8/15 (T+2). [IPTs: 3.35 '23 tap: 80-85; 3.80 '28 tap: 110-115; New 30yr: 160-165]

GUIDANCE: [McDonald's] US$ benchmark 5s/10s/30s 3-part

By Chris Reich   August 13 at 12:23 PM

[GUIDANCE] $tbd [McDonald's Corp] (MCD) Baa1/BBB+/BBB (s/s/s) SEC registered 3-part sr notes (tap of 3.35% 4/1/23 5y - $500m o/s (CUSIP: 58013MFE9), tap of 3.80% 4/1/28 10y - $500m o/s (CUSIP: 58013MFF6), and new 30y due 9/1/48). MWC (+15 on 5y and +15 on 10y; tbd on 30y) then 1mo par call on 5y, 3mos on 10y and 6mos on 30y. BAML (B&D on 5y tap)/JPM (B&D on 30y)/GS/Miz (B&D on 10y tap) joint active books. UOP: gcp, including, but not limited to, refi of debt, capex, payment of dividends, purchase of cmn stock, investments in or extensions of credit to subs, or business expansion. Pricing today. Settle 8/15 (T+2). IPTs: 3.35 '23 tap: 80-85; 3.80 '28 tap: 110-115; New 30yr: 160-165.

[GUIDANCE: 23s tap T+70a, 28s tap T+100a, new 30y T+145a. Area +/- 2bp]

LAUNCHED: [McDonald's] US$1.8bn 5s/10s/30s 3-part

By Chris Reich   August 13 at 1:25 PM

[LAUNCHED] $1.8bn [McDonald's Corp] (MCD) Baa1/BBB+/BBB (s/s/s) SEC registered 3-part sr notes (tap of 3.35% 4/1/23 5y - $500m o/s (CUSIP: 58013MFE9), tap of 3.80% 4/1/28 10y - $500m o/s (CUSIP: 58013MFF6), and new 30y due 9/1/48). MWC (+15 on 5y and +15 on 10y; tbd on 30y) then 1mo par call on 5y, 3mos on 10y and 6mos on 30y. BAML (B&D on 5y tap)/JPM (B&D on 30y)/GS/Miz (B&D on 10y tap) joint active books. UOP: gcp, including, but not limited to, refi of debt, capex, payment of dividends, purchase of cmn stock, investments in or extensions of credit to subs, or business expansion. Pricing today. Settle 8/15 (T+2). IPTs: 3.35 '23 tap: 80-85; 3.80 '28 tap: 110-115; New 30yr: 160-165. GUIDANCE: 23s tap T+70a, 28s tap T+100a, new 30y T+145a. Area +/- 2bp.

[LAUNCHED:]

- [$500m tap of 3.35% 4/1/23 5y at T+68]
- [$550m tap of 3.80% 4/1/28 10y at T+98]
- [$750m 9/1/48 new 30y at T+143]

PRICED: [McDonald's] US$1.8bn 5s/10s/30s 3-part

By Chris Reich   August 13 at 3:59 PM

[PRICED] $1.8bn [McDonald's Corp] (MCD) Baa1/BBB+/BBB (s/s/s) SEC registered 3-part sr notes (tap of 3.35% 4/1/23 5y (CUSIP: 58013MFE9), tap of 3.80% 4/1/28 10y (CUSIP: 58013MFF6), and new 30y due 9/1/48). MWC then 1mo par call on 5y, 3mos on 10y and 6mos on 30y. BAML (B&D on 5y tap)/JPM (B&D on 30y)/GS/Miz (B&D on 10y tap) joint active books. UOP: gcp, including, but not limited to, refi of debt, capex, payment of dividends, purchase of cmn stock, investments in or extensions of credit to subs, or business expansion. IPTs: 3.35 '23 tap: 80-85; 3.80 '28 tap: 110-115; New 30yr: 160-165. GUIDANCE: 23s tap T+70a, 28s tap T+100a, new 30y T+145a. Area +/- 2bp. LAUNCHED: $500m 23s tap at T+68, $550m 28s tap at T+98 and $750m new 30y at T+143. Settle 8/15 (T+2).

[PRICED:]

- [$500m tap of 3.35% 4/1/23 at 99.657 3.43% T+68] MW+15. Total o/s now $1bn.
- [$550m tap of 3.80% 4/1/28 at 99.501 3.862% T+98] MW+15. Total o/s now $1.05bn.
- [$750m 4.45% 9/1/48 99.521 4.479% T+143] MW+25.

