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THE BOND LENDING CHANNEL OF MONETARY POLICY

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Abstract

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1 Introduction

The financing of firms is vital to economic activity and a key element in the conduct of monetary policy as investment, output, and employment are all influenced by credit frictions. The current credit crisis illustrates that firms' difficulties in paying down debt or raising new funds can lead to the risk of widespread financial distress and a severe and prolonged recession.[1] Frictions in corporate financing are thus critical to the transmission of monetary policy through firms, and a (multiform) "bank lending channel" is the predominant view to understand this interaction. However, over the last two decades bond financing has been rising at the expense of bank lending. Europe is a striking example of this rapid growth: historically, its bond markets were less developed than in the U.S.—according to the European Commission, the share of market financing doubled since 2000. How does monetary transmission depend on the bond-bank share? This is an open and consequential issue—indeed, the stock of bond debt has become a significant concern for central bankers.[2]

Given that bonds and loans are not perfect substitutes, it is theoretically unclear how the pass-through of monetary policy changes with debt composition. Classical views of the bank lending channel emphasize the role of loans in monetary transmission, and tend to model bond markets as a largely frictionless "spare tire". Yet a broader corporate finance perspective implies that frictions in bond financing are relevant in practice. For instance, market debt is held by dispersed creditors, it is harder to renegotiate relative to bank loans (Bolton and Scharfstein, 1996; Becker and Josephson, 2016; Crouzet, 2017), and there is less screening or monitoring (Holmstrom and Tirole, 1997; De Fiore and Uhlig, 2011). Because bonds are more *rigid* than relationship lending, monetary easing can be more valuable for bond-reliant firms. Credible empirical investigations are thus crucial to making progress on this question.

To this end, this paper presents a high-frequency approach that combines identified

[1] "Coronavirus May Light Fuse on 'Unexploded Bomb' of Corporate Debt", *New York Times*, 03/11/2020.

[2] The January 2019 minutes of the FOMC state that "the build-up in overall nonfinancial business debt to levels close to historical highs relative to GDP was viewed as a factor that could amplify adverse shocks to the business sector." The President of the Federal Reserve of Dallas recently claimed: "As a central banker, I am carefully tracking the growth in BBB and less-than-investment-grade debt. In a downturn, some proportion of BBB bonds may be at risk of being downgraded, creating dislocations." On March 31st 2020, Moodys' downgraded its outlook on the corporate bond market from stable to negative, while Goldman Sachs forecasted over $500 billion worth of bonds will be cut to high-yield from investment-grade rating, in addition to the $149 billion that have already been downgraded year-to-date.

monetary shocks with cross-sectional firm-level stock price reactions in the Eurozone. Because monetary policy decisions are endogenous and correlated with many drivers of firm choices, high-frequency approaches have been remarkably successful in isolating monetary shocks (Nakamura and Steinsson, 2018b). Tracing the impact of those shocks on the real economy is nevertheless challenging as firm-level outcomes tend to adjust at a much lower frequency.

Our first contribution is to show how to interpret stock market reactions to learn about the effect of monetary policy on firms. An envelope argument demonstrates that, since firms maximize equity value subject to constraints, stock price reactions are directly informative about how monetary policy affects financial constraints. More specifically, we decompose the high-frequency response into (i) a "direct" effect that captures the revaluation of the present value of future profits *keeping the firm's policies unchanged*, and (ii) a "constraint" effect that captures how monetary policy tightens or relaxes financial constraints. Crucially, this second force is at the heart of macro-finance models of monetary transmission. Stock market data allows us to learn about this object within a high-frequency identification framework.

We then illustrate our "bond lending channel" in a simple framework of debt structure, investment, and financial constraints. In general, the effect of a higher share of bond financing is ambiguous. On the one hand, the bank lending channel implies that a monetary easing puts bank-financed firms in a relatively favorable position due to larger shifts in credit supply. On the other hand, the existence of frictions in bond financing dampens and can reverse this effect. Specifically, bond-financed firms face a larger cost of financial distress: because bonds are held widely, dispersed creditors are less likely to coordinate on beneficial renegotiations relative to relationship banks. Monetary easing reduces the probability of financial distress, which is especially valuable to bond-financed firms. Which effect dominates depends on the relative strength of bond financing frictions relative to the bank lending channel.

We apply our empirical approach to a cross-section of public firms in the Eurozone and ask whether a larger share of bond financing implies a lower stock price reaction. We construct a panel that combines information on policy announcements, asset prices, firm balance sheets and financing structure. The baseline analysis focuses on conventional monetary policy between 2001 and 2007, from the early years of the Euro to the beginning of the financial crisis. We use the series of high-frequency monetary shocks constructed by Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019). These shocks capture the surprise content of central banks' announcements. They are hence little affected by the release of general macro-economic information that did not fall on that specific time window of the day. Daily stock prices are merged with balance sheet information as well as comprehensive corporate bond issuance data to measure the reliance of firms on bond financing.

There are at least two econometric challenges to be addressed in this setting. First, we have to separate firms' reactions to information related and unrelated to monetary policy. Measuring firms' reaction by changes in their stock prices provides a high-frequency measure that limits the potential to pick up changes in the economic environment that are unrelated to monetary policy. Moreover, stock prices provide a convenient summary measure that capitalizes firms' exposure across states and time.[3] Second, debt structure is not randomly assigned, and we need to rule out omitted variables that drive *both* debt structure and firm reactions to monetary policy. We leverage the granularity of our firm-level data to rule out alternative interpretations. To account for changes in discount rates, we control for equity duration, since bonds are more likely to be fixed-rate and long-term relative to loans. More conventional channels, such as changes in market beliefs, consumer demand, labor supply, or input and output price levels, can also matter and, while a direct link to the bond share is less clear, an indirect link can arise through sector-level differences. We thus include sector-time fixed effects to isolate the differential impact of more bond financing within firms in the *same* sector on the *same* day. Moreover, we show that our results are not driven by bond-reliant firms being safer, larger, more mature or collateral-rich. Still, we acknowledge that without exogenous variation we cannot completely rule out all potential sources of unobserved heterogeneity within sectors.

We find strong evidence that debt structure matters for the transmission of monetary

[3]Our high-frequency identification strategy relies on stock prices adjusting rapidly, and firms maximizing equity values. Analogous to existing work in the United States, such as, Gorodnichenko and Weber (2016), we focus on constituents of a broad equity index to capture the most-liquid stocks and best-governed firms. We use the constituents of the EURO STOXX sectoral indices, which account for about 85% of market capitalization and about 80% of total bonds outstanding in the Eurozone. In a similar spirit, Anderson and Cesa-Bianchi (2020) look at the high-frequency response of credit spreads in a cross-section of U.S. rated firms. We acknowledge that the frictions at play for smaller firms are potentially different. Complementary to our approach, papers studying the low-frequency firm-level response tend to use a broader sample, although typically within the Compustat universe (Crouzet, 2019; Ottonello and Winberry, 2018; Cloyne, Ferreira, Froemel, and Surico, 2018).

policy: firms with more bond debt are relatively more affected by surprise interest rate changes. Quantitatively, after a 25 basis point increase in interest rates, firms in the bottom quartile of the bonds over assets distribution have a 99 basis points lower stock return relative to firms in the top quartile. This finding is hard to square with a bank lending channel. Irrespective of the exact micro-foundation, bank lending channel explanations would imply that bond-reliant firms are relatively less responsive, the opposite of what the data suggest. On the other hand, this evidence is consistent with the existence of intense frictions in bond financing in the Eurozone. Importantly, the effect is equally forceful during the post-crisis period, when bond financing became much more prevalent. These findings are robust to a number of alternative specifications, including the inclusion of traditional balance sheet covariates that are thought to drive the response to monetary policy, such as, leverage, default risk, size, age or CAPM betas.

We complement our high-frequency results with some suggestive evidence on credit substitution and investment. The usual caveat applies: the statistical power to assess the effect of cleanly identified shocks on real variables several quarters into the future is limited because many other shocks also affect these variables over longer periods. First, we find that firms tend to substitute away from loans towards bonds after monetary tightenings. This is in line with an extensive literature linking credit flows to monetary policy (Becker and Ivashina, 2014; Crouzet, 2019; Kashyap, Stein, and Wilcox, 1992). However, note that this substitution does not imply that firms are not affected by the shock. Crouzet (2017) shows that a switch away from bank financing leaves firms exposed to rigidity frictions in bond financing that reduce investment through a precautionary motive. Quantitatively, Crouzet (2017) shows that this "debt substitution channel" can explain up to a third of the contraction of investment during the Great Recession. We indeed find a corresponding pattern in our sample: bond-reliant firms tend to contract investment more after a rate hike relative to other firms.

Finally, we present a comparison with the United States. Our theory suggests that the bond lending channel should be much weaker when frictions in bond financing are smaller. The United States provide a natural comparison since bond financing is substantially more prevalent there relative to Europe. Indeed, we find no effect in a sample of comparable American firms. Several differences in the respective informational and legal environment support the view that there are significantly smaller frictions in bond financing, if any, in the United States relative to the Eurozone. For instance, the prevalence of rating agencies and public information is drastically lower in the Eurozone: the ECB estimates that in 2004 only 11% of firms with turnover over €50M had an S&P rating in Europe, compared to 92% in the U.S. We also show that rating downgrades have a stronger effect for firms in the Eurozone. Legal scholars have also argued that the U.S. system is better equipped to deal with the distress of firms funded by bond debt and that national insolvency laws in Europe are often unprepared for the rising importance of bond markets (Ehmke, 2018).

The chief implication of our findings is that heterogeneity in debt structure, and, in particular, the mix of bonds and bank loans, might be a consequential ingredient for macroeconomic models. Sources of external financing are not perfect substitutes, and the underlying trade-offs affect the pass-through of macroeconomic shocks. The exact mechanisms at play, as well as, the effects of specific policy interventions, are important areas for future research.

Related literature: This paper is at the intersection of macroeconomics and corporate finance. While there is an extensive body of work studying the bank lending channel of monetary policy (Kashyap and Stein, 2000; Becker and Ivashina, 2014; Drechsler, Savov, and Schnabl, 2017), we emphasize the role of frictions in bond financing.[4] Crouzet (2017) and De Fiore and Uhlig (2011, 2015) show that the optimal mix of bonds versus loans varies in the cross-section of firms and that this fact has implications for real outcomes.

In terms of its approach, this paper relies on high-frequency identification of monetary policy shocks (Kuttner, 2001; Nakamura and Steinsson, 2018a; Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa, 2019). We build on existing work tracing the impact of these shocks in the cross-section of firms using high-frequency changes in stock prices to understand monetary transmission (Gorodnichenko and Weber, 2016; Weber, 2015).[5]

We contribute to an emerging literature on monetary transmission and the bond share of credit. In the context of the United States, Crouzet (2019) introduces a model of monetary pass-through and credit disintermediation, and provides evidence consistent with

[4]Seminal contributions in the corporate finance literature include Bolton and Scharfstein (1996); Diamond (1991); Holmstrom and Tirole (1997) and Becker and Josephson (2016); Denis and Mihov (2003); Bruno and Shin (2017).

[5]See also Haitsma, Unalmis, and de Haan (2016); Ozdagli and Weber (2017); Ozdagli (2018); Gürkaynak, Karasoy-Can, and Lee (2019). Anderson and Cesa-Bianchi (2020) studies the response of credit spreads in the cross-section of U.S. bond issuers.

these predictions. Also in the United States, Ippolito, Ozdagli, and Perez-Orive (2018) document a floating rate channel of monetary policy to explain why firms with more bank loans are more affected by monetary policy. Holm-Hadulla and Thürwächter (2020) study how the aggregate composition of corporate debt financing affects the transmission of monetary policy in a panel of euro area countries using a local projections approach. In terms of its findings, this paper aligns with the growing consensus that heterogeneity is key to monetary policy transmission.[6]

2 Debt Heterogeneity and Monetary Transmission

Before moving to the empirical results, this section explains the economics behind debt structure and monetary transmission in three parts. First, we highlight the key differences between loans and bonds. Second, we present the envelope argument that will guide our empirical strategy. Third, we illustrate the channel through a stripped-down model of financial frictions, optimal debt structure, and monetary policy.

2.1 Differences Between Bank and Bond Financing

The (multiform) bank lending channel: Banks are levered intermediaries that fund illiquid loans with liquid deposits. It is well known that banks are affected by monetary policy in specific ways. Classical models emphasize the role of reserves or bank capital. In contrast, recent views contend that banks' market power, loan covenants, banks' income composition, or the floating rate nature of bank loans are quantitatively important (Drechsler, Savov, and Schnabl, 2017; Wang, Whited, Wu, and Xiao, 2018; Scharfstein and Sunderam, 2016; Greenwald, 2019; Wang, 2018; Ippolito, Ozdagli, and Perez-Orive, 2018; Gürkaynak, Karasoy-Can, and Lee, 2019). Independent of their exact micro-foundations, these theories tend to stress bank-related frictions. Bond markets are typically modeled as being fairly simple, with a lower interest rate pass-through relative to loans. The bank

[6] For instance, Ottonello and Winberry (2018) and Jeenas (2018) emphasize a heterogeneous response of firms with different financial positions, while Cloyne, Ferreira, Froemel, and Surico (2018) stress the role of firm's age. Rodnyansky (2019) investigates how firm heterogeneity together with intermediate import intensities mediate the monetary transmission process in unorthodox ways. Lian and Ma (2018) show the different macroeconomic implications of asset-based versus cash-flow based lending. Auclert (2019), Wong (2019), Kaplan, Moll, and Violante (2018), Coibion, Gorodnichenko, Kueng, and Silvia (2017) also highlight the importance of heterogeneity, with a stronger focus on the household sector.

lending channel is also often associated with the view that bond markets are "spare tires" to which borrowers can turn to when bank credit retracts. The natural prediction of the bank lending channel is thus that firms with more bond financing are relatively less affected by monetary policy.[7]

Frictions in bond financing: An equally large body of work emphasizes that relationship banking and market financing are not perfect substitutes (Bolton and Scharfstein, 1996; Crouzet, 2017; De Fiore and Uhlig, 2015). A central aspect of this difference is that bonds tend to be widely held by a dispersed base of investors, which makes them harder to renegotiate. This coordination (free-rider) problem across bond creditors means that market financing is typically seen as less flexible than bank loans. The lower flexibility implies that banks are better able to help their relationship borrowers to avoid financial distress. There is considerable empirical evidence that banks' flexibility is beneficial to borrowers in case of financial distress. Gilson, John, and Lang (1990) document a higher likelihood of private (and presumably less costly) restructuring for firms that hold a higher proportion of bank debt to total debt, while Asquith, Gertner, and Scharfstein (1994) and Hoshi, Kashyap, and Scharfstein (1990) provide similar evidence. Importantly, the value of bank flexibility is not restricted to liquidation and bankruptcy. Debt renegotiation by banks helps firms weather a period of temporarily low revenue and can take many forms, such as a maturity extension, and not just a reduction in interest and principal payments (Roberts and Sufi, 2009). This renegotiation outcome is made possible by the dynamic nature of the relationship between creditors and debtors and is significantly harder to achieve with dispersed bond creditors (Denis and Mihov, 2003; Hoshi, Kashyap, and Scharfstein, 1991).[8] Because of those rigidities in bond financing, debt structure can affect monetary transmission through a novel channel that we illustrate below.

Differences in duration: In practice, bonds tend to have longer *duration* relative to loans (i.e., a varying discount rate sensitivity). This distinction arises because corporate bonds tend to have longer maturities than bank loans, and they are more likely to have fixed interest rates (Ippolito, Ozdagli, and Perez-Orive, 2018; Gürkaynak, Karasoy-Can, and Lee, 2019). This is important as it affects borrowers' exposure to monetary policy:

[7]Note, however, that not all existing versions of the bank lending channel go in the same direction; see Wang, Whited, Wu, and Xiao (2018) for a quantitative comparison.

[8]Importantly, there is also evidence that dispersed market financing leads to renegotiation frictions in mortgage markets (Piskorski, Seru, and Vig, 2010; Piskorski and Seru, 2018).

while a rate hike decreases the present value of debt obligations, this decrease is less pronounced for loans relative to bonds. Because debt is a liability for the firm, this implies that, *ceteris paribus*, more bonds lead to a smaller (less negative) stock price reaction—larger debt duration implies a smaller equity duration. A duration channel would thus tend to predict that bond-financed firms are less affected by monetary policy.[9]

2.2 Envelope Argument: Information in Stock Price Reaction

This section offers a general illustration of the envelope argument that will guide our empirical strategy. We argue that stock prices are special. Not only are they available at high-frequencies to help with identification, but they are also particularly revealing through their connection to the objective function of firms. As firms maximize equity value subject to constraints, stock price reactions have a clear interpretation given by the envelope theorem.

To fix ideas, consider first a setting that potentially fits many macro-finance models of firms facing financial constraints. The next section specializes the framework to debt structure. A firm has a vector of characteristics x, and denote the monetary policy target by r^f. The firm chooses its optimal policies $y^* = (I^*, N^*, D^*...)$ for path of inputs, employment, debt, etc. These policies are chosen to maximize the present value of future expected profits $E(y, x, r^f) = \mathbb{E}\left[\Sigma_t \frac{\pi_t(y,x)}{(1+r_t)^t}\right]$. In addition, the firm is subject to a number K of constraints $G_k(y, x, r^f) \geq 0$, which potentially depend on the policy rate r^f. In this setting, equity value is the value function:

$$V = \max_y E(y, x, r^f) \text{ s.t. } G_k(y, x, r^f) \geq 0 \forall k$$

The stock price reaction to small monetary policy shocks can be computed directly using the envelope theorem:

$$\frac{\mathrm{d}V}{\mathrm{d}r^f} = \underbrace{\frac{\partial E(y^*, x, r^f)}{\partial r^f}}_{\text{direct effect}} + \underbrace{\Sigma_k \lambda_k \frac{\partial G_k(y^*, x, r^f)}{\partial r^f}}_{\text{how MP affects constraints}}$$

[9]Note that these differences are less noticeable in the Eurozone relative to the United States: European bonds tend to have shorter maturities, and the share of bank loans with floating rates is significantly smaller. Additionally, bonds are less likely to be collateralized relative to loans, and, in general, they tend to be junior to bank debt.

In particular, the change in optimal policy $\frac{\mathrm{d}y^*}{\mathrm{d}r^f}$ induced by monetary policy is of a second order.[10] Instead, the stock price reaction can be decomposed into two terms.

The first term is the direct effect: the revaluation of the objective function induced by the shock *keeping the firm's policies constant*. There are at least three channels that can create a direct effect. First, a change in discount rates: equity value is an NPV.[11] We call this the "equity duration" effect, borrowing from the asset pricing literature, where it denotes the interest-rate sensitivity of the present value of a given cash flow stream (Gormsen and Lazarus, 2019; Weber, 2018). A second channel for the direct effect is the change in beliefs: equity value is an expectation. This captures both the standard channel that a rate hike is contractionary, as well as an "information effect," in which a rate hike reveals that the central bank is optimistic about the state of the economy. In both cases, there is a direct effect on the market beliefs of good versus bad states. Third, changes in prices in general equilibrium. Changes in nominal input or output prices, as well as a revaluation of nominal debt obligations, can directly affect firms' profits.

The second term is of particular interest in understanding the monetary transmission channel. It captures how monetary policy relaxes or tightens the constraints faced by firms. This channel is central to macro-finance models with financial frictions. Interestingly, our envelope argument shows that stock prices are *directly informative* about this channel if we can control for direct effects. This is remarkable since an empirical detection of constraints is generally challenging. More precisely, the constraint effect is the product of two terms. First, a pass-through term that measures how much a policy surprise mechanically tightens the constraint faced by the firm. Second, the shadow price of this constraint: the Lagrange multiplier that measures the distortion in a firm's policies relative to the unconstrained optimum. Note also that the idea is quite general—it only relies on the fact that firms maximize equity value and not on the type of policies or constraints considered.[12] Our empirical high-frequency approach leverages this insight

[10]To the best of our knowledge, the first trace of this argument in the context of monetary policy can be found in Ozdagli (2018).

[11]Importantly, a change in the discount rate can occur not only through a change in the risk-free rate but also in the risk premium (Drechsler, Savov, and Schnabl, 2018; Kekre and Lenel, 2019; Gertler and Karadi, 2015; Anderson and Cesa-Bianchi, 2020).

[12]This formal decomposition supports the extensive use of stock market data to learn about the effects of monetary policy by showing that stock price reactions are not purely "financial" variables but are also informative about real effects (Bernanke and Kuttner, 2005; Gorodnichenko and Weber, 2016; Weber, 2015; Ozdagli and Weber, 2017; Gürkaynak, Karasoy-Can, and Lee, 2019; Ippolito, Ozdagli, and Perez-Orive, 2018; Ozdagli, 2018; Ozdagli and Velikov, 2020).

by combining a time-series of identified monetary shocks and with cross-sectional stock price reactions of firms with different debt composition.

2.3 Illustrating the Mechanism

This section illustrates the role that frictions in bond financing play in monetary transmission and applies our envelope decomposition to understanding what the cross-sectional stock price reaction reveals. To this end, we present a stripped-down corporate finance model of financial frictions, optimal debt structure, and monetary policy. We acknowledge that for the sake of tractability, some modeling choices are particularly stark. We discuss alternative modeling choices in the Online Appendix.[13]

Firms jointly choose how much to borrow for investment and their mix of loan and bond financing. We need to model three ingredients: (i) credit constraints, (ii) the trade-off in debt structure, and (iii) the effect of monetary policy. The trade-off in debt structure is in the spirit of the static model of Crouzet (2019), with some simplifications.

Credit constraints: We follow the canonical moral hazard framework of Holmstrom and Tirole (1997). Borrowing is constrained because, to preserve entrepreneurs' incentives, the maximum income that can be pledged to an investor is lower than the total return of the project. The firm has assets/cash on hand of A and chooses investment level I, which yields RI in the high state and χI in the low state, with $\chi \in [0, R)$. Importantly, the payoff in the low state includes any indirect cost of financial distress, which amplifies fundamental cash-flow shocks and can take many forms.[14] If the entrepreneur behaves well, the high state realizes with probability p_H. If they misbehave, it realizes with probability $p_H - \Delta p$ and the entrepreneur receives private benefit B per unit of investment. For incentive reasons, the maximum pledgeable income in the high state is thus only $(R - B/\Delta p)I$, where $B/\Delta p$ captures the agency friction that leads to inefficient credit rationing. The entrepreneur receives nothing in case of failure. A key object is the expected

[13] Even though some building blocks can be found in the pioneering contributions of Crouzet (2017), Crouzet (2019), Ippolito, Ozdagli, and Perez-Orive (2018), Ajello (2016) or Chang, Fernández, and Gulan (2017), much work remains to be done when it comes to formulating a comprehensive model for quantitative analysis.

[14] For instance, low cash-flows can lead to a rating downgrade or violating a covenant (Greenwald, 2019; Lian and Ma, 2018), with adverse consequences for the firm's operations. Defaults and liquidation are the most extreme forms of financial distress, although not the most common.

pledgeable income per unit of investment:

$$\mathcal{P} = p_H(R - B/\Delta p) + (1 - p_H)\chi$$

The firm can borrow $I - A$ from lenders with cost of funds ρ. Credit constraints arise because lenders must break-even on the debt while pledgeable income is limited by moral hazard: $\mathcal{P}I \geq (I - A)\rho$.

Debt structure: The firm jointly choose how much to borrow using loans and bonds. Denoting the bond share by $\beta \in [0, 1]$, total bonds are $\beta(I - A)$ and loans are $(1 - \beta)(I - A)$. We follow Crouzet (2019, 2017) and model the trade-off between intermediated and market financing in a simple way. Loans are more flexible than bonds because they are held by concentrated creditors, and can be renegotiated more easily to reduce the cost of financial distress. The payoff χ in the bad state thus depends on the debt structure, with $\chi(\beta) = \chi_0 - \chi_1\beta^2$. Frictions in bond financing are captured by the slope parameter $\chi_1 > 0$: bond financing implies a higher cost of financial distress.[15] On the other hand, banks incur an intermediation cost and have thus a higher cost of funds relative to bonds. Therefore, lenders' cost of funds ρ depends on the debt structure β, with $\partial\rho/\partial\beta < 0$, as well as the policy rate r. Assume a linear functional form: $\rho(\beta, r) = \beta r + (1 - \beta)(1 + c)r$. The term $c > 0$ captures intermediation costs born by banks. In equilibrium, the firm optimal bond share trades-off a lower cost of debt with less pledgeable income because of inefficient liquidation. The assumption $c > 0$ also implies a higher interest-rate pass-through on bank loans which captures the bank lending channel in a reduced-form way.[16] In other words, rate hikes reduce both loan and bond supply, but loan supply contracts relatively more.