Appendix B. Parallel Trends

Table IX Parallel Trends

	Bottom tercile exposure		Top tercile exposure		Difference	
	mean	sd	mean	sd	mean	t-stat
Panel A: Firm Characteristics						
growth(Revenue)	0.01	0.22	0	0.21	0.01	1.18
growth(Total Assets)	0.02	0.09	0.01	0.07	0	1.64
growth (LT Debt / Assets)	0	0.03	0	0.03	0	-0.03
Panel B: Issuance Characteristics						
growth(NICS)	1.45	11.32	-0.3	8.95	1.75	1.33
growth(Oversub)	-0.24	1.47	-0.05	1.53	-0.19	-0.95
growth(Amount)	-23.46	1482.81	-36.89	1579.32	13.43	0.34
Observations	3290		3329		6619	

Panel C: Bank Characteristics						
growth(Rev)	0.03	0.07	-0.03	0.3	0.05	1.14
growth(Total Assets)	0.01	0.33	0.04	0.8	-0.03	-0.49
growth(Cash)	0.01	0.72	0.07	0.99	-0.06	-0.78
growth(Net Income)	0.01	0.65	-0.07	1.59	0.08	0.65
Observations	432		435		867	

Notes. I compare the bottom and top third of firms [banks] sorted by *Eurexp*. The mean and standard deviations are computed on firm [bank]-quarter data. Deal dynamics are aggregated to the quarter level by firm: mean of NICs, oversubscription, tenor, and rating; sum of amount. 2010-2015. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

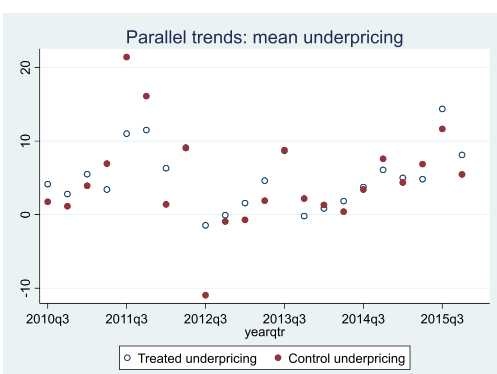


Figure 8. Underpricing: parallel pre-trends

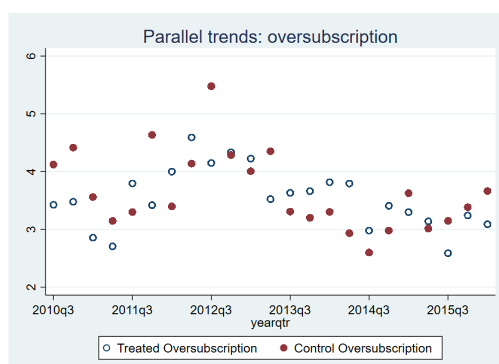


Figure 9. Oversubscription: parallel pre-trends

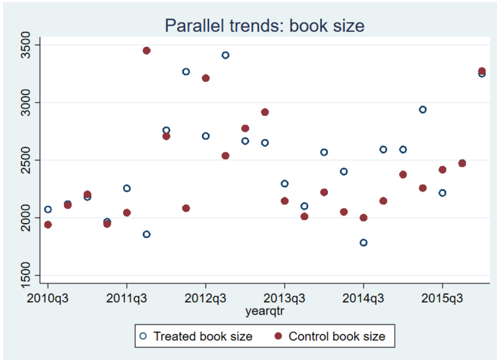


Figure 10. Book size: parallel pre-trends

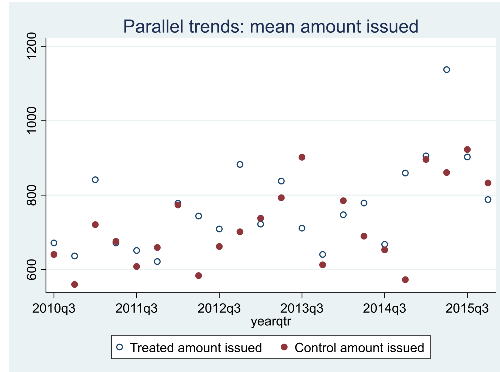


Figure 11. Amount issued: parallel pre-trends

Appendix C. Further Robustness Checks

One potential source of endogeneity is the following: some firms anticipate the increase in demand for more European-exposed banks. These firms switch to work with more European banks. Firms that switch banks have some characteristic, unobserved by the econometrician, that is correlated with demand shocks following the ECB QE program. To check if switching is driving my results, I conduct the following test. I exclude any firm that has switched banks following the start of CSPP. That is, any firms that issue bonds with a bank that it has not previously worked with in my sample (2000-2016) are excluded from the analysis. I run my primary Diff-in-diff specification on the subset of firms that work exclusively with banks with which they had prior relationships after June 2016. That is, firms that select *any* new banks after June 8, 2016 are excluded from the analysis. The results are in Table (X). The coefficients do not change in economic or statistical significance. Even narrowing down to bond issuances where the firm exhibits zero switching behavior, the effect still holds. Thus, firms switching banks cannot be driving my result.

Table X Main specification, excluding switching firms

	(1) Oversubscription	(2) Underpricing (NICs)
Diff-in-diff	4.477***	-19.48**
	(3.00)	(-2.01)
Deal, firm controls	Yes	Yes
Lev x Post, Size x Post controls	Yes	Yes
Firm FE	Yes	Yes
Industry x Post FE	Yes	Yes
Quarter FE	Yes	Yes
r2	0.450	0.544
N	2620	2620

Notes. Includes non-Eurozone USD non-financial corporate issuance, September 2010-June 2018. Post is after June 8, 2016. t-statistics in parentheses. Estimation is via OLS. Controls are normalized to variance 1 and include rating, tenor, amount, revenue, and number of underwriting banks. Standard errors, in parentheses, are clustered at the firm level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.010$

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