Monetary policy: We model the monetary transmission process in a simple reduced-form way. The central bank's actions affect firms in two ways: by (i) shifting in lenders' cost of funds ρ, and by (ii) affecting the distribution of cash-flows p_H. Our core economic

[15] At the cost of additional notation, a more complete assumption would that $\chi(\beta) = R_L(1 - \xi(\beta))$, where R_L is the low state cash-flow and ξ represents the dead-weight loss of financial distress. Alternatively, one could assume that bond investors are less skilled at monitoring, such that private benefits B increases with the bond share β, in the spirit of Holmstrom and Tirole (1997), De Fiore and Uhlig (2011) or Chang, Fernández, and Gulan (2017). This alternative is similar in terms of the economics, as what matters is that more bonds can reduce pledgeable income.

[16] Figure IA.2 in the Online Appendix provides suggestive evidence for a difference in pass-through. See Anderson and Cesa-Bianchi (2020) for a sharp analysis of bond spreads using detailed microdata. Crouzet (2019) shows that there can be heterogeneous effects even without this differential pass-through.

mechanism would apply both to conventional interest rate policy as well as unconventional measures aimed at stimulating credit markets and the real economy. Nevertheless, for tractability, we summarize the stance of monetary policy through the rate r.[17] We assume first that $\partial\rho/\partial r > 0$. In our simple risk-neutral economy, there is no effect on the risk premium, although that could be relaxed (Drechsler, Savov, and Schnabl, 2018; Kekre and Lenel, 2019; Anderson and Cesa-Bianchi, 2020). Second, we model contractionary effect on the real economy as lowering the probability of a high cash-flow, such that $p'_H(r) < 0$.[18] Essentially, we abstract from explicitly modeling nominal frictions and assume that monetary policy moves real rates (Nakamura and Steinsson, 2018a; Hanson and Stein, 2015).

Equilibrium: The firm jointly chooses investment scale I and debt structure β to maximize profits subject to its credit constraints, given assets/cash on hands A and the policy rate r. The analysis of investment follows closely Holmstrom and Tirole (1997). Given constant returns to scale, the credit constraint binds in equilibrium. This fact implies that investment is proportional to A: $I = m(\beta, r)A$, where the multiplier is given by:

$$m(\beta, r) := \frac{1}{1 - \frac{\mathcal{P}(\beta,r)}{\rho(\beta,r)}} \tag{1}$$

The multiplier reflects the firm's debt capacity and decreases with financial constraints. When it is large, investment and borrowing are large. It is driven by both pledgeable income and the lenders' cost of funds. In fact, the ratio $\frac{\mathcal{P}(\beta,r)}{\rho(\beta,r)}$ is nothing but the present value of what can be pledged to creditors. This object is at the heart of many macroeconomic models with financial frictions, such as the financial accelerator or the collateral channel. Importantly, the multiplier depends on the debt structure choice: a larger share of bonds reduces lenders' cost of funds, but decrease pledgeable income due to a larger cost of financial distress. The multiplier also depends on the stance r of monetary policy. This multiplier will be at the core of empirical predictions of the cross-sectional response to monetary shocks.

Because the firm promises all its pledgeable income to lenders, it only receives a payoff

[17] The empirical section focuses on conventional monetary policy for identification reasons, as the high-frequency identification of shocks to the target rate is well-established in the literature.

[18] "Information shocks" can be easily modeled by assuming the opposite sign instead.

in the high state in order to preserves its incentives:

$$V = \max_{I,\beta} \left\{ \frac{1}{r} p_H(r) \frac{B}{\Delta p} I \right\} \quad \text{s.t.} \quad I = m(\beta, r)A$$

The optimal share of bonds β^* maximizes debt capacity m by trading-off cost of funds ρ with pleagable income $\mathcal{P}$:

$$\frac{\partial m(\beta^*, r)}{\partial \beta} = 0$$

Importantly, riskier firms (lower p_H) or firms that are subject to more frictions (higher χ_1) choose less bond financing. We discuss this potential selection problem in the empirical section below.[19]

Stock Price Reaction: The stock price reaction of a small change in the policy rate r is given by the envelope theorem:

$$\frac{\mathrm{d}V}{\mathrm{d}r} = \underbrace{-\frac{1}{r^2} p_H \frac{B}{\Delta p} I^*}_{\substack{\text{change in discount} \\ \text{rate (direct effect)}}} + \underbrace{\frac{1}{r} p_H'(r) \frac{B}{\Delta p} I^*}_{\substack{\text{change in beliefs} \\ \text{(direct effect)}}} + \underbrace{\lambda^* \frac{\partial m(\beta^*, r)}{\partial r} A}_{\text{constraint effect}}$$

The direct effect corresponds to a revaluation of the firm's equity following a rate hike, *keeping the firm's equilibrium policies unchanged*. In this simple setting, there are two components. First, a change in discount rates that captures "equity duration." Second, a rate hike alters market beliefs about the probability of project success. A third potential direct channel that is absent from this simple model is a change in input or output prices in general equilibrium. Financial constraints do not drive those effects, and their magnitude or sign is independent of the firm's real response.

The constraint effect reflects how monetary policy affects constraints and is the product of two terms. The first term is the shadow price of the constraint, given by the Lagrange multiplier $\lambda^* = \frac{1}{r} p_H(r) B / \Delta p$. The second term is a pass-through measure that reflects how monetary policy tightens the constraint. Here, the pass-through is given by how much the multiplier falls after a rate hike $\partial m(\beta^*, r)/\partial r$. The constraint tightens for two reasons: an increase in lenders' cost of funds, and a fall in pledgeable income.

[19] However, the linearity of the model implies that debt structure is independent of internal funds A, an assumption that is relaxed in Crouzet (2019).

To make the algebra more intuitive, assume that the multiplier m is proportional to the difference between pleadgeable income $\mathcal{P}(\beta, r)$ and lenders' cost of funds $\rho(\beta, r)$. The expressions above for $\mathcal{P}$ and ρ imply:

$$\frac{\partial m(\beta, r)}{\partial r} \approx \underbrace{(R - B/\Delta p - \chi(\beta))\, p'_H(r)}_{\downarrow \text{ pledgeable income}} - \underbrace{(\beta + (1-\beta)(1+c))}_{\uparrow \text{ cost of funds}} < 0$$

Contractionary monetary policy unambiguously tightens financial constraints in this setting. The key question is how this pass-through depends on debt structure:

$$\frac{\partial^2 m(\beta, r)}{\partial \beta \partial r} \approx \underbrace{-p'_H(r)\chi'(\beta)}_{\substack{\text{effect of frictions in} \\ \text{bond financing} < 0}} + \underbrace{c}_{\substack{\text{bank lending} \\ \text{channel} > 0}} \tag{2}$$

This equation summarizes the main message of the paper. The bank lending channel, irrespective of its exact microfoundations, predicts that bond-dependent firms are less responsive to monetary shocks (recall that $\partial m(\beta^*, r)/\partial r$ is negative). However, the existence of frictions in bond financing is a countervailing force. Intuitively, a rate hike increases the probability of the low cash-flow state. This effect is especially pronounced for firms with more bonds as they face larger costs of financial distress (lower χ). When bond market frictions are present, i.e., when $\chi_1 \neq 0$, the cross-sectional prediction of the bank lending channel becomes weaker. For frictions large enough, the prediction can even reverse: bond-dependent firms turn out to be relatively more responsive to monetary shocks.

Alternative Models: While the model above makes some stark assumptions for tractability, the idea that rigidity frictions in bond financing can attenuate the prediction of the bank lending channel is rather general. To illustrate, the Online Appendix presents an alternative model in which renegotiation frictions associated with bond financing matter through a liquidity management channel that connects naturally with recent work on the role of corporate liquidity in monetary transmission (Rocheteau, Wright, and Zhang, 2018; Kiyotaki and Moore, 2018; Ajello, 2016; Drechsler, Savov, and Schnabl, 2018; Nagel, 2016). We nevertheless acknowledge that any model has shortcomings and that many other important forces could play a prominent role, including nominal long-term debt (Gomes, Jermann, and Schmid, 2016), bond supply (Becker and Ivashina, 2015), or the Fed put (Cieslak and Vissing-Jorgensen, 2017). We also do not explicitly model the general equilibrium effects on inflation, intermediate input prices, exchange rates, or consumer demand, and much work remains to be done to understand how those forces interact with firms' debt structures.

3 Empirical Analysis

3.1 Data and Summary Statistics

The main focus of our empirical analysis is on conventional monetary policy in the Eurozone starting in 2001.[20] The baseline sample ends in July 2007 with the onset of the financial crisis, but Section 3.5 considers the post-crisis. The period covers a full monetary cycle, as can be seen in Figure 1. Moreover, the banking sector appears relatively stable during our sample period, as shown in Figure IA.1 in the Appendix.[21]

Construction of monetary shocks: We rely on Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019) that construct a time series of monetary policy shocks using high-frequency data on overnight interest swaps (OIS swaps). They use the Thomson Reuters Tick database to calculate changes in the OIS swap rate in a 50 minutes window around the press release time.[22] OIS swaps exchange the overnight rate, EONIA, against a fixed rate for an agreed period. At the point of contracting, the fixed rate represents the geometric average of the expected overnight rate over the contract period.[23] In other words, the fixed rate is the average of the rate at the short end of the yield curve—the primary instrument for conventional monetary policy. OIS swaps represent an attractive alternative to futures on the overnight rate, which are commonly used in the U.S. for high-frequency identification of monetary policy. Lloyd (2017) finds that the OIS swap rates

[20] The Euro was formally introduced on 01/01/1999, which locked all national currencies at a fixed rate to the Euro. Contemporaneously, the ECB began to set its target rate. The initial period was associated with considerable operational and policy uncertainty, as reflected by the ECB's decision to narrow the corridor of its main refinancing rate. For this reason, we allow for some phasing in.

[21] See also Figure 1 in Becker and Ivashina (2018).

[22] Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019) also measure the change in the OIS swap rate in a tight time window around the press conference. In addition to the shocks in these two non-overlapping time windows, they provide an aggregate "Monetary Event Window" shock, which is the sum of the two. Our baseline result is robust to using this aggregated shock. Still, we prefer to use the shock around the press release as it provides a sharper characterization of conventional monetary policy.

[23] EONIA is the counterpart to the effective federal funds rate in the United States. Note also that the ECB target rate and the EONIA have historically tracked each other tightly as the ECB target rate can be understood as the target that is intended to be implemented by open market operations.

accurately measure expectations of future short-term interest rates at a horizon between 1 and 24 months in the Eurozone until 09/2007.[24]

Table 1 tabulates the summary statistics of the shocks. Our baseline shock is the change in the OIS 1M swap rate by Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019) in the first row. We tabulate alternatives to this choice for comparison. Additionally, we contrast the Eurozone shocks with shocks in the United States taken from Nakamura and Steinsson (2018a). The properties of the identified monetary policy shock in the Eurozone are comparable with those of the better-known shock in the United States. Many shocks are a few basis points and have a standard deviation of 4 to 5 bps. The summary statistics suggest that the market largely anticipated monetary policy announcements. On the other hand, there were a significant number of occasions when the announcement contained unexpected information. Some of these shocks had a magnitude of ten to twenty basis points, which is large given that rate changes are typically twenty-five basis points and are concentrated in the first half of the sample.

Firm-level data: We combine different data sources to create a panel of firms during our period of interest. Balance sheet items come from Thomson Reuters Worldscope and stock information from Datastream. Information on market financing comes from Capital IQ, which contains more granular information regarding the debt structure of firms than what is present in Worldscope. We define "bond financing" as the sum of the Capital IQ variables senior bonds, subordinated bonds and commercial paper to capture total market financing in a broad sense. Because the coverage of Capital IQ is sparse at the beginning of the sample, we collect data for 2001 and 2002 manually.

Our high-frequency cross-sectional approach requires a focus on a subset of large

[24]The Eurozone money market underwent significant stress post 09/2007; the baseline sample period stops in July 2007 such that the identified monetary shocks are unaffected by this. In addition, Section 3.3 shows robustness to using other definitions of monetary shocks that build on the work of Corsetti, Duarte, and Mann (2018) and Jarocinski and Karadi (2018). The latter paper classifies the shocks into monetary policy shocks and information shocks based on the covariance with the stock market. Thus, we can exclude "information shocks" and find that the information effect of monetary policy does not drive our result. Conventional monetary policy targets the short end of the yield curve directly; it may have, however, indirect effects on longer maturities of the yield curve. Gürkaynak, Sack, and Swanson (2005) find that two factors are required two capture the full effect of monetary policy; they refer to the change in the short rate as "target factor" and a change in longer interest rates as "path factor". The factors are constructed by principal component analysis and subsequent rotation and re-scaling. Lunsford (2018) uses an alternative approach by residualizing the change in the expected path with respect to the change in the short rate. It is important to note that both approaches lead to factors that are statistically orthogonal by construction. Hence, the inclusion of the "path factor" will not materially affect our estimates.

firms. The envelope argument relies on firms that maximize equity values, and on stock markets that accurately reflect true equity values. For this reason, we constrain our analysis to the constituents of the highly visible stock market EURO STOXX sectoral indices. These represent the most liquid stocks and best-governed firms in the Eurozone. Their inclusion in an index ensures that firms are monitored carefully by analysts and market participants during the day, ensuring that their stock prices incorporate new information about monetary policy at a high frequency.[25] The second advantage of this procedure is that it leads to an unbalanced panel that automatically accounts for mergers and acquisitions, as well as, the rise of new industry leaders or the demise of former incumbents. Proceeding in this way and excluding financials and utilities, we obtain a sample of 282 distinct firms. The country composition is as expected: all countries are represented, although larger countries like Germany and France capture a bigger share. Importantly, while this sample only covers a small fraction of public firms, Figure IA.7 shows that it accounts for about 80% of total corporate bonds outstanding in the Eurozone. Moreover, the distribution of size and leverage are very similar to U.S. firms included in the S&P 500 stock market index.

Interestingly, there is large heterogeneity in firms' financing structures even within those large Eurozone firms. Summary statistics are reported in Table 2 and the corresponding histograms in Figure 2. While the average bond debt to asset ratio is relatively low at 10%[26], there is a considerable amount of heterogeneity. About a third of firms have no bonds outstanding, while others are funding most of their debt using bond markets. Dividing firms in three even-sized categories by their bond to assets ratio, the first group has (virtually) no bond debt: the 75th percentile has zero bond debt. The middle category has low bond debt: the median bond debt over debt is 32%. The last category has high bond debt: for the median firm, bonds represent 71% of total debt. Finally, note that this richness in debt structure implies that bonds do not automatically insulate firms from changes to the cost of credit—firms in the top tercile of bond debt still have about a quarter of their debt due within one year, and the average is close to 34%.

[25]For instance, Gorodnichenko and Weber (2016) focus on the constituents of the S&P 500 for similar reasons.

[26]This can be compared with about 19% among members of the S&P 500 and embodies a well-known fact, sometimes referred as a European "bank bias" (Langfield and Pagano, 2016). The low level persists today despite some recent upward trends and convergence to the United States. Institutional and legal reasons have been put forward to explain those differences (Becker and Josephson, 2016).

In line with the model of the previous section, different firms choose different debt structures. Figure 5 presents some statistics on the cross-sectional determinants of debt mix. Empirically, the best predictor of bond debt is total debt: larger firms with more leverage are more likely to have a larger share of bond debt. This is not surprising given that bond markets are designed to raise large amounts of external finance, and bond issuance often exceeds amounts that are typically raised from banks or syndicates of lenders. Second, the share of bond debt (as well as leverage) varies considerably across sectors, likely reflecting different liquidity needs or asset characteristics, as shown in Figure IA.5. Firms selecting into the bond market implies a potential omitted variable problem, that we address in details below.

3.2 Model Specification and Identification

To understand the role of debt structure on monetary transmission, we run a panel regression of the form:

$$\Delta \log P_{i,t} = \gamma \Delta MP_t \times BondShare_{i,t-1} + \text{Firm FE} + \text{Sector-Time FE} + \text{Controls} + \epsilon_{i,t} \quad (3)$$

We use the convention that a positive monetary policy shock $\Delta MP_t > 0$ corresponds to a rise in the policy rate. The coefficient of interest is γ as it captures how the share of bond financing affects the response to a monetary policy shock. The classical bank lending channel implies $\gamma > 0$: firms with more bonds are relatively less affected by a rate hike (recall that the average effect is negative). On the other hand, if frictions in bond financing are strong enough, the relationship can revert and $\gamma < 0$. Our primary measure of the bond share is the ratio of bonds to assets in the previous year, but we show robustness to using alternatives. We measure firms' reactions as the daily difference in log stock prices. The panel structure allows for a rich set of fixed effects and controls which act as a defense against confounding factors.

Concretely, there are at least two identification concerns in this setting. First, there are macroeconomic news that correlate with monetary policy and changes in firms' stock prices. A high-frequency approach using a narrow window helps to alleviate the concern that firms' responses are driven by news unrelated to monetary policy. Importantly, in the spirit of the pioneering work on high-frequency identification, both our shock and response variable are measured at high-frequency (Cook and Hahn, 1989; Kuttner, 2001; Bernanke and Kuttner, 2005; Cochrane and Piazzesi, 2002; Nakamura and Steinsson, 2018a). Relative to using data from firms' financial statements, an advantage of using stock market responses is that they incorporate the effects of a shock more quickly and "capitalize" the impact across all future periods and states of the world. Asset prices reflect all publicly available information before the monetary policy announcement, and changes in asset prices reflect the effect of a monetary surprise.

Second, debt structure is not randomly assigned. The decision to access bond or bank debt is a choice, which leads to a potential identification concern akin to an omitted variable problem. A differential response to monetary policy for bond-reliant firms could be due to firm characteristics that drive selection into bond financing as opposed to the effect of debt structure itself. Unfortunately, we do not have quasi-random variation in debt structure. In line with the literature on the firm-level effects of monetary policy, we instead do our best to use the granularity of our data to rule out specific alternatives.[27] But note that we do not have to control for all drivers of monetary policy responsiveness, only those correlated with debt structure.

Our envelope argument shows that a first important confounder is the effect of changes in the discount rate, or *equity duration*. There is a direct correlation with debt structure: it is well-known that bonds tend to have longer duration relative to loans, as they are more likely to be fixed-rate and long-term (Ippolito, Ozdagli, and Perez-Orive, 2018; Gürkaynak, Karasoy-Can, and Lee, 2019). A rate hike decreases the present value of debt obligations, but this decrease is less pronounced for loans relative to bonds. Everything else equal, this duration should make bond-financed firms less affected by a monetary contraction, i.e., $\gamma > 0$.[28] To control for this, we lean on recent developments in the asset pricing literature that measure equity duration at the firm level and include $\Delta MP_t \times EquityDuration_{i,t}$ interactions in all specifications. We borrow from Gormsen and Lazarus (2019) who show that equity duration is analytically related to the growth

[27]See, for instance, Ippolito, Ozdagli, and Perez-Orive (2018), Ottonello and Winberry (2018), Jeenas (2018), Cloyne, Ferreira, Froemel, and Surico (2018), Gorodnichenko and Weber (2016), or Crouzet (2019). Ozdagli (2018) is an exception and studies a natural experiment around the Enron scandal to isolate the role of informational frictions.

[28]Naturally, firms could decide to engage in hedging contracts to remove this duration effect. Ippolito, Ozdagli, and Perez-Orive (2018) show that only a fraction of U.S. firms appears to hedge interest rate risk and that those that do are indeed largely unaffected by monetary policy. Our comparison with the U.S. in Section 3.5 is in line with these findings.

rate in earnings per share in a Gordon growth model and use analyst forecasts for long term growth (LTG) of earnings per share from IBES.[29] In robustness tests, we also account for firm-level CAPM betas.

Leverage, i.e., total debt over assets, is another variable that can correlate with both debt structure and sensitivity to monetary policy (Ottonello and Winberry, 2018; Anderson and Cesa-Bianchi, 2020). Although more leverage tends to predict a higher share of bonds, it also increases default risk, sensitivity to interest rates, and worsens real frictions through debt financing (i.e., debt overhang). Therefore, we flexibly include leverage as a control in our specifications, along with firm fixed-effects that absorb time-invariant firm characteristics. We can, therefore, estimate the differential effect of more bond financing *within* firms with similar total debt. More generally, we account for time-varying observable firm characteristics, on which firms could select into bond financing, and which have been found to drive the cross-sectional response to monetary policy in the United States. We carry out a myriad of additional tests to show that our coefficients' magnitudes and significance vary little when including interactions with size, default risk, age, tangibility, cash over assets as well as other firm characteristics.

One might likewise be concerned about potential transmission channels of monetary policy that affect firms beyond a credit channel, such as consumer demand, labor supply, price stickiness, exchange rates or network effects. While, to the best of our knowledge, no direct correlation with debt structure has yet been documented for those channels, an indirect correlation could still arise through sector-level differences. Industries vary in terms of their bond financing intensity and they can have different exposures to monetary policy through those channels. We thus include sector-time fixed-effects in all our specifications. These controls are very tight and they isolate the differential impact of more bond financing across firms within the *same* sector, on the *same* day. In other words, they flexibly account for distinct reactions to any given monetary policy shock across industries, allowing for the possibility that sector-level responses are time-varying.

[29] For those firm-year observations for which the measure is unavailable, we impute equity duration by a linear prediction that uses the duration measure of Weber (2018), return on equity and sales growth as inputs. The results change only marginally by excluding missing observations or by using the imputed measure for the entire sample.

3.3 Main Results: The Role of Debt Structure

We find strong evidence that debt structure drives firms' response to monetary policy in the Eurozone. Firms with a larger share of bond debt are robustly more affected by monetary shocks. Table 3, column 1, shows that the bonds-over-assets ratio significantly increases firms' sensitivity to interest rate shocks. The economic significance of this effect is not trivial: following a 25 basis points increase in interest rates, firms at the 25th percentile of the bonds over assets distribution have a 99 basis points lower stock return relative to firms at the 75th percentile. Columns 2 and 3 confirm this result when estimated non-parametrically, by using a bond outstanding dummy and terciles of bonds-over-assets, respectively. Importantly, columns 4 to 7 control for the firm's total leverage, either as the continuous ratio of total debt to asset or non-parametric quintile indicators. In all specifications, the share of debt raised through bonds is strongly significant, for a given level of indebtedness.

Collectively, those results point to the special role of bond debt in monetary transmission. They are hard to square with the classical bank lending channel. Irrespective of the exact micro-foundation, this type of explanation would imply that bond-reliant firms are relatively less responsive to monetary tightening, the opposite of what the data indicates. On the other hand, the evidence is consistent with the existence of intense frictions in bond financing in the Eurozone.

Robustness: The results are robust to a variety of model alterations. First, we explore using different definitions of monetary shocks. Table IA.1 shows that the main result is robust to the use of three alternative monetary shocks. This includes a longer maturity in the OIS swap to 3M. While the immediate impact of monetary policy is largest for the short-rate over the next month, we do not want to preclude an effect that lasts beyond that. Another alternative is the quasi-intraday changes in the OIS 1M swap rate by Corsetti, Duarte, and Mann (2018). A third alternative is the changes in the OIS 3M constructed by Jarocinski and Karadi (2018). While this time series is similar to the series built by Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019), the authors classify the shocks as monetary policy shocks or information shocks based on the covariance of the shock with the stock market; the latter is used in Table IA.4 which excludes information shocks as a separate robustness test of our results. It turns out that the sign, magnitude, and statistical significance are in line with our baseline results.

Another concern might be that the results are confounded by other firm characteristics which are correlated with debt structure. Firm risk is such a potential confounder. Ottonello and Winberry (2018) show that in the United States safer firms are less responsive to monetary policy. Tables 4 adds interactions of the rating category with the monetary policy shocks. The effect of debt structure is unchanged, and the impact of default risk is aligned with Ottonello and Winberry (2018). Table IA.2 shows similar findings when using "distance-to-default" based on the framework by Merton (1974) and subsequently adopted by, among others, Gilchrist and Zakrajšek (2012), a market based measure of the firms' likelihood to default in the following year.[30] We also check the robustness of our results with respect to a single factor model—the CAPM. The results are robust to considering only abnormal returns, as shown in Table IA.3.

In the Online Appendix, we carry out extensive additional tests that include interactions with variables that have been shown to drive the cross-sectional response to monetary policy in the U.S. Table IA.5 includes seven of these characteristics and shows that the magnitude and significance of our main coefficients vary little when including these interactions. These variables consist of age since incorporation, two proxies for size (book assets and enterprise value), fixed assets over assets, cash over assets, operating profitability, interest coverage ratio, and equity volatility.[31][32]

3.4 Credit Substitution and Real Effects

We complement our high-frequency results with some suggestive evidence on credit substitution and investment. A large body of work has documented the link between credit flows and monetary policy and, in particular, that bond financing rises relative to bank lending after a rate hike (Becker and Ivashina, 2014; Kashyap, Stein, and Wilcox, 1992;

[30]The "distance-to-default" model underwent a few alterations after its initial publication and is nowadays better known in its commercial version as KMV model which is used by Moody's.

[31]While Ozdagli (2018) and Ozdagli and Velikov (2020) also show that, for U.S. stocks, the financial constraint index from Whited and Wu (2006) and cash-flow volatility has predictive power for the cross-sectional response to monetary shocks, constructing these measure for European firms is not trivial. The Whited-Wu index was designed from United States and there is some debate on how reliable these proxies are outside of their original context (Ozdagli, 2018; Farre-Mensa and Ljungqvist, 2016). Moreover, cash-flows are only reportedly reliably at an annual frequency in the Eurozone, we thus use equity volatility as a proxy instead.

[32]In additional untabulated robustness tests, we find that easing shocks have larger effects than surprise tightenings. This asymmetry could potentially indicate a non-linearity in monetary transmission, which can be nested in the framework of Section 2.3 via the shape of $p_H(r)$.

Crouzet, 2019; Lhuissier and Szczerbowicz, 2018; Elliott, Meisenzahl, Peydró, and Turner, 2019).[33] Consistent with a bank lending channel, such credit substitution shows that firms adjust their debt structure in response to the banking sector being negatively impacted by monetary tightening. We find similar but weak effects in our sample.

In principle we would like to trace the impact of monetary policy shocks on debt structure and investment at high frequency. This is, however, infeasible since financial statements are only available at quarterly frequency, and the bond debt variable is annual from Capital IQ. Thus, we move away from a pure high-frequency approach which comes with the usual caveat: the statistical power to assess the effect of cleanly identified shocks on real variables several quarters in the future is limited because many other shocks also affect these variables over longer time periods (Nakamura and Steinsson, 2018b). We follow existing studies and aggregate the monetary policy shocks at lower frequency (Ottonello and Winberry, 2018; Corsetti, Duarte, and Mann, 2018; Cloyne, Ferreira, Froemel, and Surico, 2018; Crouzet, 2019). Concretely, we aggregate the shock to a monthly frequency and use bond issuance data from Bloomberg to test the credit substitution hypothesis. Analogously, we use the shock and balance sheet variables at quarterly frequency for investment.

Keeping the regression model close to our high-frequency approach, we estimate local projections following Jordà (2005) for horizons h:

$$y_{i,t+h,t} = \alpha_i + \beta^h_{Shock} MPShock_t + \gamma X_{i,t-1} + \psi Z_{t-1} + u_{i,t+h,t} \tag{4}$$

A simple test for the credit substitution hypothesis is whether firms issue a bond in response to a monetary policy shock. Under the assumption of a linear probability model, the outcome variable $y_{i,t+h,t}$ is a dummy that equals one if a bond has been issued after h months. We measure the investment response as a percentage change in property plant and equipment. In the spirit of the sector-time fixed effects in equation 3, we demean the outcome variable within sector and quarter, that is, $\Delta y_{i,t+h,t} - \Delta \bar{y}_{i,t+h,t}$. In addition, we include a firm fixed effect, α_i, and firm specific control variables, $X_{i,t-1}$, which encompass log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. For the investment response,

[33] Grosse-Rueschkamp, Steffen, and Streitz (2019), Arce, Gimeno, and Mayordomo (2018), and Ertan, Kleymenova, and Tuijn (2019) also document credit substitution following quantitative easing.

we follow Crouzet (2019) and include two lags of asset growth to proxy for firms' investment opportunities. Z_{t-1} contains macroeconomic controls, that is, two quarters of lagged GDP growth and the year-over-year inflation rate.

Panel (a) of Figure 3 shows a weak substitution towards bonds after a monetary tightening. Statistical power is limited by design, and estimated confidence bands are wide. Economically, credit substitution dampens the effect of the shock by curbing the drop in credit supply faced by firms. However, this substitution does not imply that firms are entirely unaffected by the shock. As long as bonds and loans are not perfect substitutes, there can be real effects even if total credit is stable. Crouzet (2017) shows the importance of such a "debt substitution channel," whereby a switch away from bank financing exposes firms to rigidity frictions in bond financing and reduces investment through a precautionary motive. Quantitatively, this channel can explain up to a third of the contraction of investment during the Great Recession.

We indeed find a corresponding pattern in our sample: bond-reliant firms tend to contract investment more after a rate hike relative to other firms. Panel (b) of Figure 3 displays the response for firms in the first and third tercile of the bond debt over asset distribution. In response to a contractionary monetary policy shock, net fixed assets contract relatively more for firms with more bond debt. However, the statistical power is low, and the response for firms with high bond leverage is at best marginally significant. Nevertheless, the point estimates are not small. One quarter after the shock, a firm in the third tercile of the bond debt to assets distribution experiences an about 4 ppt reduction in investment relative to a firm in the first tercile for a shock equivalent to one standard deviation. We take those findings as suggestive evidence consistent with bonds and loans not being perfect substitutes. Firms do not necessarily reap the full benefits of credit substitution in the presence of frictions in bond financing.

3.5 Other Findings

Post-crisis results: While our baseline sample stops in July 2007, at the onset of the financial crisis, in this section, we show that our main results hold in a more recent period spanning the beginning of 2013 to the end of 2018. As the sovereign debt crisis followed the financial crisis in Europe, the start of the recovery period is somewhat arbitrary, and we use 2013 as sovereign bond spreads had started to normalize around that time. We apply the same selection criterion for our firm panel based on inclusion in the EURO STOXX index. To ease comparability with the main analysis, we focus on shocks to the short-end of the yield curve, that is, changes in the OIS 1M rate.[34] Table 5 shows that bond-financed firms are more affected by monetary surprises in this more recent sample as well. If anything, the effect of debt structure is stronger. It is important that the effect has not attenuated in recent years, although the share of bond financing has grown massively post-crisis. It appears that the rise of bond financing was not accompanied by a reduction in bond market frictions, which could be a concern for Eurozone policymakers—a point we come back to in Section 3.6.

Comparison with the United States: We draw a comparison with the United States. Conceptually, our channel should be much weaker when frictions in bond financing are smaller. The United States provide a natural comparison to the Eurozone since bond financing has been historically much more prevalent there. Table IA.7 in the Online Appendix replicates our baseline analysis for the sample of comparable U.S. firms. We use the monetary shock series from Nakamura and Steinsson (2018a), the same baseline years of 2001 to July 2007, and the sample of firms consisting of the constituents of the S&P 500 stock market index. Summary statistics are provided in Table IA.6; the distributions of assets and total debt are similar to the Eurozone sample, but we find no difference in the United States across firms with varying debt structure, once we control for equity duration and leverage. These findings imply significantly smaller frictions in bond financing, if any, in the United States relative to the Eurozone, in line with prior studies (De Fiore and Uhlig, 2011; Crouzet, 2019; Ippolito, Ozdagli, and Perez-Orive, 2018).

3.6 Discussion and Implications

We have provided some evidence consistent with frictions in bond financing affecting the pass-through of monetary policy in the Eurozone. In this section, we offer some stylized facts and institutional details in line with the existence of such frictions. First, the legal environment is particularly important. In line with Becker and Josephson (2016), legal

[34] In principle, shocks related to QE and longer-term rate could also be insightful, although the transmission channel might potentially be different. The shock series in the sample from 2013 to the end of 2018 has a smaller standard deviation as compared to the sample between 2001 and July 2007. It is, however, comparable to a subsample of the latter; such as, between 2004 and July 2007.

scholars have argued that the U.S. is better equipped to deal with the distress of firms funded by bond debt, and that national insolvency laws in Europe are often not prepared for the rising importance of bond debt (Ehmke, 2018).[35] The outcome of the 2019 EU directive to reform insolvency laws will be determinant as commentators have argued that current proposals have critical flaws (Becker, 2019; Malakotipour, Perotti, and de Weijs, 2020).

Second, the European informational environment is distinct from the one in the United States: the sparseness of public information makes it difficult for a firm to access capital markets in bad times, which plausibly renders banking relationships more valuable in Europe. While rating agencies are critical to the dissemination of information across dispersed bond creditors, the ECB estimates that in 2004 only 11% of firms with turnover in excess of €50M had an S&P rating in Europe, compared to 92% in the U.S. Figure IA.4 in the Online Appendix shows that even in our sample of large public firms between 70% and 50% do not have such a rating. Second, we also show that rating downgrades have a stronger effect on Eurozone firms. Figure 4 presents the average stock market response to being downgraded from investment grade (BBB- and above) to speculative-grade (BB+ and below) across the two regions. The raw data reveal that the difference is large and significant: about five percentage points lower in Europe relative to the United States.

Finally, the COVID-19 outbreak has exposed some of the frictions in the bond market. While the banking sector appears healthy at the outset, bond markets have shown signs of strain and there is widespread concern over firms' ability to access credit in the near future. Difficulty to cover operating costs and rolling over debt could lead to a wave of layoffs and a sharp contraction in real activity. Firms with well-established banking relationships may find it easier to access credit than those that depend on the bond market. Moreover, restrictions on the investment universe of corporate bond investors make dislocations in the credit market all the more likely.[36] Even though central banks have an extensive toolbox to stimulate bank lending, they have to innovate to stimulate bond

[35]"A change in the body of creditors' structure leads to new challenges, which put the law for restructuring and insolvency law to the test. Particularly where the public ordering restructuring and insolvency law is designed for a concentrated lending structure, the question as to whether the law provides the suitable framework to deal with the problems associated with a cloudy body of creditors becomes pressing. [. . .] A law which produces an efficient outcome in times of pre-dominant relationship-lending does not necessarily promote successful bond restructurings" (Ehmke, 2018).

[36]Goldman Sachs forecasted over $500 billion worth of bonds will be cut to high-yield from investment-grade, in addition to the $149 billion that have already been downgraded year-to-date.

markets. While the ECB expanded the range of eligible bonds under its corporate sector purchase program, the Federal Reserve has invoked Section 13(3) to the Federal Reserve Act which is reserved for "unusual and exigent circumstances" to set up the Primary Market Corporate Credit Facility (PMCCF) for new bond issuances and the Secondary Market Corporate Credit Facility (SMCCF) to provide liquidity for outstanding corporate bonds.

4 Conclusion

The share of firm financing that comes from bond markets has been rising globally throughout the past decade. What does that entail for how firm heterogeneity mediates the monetary transmission process? This paper develops a high-frequency framework to shed light on this question. Contrary to the predictions of the classical bank lending channel, Eurozone firms with more bonds are disproportionately affected by monetary policy. This evidence is consistent with significant frictions in bond financing in the Eurozone, relative to the United States. Alleviating bond market frictions is vital to maximizing the benefits stemming from a diversification of firm funding sources. The overall macroeconomic implications of firms' debt composition are still insufficiently understood. This paper provides evidence that sources of external financing are not perfect substitutes, and the underlying trade-offs affect the pass-through of monetary policy. Existing debt structure is driven by past financing patterns, which are, in turn, driven by previous policies, suggesting a path-dependence. After quantitative easing and extensive periods of low long-term interest rates, a large share of the economy now borrows from the bond market.

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Appendix A: Figures and Tables

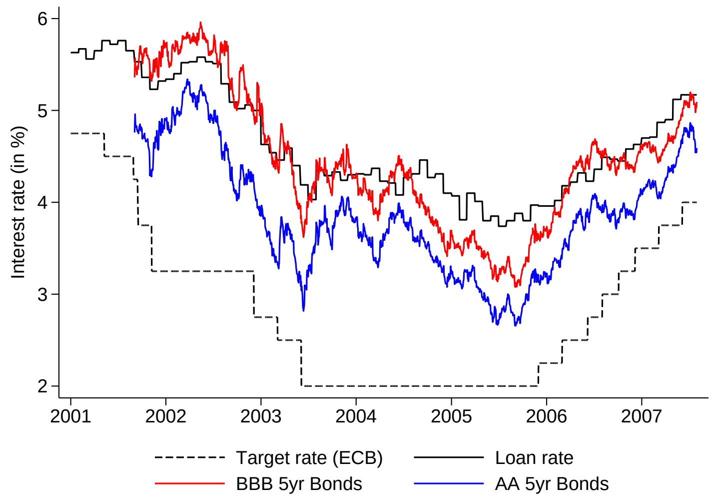


Figure 1 – Debt Yields across Monetary Cycle

Notes: The ECB target rate is taken from the official ECB interest rates; the average loan rate in the Eurozone comes from the ECB statistical data warehouse; and yields to maturity for bond portfolios with remaining maturity of 5yr and BBB and AA rating are sourced from Bloomberg: BFV 5yr EUR Eurozone Industrial BBB Bond Yield and BFV 5yr EUR Eurozone Industrial AA Bond Yield.

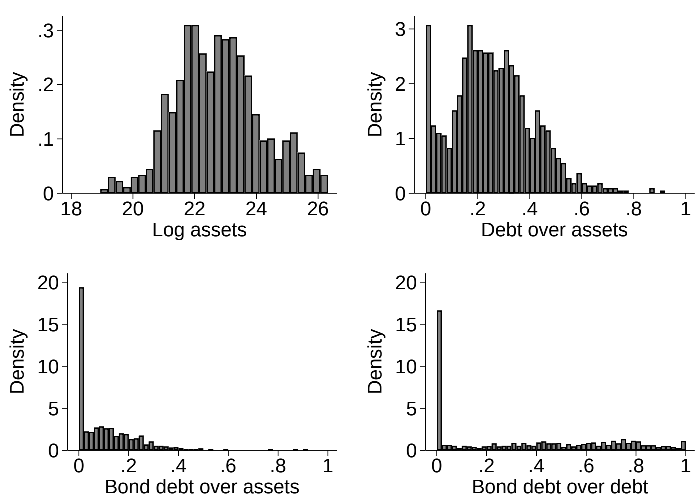
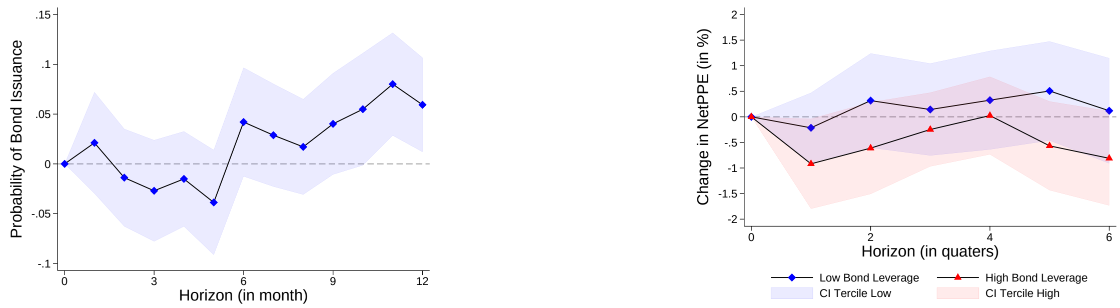


Figure 2 – Histograms

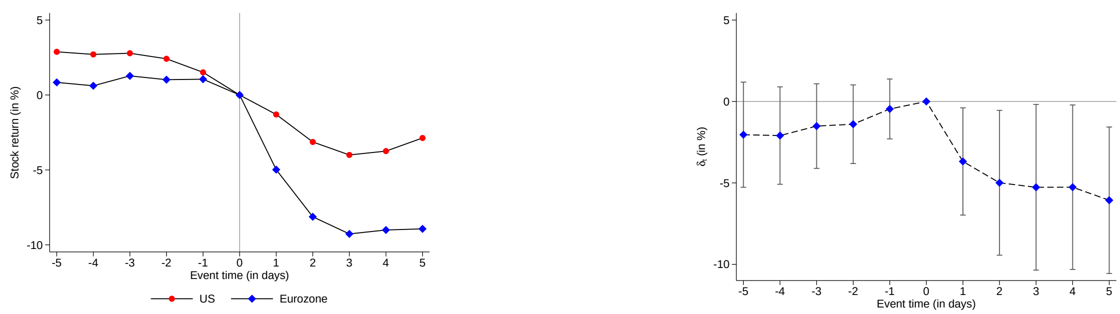
Notes: The sample is an unbalanced panel of the European firms that are constituents of the EURO STOXX sectoral indices between 2001 and 2007, excluding financials and utilities. Balance sheet data come from Worldscope and bond debt from Capital IQ, defined as the sum of all bonds plus commercial paper.



(a) Change in Probability to Issue Bond (b) Differential change in Net PPE

Figure 3 – Local Projection Bond Issuance and Net PPE

Notes: The panels show estimates from a local projection following Jordà (2005). We estimate local projections of the form $y_{i,t+h,t} = \alpha_i + \beta^h_{Shock} MPShock_t + \gamma X_{i,t-1} + \psi Z_{t-1} + u_{i,t+h,t}$*, where in panel (a)* $y_{i,t+h,t}$ *is a dummy that equals one if a bond has been issued after* h *months. In panel (b) the investment response is measured as a percentage change in property plant and equipment. The outcome is demeaned within sector and quarter, that is,* $\Delta y_{i,t+h,t} - \Delta \bar{y}_{s(i),t+h,q(t)}$ *and the specification is estimated separately for each tercile of the bond debt over asset distribution. In addition, we include a firm fixed effect,* α_i*, and firm specific control variables,* $X_{i,t-1}$*, which encompass log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. For the investment response we follow Crouzet (2019) and include additionally two lags of asset growth to proxy for the firm's investment opportunities.* Z_{t-1} *includes macroeconomic controls, that is, two quarters of lagged GDP growth and the year-over-year inflation rate. Bond issuances data come from Bloomberg and balance sheet variables from Worldscope. The shaded area indicates the* 90% *confidence interval for the parameter estimates.*



(a) (b)

Figure 4 – Rating Downgrade

Notes: Sample encompasses all entity ratings from the S&P rating panel available on WRDS. Rating downgrade is defined as downgrade from investment grade (BBB- and above) to speculative grade (BB+ and below). Stock price data is obtained from Datastream. Panel (a) plots average raw returns with respect to the event date for the Eurozone and the US separately. Panel (b) plots the coefficients $\{\delta_t\}^5_{t=-5}$ *of the following model* $(\ln(P_{it}) - \ln(P_{i0})) * 100 = \sum^5_{s=-5} \gamma_s \times \mathcal{I}_{s=t} + \sum^5_{s=-5} \delta_s \times \mathcal{I}_{s=t} \times \mathcal{I}_{Europe_i} + \epsilon_{it}$*, where* t *denotes event time and* $\mathcal{I}$ *is the indicator function. Bars indicate the* $\alpha = 0.9$ *confidence intervals.*

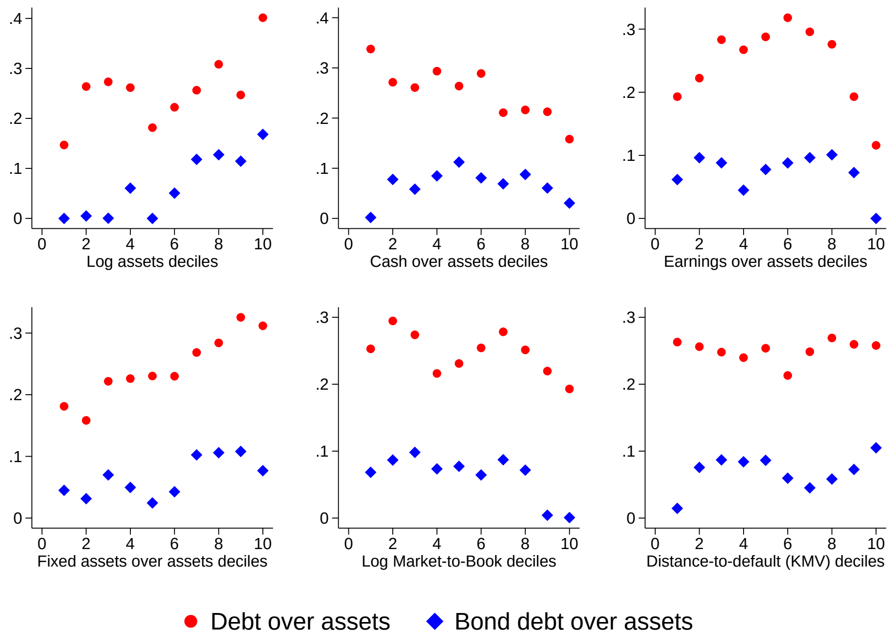


Figure 5 – Cross-sectional Capital Structure

Notes: The sample is an unbalanced panel of the European firms that are constituents of the EURO STOXX sectoral indices between 2001 and 2007, excluding financials and utilities. Balance sheet data come from Worldscope and bond debt from Capital IQ, defined as the sum of all bonds plus commercial paper.

	N	Mean	SD	Min	Max
Δ OIS1M	91	0.076	4.80	-35.00	8.65
Δ OIS3M	91	-0.119	4.01	-30.00	5.50
Δ OIS1M Corsettietal	91	-0.046	5.53	-39.25	15.00
Δ OIS3M JK	91	-0.003	4.33	-30.50	9.50
Δ FFR	52	-0.079	4.71	-20.00	12.50

Table 1 – Summary Statistics Shocks

Notes: Summary statistics for shocks in the sample period January 2001-July 2007 from Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019) (Δ OIS1M, Δ OIS3M); Jarocinski and Karadi (2018) (Δ OIS3M JK) and Corsetti, Duarte, and Mann (2018) (Δ OIS1M Corsettietal) and in the United States from Nakamura and Steinsson (2018a) (ΔFFR).

	mean	p25	p50	p75	count
No bond debt					
Assets (in bn)	7.445	2.034	3.476	7.259	4,130
Cash over assets	0.063	0.019	0.037	0.076	4,130
Earnings over assets	0.148	0.099	0.136	0.198	4,130
Fixed assets over assets	0.237	0.087	0.202	0.359	4,130
Equity duration proxy	9.238	0.000	8.000	13.100	4,130
Market-to-Book	3.756	1.610	2.468	4.663	4,130
Debt over earnings	1.232	0.284	1.379	2.563	4,130
Earnings over interest expenses	31.398	6.154	11.587	24.738	4,130
Debt over assets	0.202	0.062	0.177	0.304	4,130
Debt due within year over debt	0.429	0.169	0.354	0.644	4,130
Bond debt over assets	0.000	0.000	0.000	0.000	4,130
Bond debt over debt	0.018	0.000	0.000	0.000	4,130
Low bond debt					
Assets (in bn)	24.398	3.993	10.015	22.778	4,382
Cash over assets	0.058	0.023	0.041	0.071	4,382
Earnings over assets	0.137	0.085	0.129	0.184	4,382
Fixed assets over assets	0.263	0.116	0.238	0.377	4,382
Equity duration proxy	7.550	0.000	6.880	11.190	4,382
Market-to-Book	2.814	1.220	1.768	2.847	4,382
Debt over earnings	2.610	1.010	1.795	2.755	4,382
Earnings over interest expenses	18.288	6.100	9.766	17.303	4,382
Debt over assets	0.218	0.141	0.196	0.296	4,382
Debt due within year over debt	0.358	0.195	0.319	0.500	4,382
Bond debt over assets	0.064	0.030	0.066	0.096	4,382
Bond debt over debt	0.349	0.157	0.319	0.490	4,382
High bond debt					
Assets (in bn)	33.390	4.657	13.452	34.586	4,467
Cash over assets	0.062	0.020	0.036	0.074	4,467
Earnings over assets	0.116	0.086	0.122	0.159	4,467
Fixed assets over assets	0.272	0.115	0.273	0.394	4,467
Equity duration proxy	7.227	0.000	5.500	10.630	4,467
Market-to-Book	2.895	1.283	2.010	3.379	4,467
Debt over earnings	3.247	1.899	2.648	3.917	4,467
Earnings over interest expenses	8.712	4.581	6.907	11.368	4,467
Debt over assets	0.358	0.270	0.340	0.430	4,467
Debt due within year over debt	0.247	0.125	0.211	0.350	4,467
Bond debt over assets	0.241	0.167	0.217	0.286	4,467
Bond debt over debt	0.683	0.537	0.709	0.810	4,467
Total					
Assets (in bn)	22.099	3.061	8.122	19.368	12,979
Cash over assets	0.061	0.021	0.038	0.072	12,979
Earnings over assets	0.133	0.090	0.128	0.178	12,979
Fixed assets over assets	0.258	0.107	0.231	0.381	12,979
Equity duration proxy	7.976	0.000	6.780	11.990	12,979
Market-to-Book	3.142	1.308	2.087	3.446	12,979
Debt over earnings	2.391	1.010	1.976	3.090	12,979
Earnings over interest expenses	19.164	5.280	8.915	15.099	12,979
Debt over assets	0.261	0.158	0.250	0.354	12,979
Debt due within year over debt	0.342	0.156	0.282	0.476	12,979
Bond debt over assets	0.105	0.000	0.071	0.170	12,979
Bond debt over debt	0.359	0.000	0.336	0.668	12,979

Table 2 – Eurozone Firms Balance Sheet Summary Statistics

Notes: The table presents summary statistics for an unbalanced panel of European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 91 ECB announcements days between 2001 and 2007. The subsamples "No bond debt", "Low bond debt" and "High bond debt" correspond to the terciles of the bond debt over assets ratio, recalculated every year. Bond debt includes senior bonds, subordinated bonds, and commercial paper. Balance sheet data come from Worldscope, bond debt comes from Capital IQ.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ OIS1M $\times$ Bond debt over assets	-23.40***					-28.78***	-31.98***	
	(5.254)					(7.148)	(8.331)	
Bond debt over assets	-10.61					-25.18	-26.59	
	(38.76)					(37.02)	(40.54)	
Δ OIS1M $\times$ bond outstanding		-2.504***						
		(0.807)						
Market fin. outstanding		-1.240						
		(7.017)						
Δ OIS1M $\times$ Tercile of bond debt over assets			-1.881***					
			(0.539)					
Tercile of bond debt over assets			4.322					
			(4.298)					
Δ OIS1M $\times$ Bond debt over debt				-8.453***				
				(2.522)				
Bond debt over debt				-1.572				
				(11.95)				
Δ OIS1M $\times$ Tercile of bond debt over debt					-2.421***			
					(0.787)			
Tercile of bond debt over debt					2.248			
					(3.996)			
Δ OIS1M $\times$ Debt over assets				1.210	0.524	7.402		-4.315
				(4.196)	(4.244)	(4.490)		(3.604)
Debt over assets				22.12	20.02	34.03		22.24
				(42.87)	(42.95)	(42.44)		(44.13)
R^2	0.374	0.373	0.373	0.374	0.373	0.374	0.375	0.372
Duration control	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector $\times$ Date FE	✓	✓	✓	✓	✓	✓	✓	✓
Lev. Quintile Interaction							✓	
Observations	12717	12717	12717	12717	12717	12717	12717	12717

Table 3 – Eurozone Debt Structure and Monetary Policy Shocks

*Notes: This table presents regression results for estimating Equation 3 using different measures for the bond share. Bond debt includes senior, subordinated bonds and commercial paper. The dependent variable is daily stock return, and MP Shock are taken from Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019). The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 91 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date-times-sector fixed effects, and time varying firm controls (all lagged to preceding year): log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. The sector is defined based at the 2 digit SIC code level. Balance sheet data come from Worldscope, market financing from Capital IQ and stock market information comes from Datastream. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

	(1)	(2)	(3)	(4)
Δ OIS1M × Bond debt over assets		-21.47***	-25.93***	
		(7.559)	(9.143)	
Bond debt over assets		-8.220	-24.24	
		(36.67)	(34.59)	
Δ OIS1M × Bond debt over debt				-7.312**
				(3.238)
Bond debt over debt				-0.890
				(10.81)
Δ OIS1M × Debt over assets			6.627	1.540
			(4.433)	(4.031)
Debt over assets			36.40	24.69
			(42.47)	(42.61)
High Yield	-9.920	-9.116	-7.332	-8.898
	(26.16)	(25.16)	(25.49)	(25.31)
IG below AA	4.858	4.834	6.228	5.331
	(11.75)	(11.62)	(11.54)	(11.39)
IG AA and above	19.34	19.26	21.84	21.09
	(15.03)	(14.90)	(14.16)	(14.16)
High Yield × Δ OIS1M	-7.974	-4.569	-4.413	-5.295
	(8.313)	(7.450)	(7.455)	(7.268)
IG below AA × Δ OIS1M	-3.115***	-0.322	-0.485	-0.908
	(1.085)	(1.891)	(1.749)	(1.757)
IG AA and above × Δ OIS1M	-5.313***	-4.222**	-3.770**	-2.790*
	(1.732)	(1.620)	(1.528)	(1.458)
R^2	0.373	0.374	0.374	0.374
Duration control	✓	✓		
Firm FE	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓
Observations	12717	12717	12717	12717

Table 4 – Eurozone Rating Categories and MP Shocks

*Notes: This table presents regression results for estimating Equation 3 using different measures for the bond share, adding interactions with rating categories (Unrated is the excluded category). The ratings encompass the three major rating agencies, that is, Moody's, S&P and Fitch and are retrieved via Bloomberg. If there are multiple ratings for one entity the mean is computed. The dependent variable is daily stock return, and MP Shock are taken from Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019). The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 91 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date-times-sector fixed effects, and time varying firm controls (all lagged to preceding year): log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. The sector is defined based at the 2 digit SIC code level. Balance sheet data come from Worldscope, bond debt from Capital IQ, defined as the sum of all bonds plus commercial paper, and stock market information comes from Datastream. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ OIS1M × Bond debt over assets	-60.98***					-65.24***	-53.84***	
	(11.40)					(16.54)	(16.67)	
Bond debt over assets	-40.94					-89.45**	-67.52*	
	(37.53)					(39.45)	(40.14)	
Δ OIS1M × bond outstanding		-18.25***						
		(3.338)						
Market fin. outstanding		-0.191						
		(8.139)						
Δ OIS1M × Tercile of bond debt over assets			-10.04***					
			(1.315)					
Tercile of bond debt over assets			-1.825					
			(4.369)					
Δ OIS1M × Bond debt over debt				-16.15***				
				(5.340)				
Bond debt over debt				-22.56				
				(14.26)				
Δ OIS1M × Tercile of bond debt over debt					-5.631***			
					(1.984)			
Tercile of bond debt over debt					0.136			
					(4.332)			
Δ OIS1M × Debt over assets				-19.73	-24.13*	5.843		-27.41**
				(13.75)	(13.17)	(17.83)		(13.16)
Debt over assets				85.69*	90.25*	124.6**		92.61*
				(48.15)	(49.48)	(53.29)		(49.29)
R^2	0.410	0.410	0.410	0.410	0.410	0.410	0.411	0.410
Duration control	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓	✓	✓	✓
Lev. Quintile Interaction							✓	
Observations	9520	9520	9520	9520	9520	9520	9520	9520

Table 5 – Eurozone Post Crisis

*Notes: This table presents regression results for estimating Equation 3 using different measures for the bond share. The dependent variable is daily stock return, and MP Shock are taken from Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019). The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 56 ECB announcements days between 2013 and 2018. Controls include firm fixed effects, date-times-sector fixed effects, and time varying firm controls (all lagged to preceding year): log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. The sector is defined based at the 2 digit SIC code level. Balance sheet data come from Worldscope, bond debt from Capital IQ, defined as the sum of all bonds plus commercial paper, and stock market information comes from Datastream. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

Online Appendix

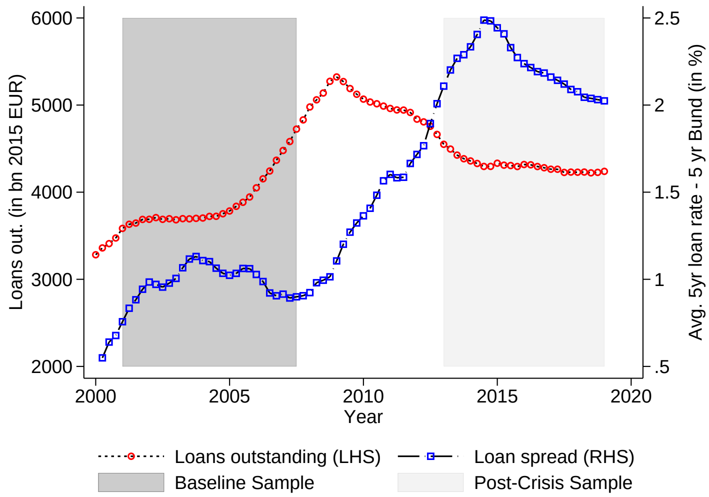


Figure IA.1 – Loans Outstanding and Loans Spread Cycle

Notes: Volume outstanding is the outstanding amount for the Euro area (changing composition) for MFIs excluding ESCB reporting sector from the ECB statistical data warehouse with key BSI.M.U2.N.A.A20.A.1.U2.2240.Z01.E. The loan spread is the difference between the average interest rates for loans to corporations of over EUR 1M with an IRF period of over five years taken from the ECB statistical data warehouse with key: MIR.M.U2.B.A2A.J.R.1.2240.EUR.N and the Bund is the 5 year constant maturity German fixed income security taken from Bloomberg.

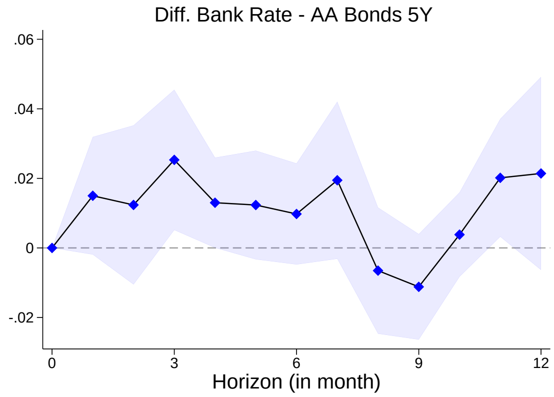


Figure IA.2 – Loan rates vs. AA bond yields

Notes: The panel shows estimates from a local projection following Jordà (2005). It uses monthly times series data for which following baseline model is estimated $\Delta y_{t+h,t} = \alpha + \beta^h_{Shock} MPShock_t + \Gamma X_t + u_{t+h,t}$*; where* $\Delta y_{t+h,t}$ *denotes the difference over* h *months,* α *is a constant, and* X_t *contains three lags of the dependent variable. The outcome variable is the difference of the average loan rate in the Eurozone from the ECB statistical data warehouse; and yields to maturity for bond portfolios with remaining maturity of 5yr and AA rating from Bloomberg: BFV 5yr EUR Eurozone Industrial AA Bond Yield. The shaded area indicates the* 90% *confidence interval for the parameter estimates with Newey-West standard errors to account for overlapping observations. Data on bank rate and yield for a broad bond index comes from ECB and Bloomberg, respectively.*

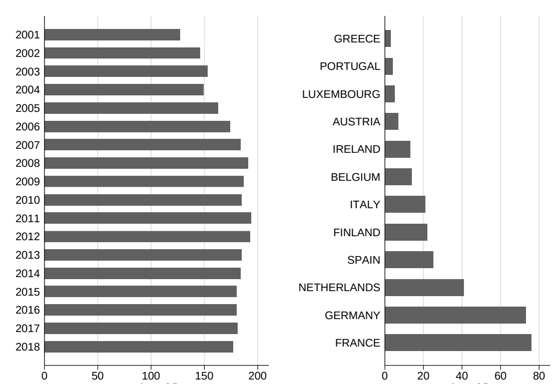


Figure IA.3 – Sample Description

Notes: The figure displays the raw counts of distinct firms in the sample by year and by country. The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities.

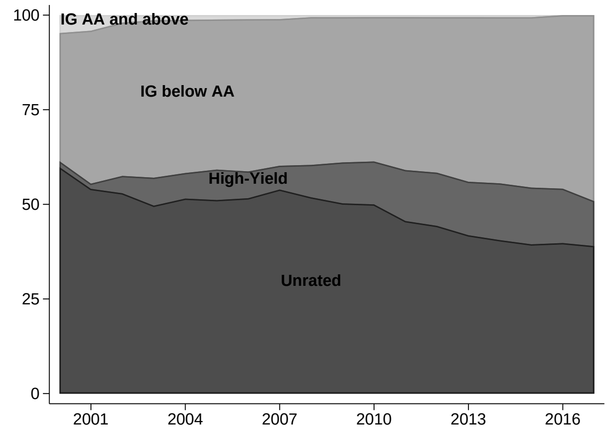


Figure IA.4 – Rating Coverage

Notes: The figure displays the sample share by rating categories. The ratings encompass the three major rating agencies, that is, Moody's, S&P and Fitch and are retrieved via Bloomberg. If there are multiple ratings for one entity the mean is computed. The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities.

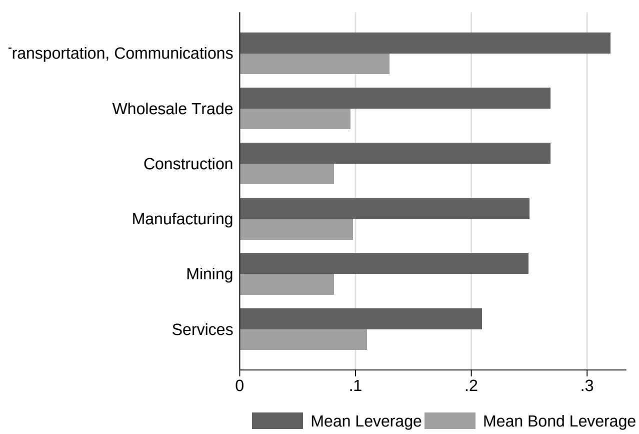


Figure IA.5 – Capital Structure by Industry

Notes: The bar chart displays the mean of leverage and bond leverage by a broad industry classification for the baseline sample between 2001 and 2007. Broad industries are defined on following SIC code ranges: Mining (1000-1499); Construction (1500-1799); Manufacturing (2000-3999); Transportation, Communications (4000-4999); Wholesale Trade (5000-5199); Services (7000-8999). Bond debt includes senior, subordinated bonds and commercial paper. The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities.

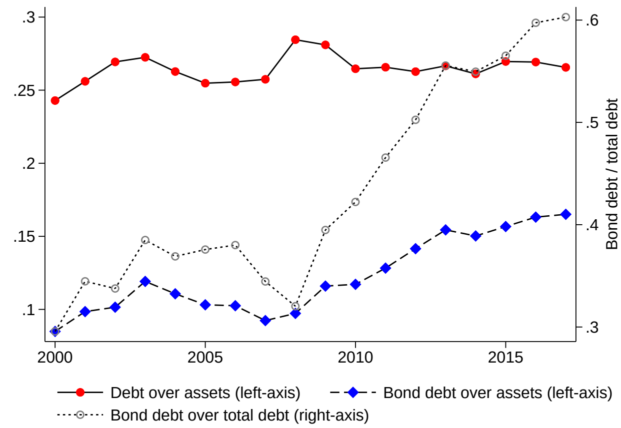


Figure IA.6 – Sample Capital Structure

Notes: The figure shows the time series of equal-weighted sample averages of debt over assets, bond debt over assets, and bond debt over total debt. The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. The bond debt comes from Capital IQ and balance sheet data from Worldscope.

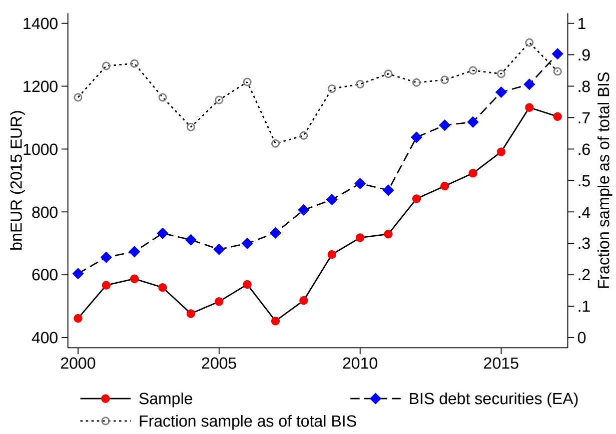


Figure IA.7 – Sample Coverage Debt Securities

Notes: The figure shows the aggregate debt securities outstanding for the sample and the BIS account for short and long-term debt securities in the Euroarea. All values are expressed in 2015 billion EUR. The dashed line describes the fraction that the sample represents as of total BIS debt securities. The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. The bond debt comes from Capital IQ and BIS data are downloaded from https://www.bis.org/statistics/secstats.htm.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ OIS1M × Bond debt over assets	-23.40***							
	(5.254)							
Δ OIS1M × Bond debt over debt		-8.453***						
		(2.522)						
Δ OIS1M × Debt over assets		1.210						
		(4.196)						
Δ OIS3M × Bond debt over assets			-25.14***					
			(7.139)					
Δ OIS3M × Bond debt over debt				-9.131***				
				(3.059)				
Δ OIS3M × Debt over assets				1.805				
				(3.637)				
Δ OIS1M Corsettietal × Bond debt over assets					-19.57***			
					(5.541)			
Δ OIS1M Corsettietal × Bond debt over debt						-6.249**		
						(2.834)		
Δ OIS1M Corsettietal × Debt over assets						-0.777		
						(3.758)		
Δ OIS3M JK × Bond debt over assets							-21.88***	
							(7.780)	
Δ OIS3M JK × Bond debt over debt								-6.777*
								(3.514)
Δ OIS3M JK × Debt over assets								-1.545
								(4.770)
R^2	0.374	0.374	0.373	0.373	0.373	0.373	0.373	0.373
Duration control	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	12717	12717	12717	12717	12717	12717	12717	12717

Table IA.1 – Eurozone Other MP Shocks

*Notes: This table presents regression results for estimating Equation 3 using different measures for the bond share, using alternative measures of monetary policy shock. Dates include 91 ECB announcements days between 2001 and 2007. The dependent variable is daily stock return, and MP Shock are from Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019) (Δ OIS1M, Δ OIS3M); Jarocinski and Karadi (2018) (Δ OIS3M JK) and Corsetti, Duarte, and Mann (2018) (Δ OIS1M Corsettietal). The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding year): log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. The sector is defined based at the 2 digit SIC code level. Balance sheet data come from Worldscope, bond debt from Capital IQ, defined as the sum of all bonds plus commercial paper, and stock market information comes from Datastream. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

	(1)	(2)	(3)	(4)
Δ OIS1M × Bond debt over assets	-21.22***	-20.68***		
	(5.123)	(5.084)		
Bond debt over assets	-6.100	-7.074		
	(39.75)	(39.02)		
Δ OIS1M × Tercile of bond debt over assets			-1.534***	-1.516***
			(0.510)	(0.562)
Tercile of bond debt over assets			4.464	4.073
			(4.536)	(4.581)
Δ OIS1M × Default probability (KMV)	6.309***		6.409***	
	(1.139)		(0.634)	
Default probability (KMV)	45.63		47.22	
	(31.71)		(31.87)	
Quartile Default=1 × Δ OIS1M		0.451		1.062
		(1.672)		(1.493)
Quartile Default=2 × Δ OIS1M		-2.037		-2.022
		(1.449)		(1.324)
Quartile Default=3 × Δ OIS1M		-0.602		-0.372
		(2.067)		(2.115)
R^2	0.377	0.377	0.376	0.376
Duration control	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓
Observations	12285	12285	12285	12285

Table IA.2 – Distance-to-Default and Monetary Policy Shocks

*Notes: This table presents regression results for estimating Equation 3 using different measures for the bond share, adding a measure of the default probability. The default probability is derived according to the "distance-to-default" framework by Merton (1974) and subsequently adopted by, amongst others, Gilchrist and Zakrajšek (2012). The dependent variable is daily stock return, and MP Shock are taken from Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019). The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 91 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date-times-sector fixed effects, and time varying firm controls (all lagged to preceding year): log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. The sector is defined based at the 2 digit SIC code level. Balance sheet data come from Worldscope, bond debt from Capital IQ, defined as the sum of all bonds plus commercial paper, and stock market information comes from Datastream. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ OIS1M × Bond debt over assets	-20.91***					-20.85***	
	(4.564)					(6.637)	
Bond debt over assets	-12.33					-25.54	
	(41.19)					(41.41)	
Δ OIS1M × bond outstanding		-2.727***					
		(0.706)					
Market fin. outstanding		-0.851					
		(6.793)					
Δ OIS1M × Tercile of bond debt over assets			-1.851***				
			(0.440)				
Tercile of bond debt over assets			4.178				
			(4.229)				
Δ OIS1M × Bond debt over debt				-6.658***			
				(2.211)			
Bond debt over debt				-0.174			
				(12.47)			
Δ OIS1M × Tercile of bond debt over debt					-2.136***		
					(0.738)		
Tercile of bond debt over debt					3.181		
					(4.248)		
Δ OIS1M × Debt over assets				-4.182	-4.261	-0.0368	-8.533***
				(2.990)	(2.845)	(3.577)	(2.338)
Debt over assets				18.26	15.63	30.72	18.71
				(41.37)	(41.47)	(41.34)	(42.41)
R^2	0.241	0.240	0.240	0.241	0.241	0.241	0.240
Duration control	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓	✓	✓
Lev. Quintile Interaction							
Observations	12717	12717	12717	12717	12717	12717	12717

Table IA.3 – Eurozone - Abnormal Returns

*Notes: This table presents regression results for estimating Equation 3 using different measures for the bond share. The dependent variable is abnormal daily stock return with respect to the CAPM where the market beta is estimated with a one year rolling window. The MP Shock are taken from Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019). The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 91 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date-times-sector fixed effects, and time varying firm controls (all lagged to preceding year): log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. The sector is defined based at the 2 digit SIC code level. Balance sheet data come from Worldscope, bond debt from Capital IQ, defined as the sum of all bonds plus commercial paper, and stock market information comes from Datastream. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

	(1)	(2)	(3)	(4)	(5)
Δ OIS3M JK × Bond debt over assets	-24.88***				-33.62***
	(7.564)				(8.477)
Bond debt over assets	33.72				-6.325
	(40.65)				(43.91)
Δ OIS3M JK × Tercile of bond debt over assets		-1.902**			
		(0.804)			
Tercile of bond debt over assets		7.899			
		(5.226)			
Δ OIS3M JK × Bond debt over debt			-9.726***		
			(2.788)		
Bond debt over debt			12.15		
			(13.48)		
Δ OIS3M JK × Tercile of bond debt over debt				-2.810***	
				(0.774)	
Tercile of bond debt over debt				5.910	
				(4.381)	
Δ OIS3M JK × Debt over assets			4.971	4.261	12.29**
			(4.754)	(4.820)	(4.866)
Debt over assets			83.23*	82.48*	90.41**
			(42.95)	(43.49)	(44.09)
R^2	0.402	0.401	0.403	0.402	0.403
Duration control	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓
Observations	7185	7185	7185	7185	7185

Table IA.4 – Eurozone Debt Structure - No Information Shocks

*Notes: This table presents regression results for estimating Equation 3 using different measures for the bond share. The dependent variable is daily stock return, and MP Shock are taken from Jarocinski and Karadi (2018), including the classification of the shock into monetary policy and information shock. This specification excludes shock that are classified as information shock; this reduces the number of ECB announcement dates to 51 between 2001 and 2007. The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Controls include firm fixed effects, date-times-sector fixed effects, and time varying firm controls (all lagged to preceding year): log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. The sector is defined based at the 2 digit SIC code level. Balance sheet data come from Worldscope, bond debt from Capital IQ, defined as the sum of all bonds plus commercial paper, and stock market information comes from Datastream. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ OIS1M × Bond debt over assets	-25.92***	-26.33***	-21.12***	-31.87***	-31.78***	-31.62***	-32.00***	-32.18***
	(8.549)	(8.587)	(6.719)	(8.338)	(8.111)	(8.137)	(7.864)	(9.024)
Bond debt over assets	-37.25	-26.87	-11.79	-27.20	-26.74	-27.09	-29.35	-26.11
	(43.74)	(40.52)	(42.68)	(40.56)	(40.62)	(40.60)	(41.43)	(40.59)
Δ OIS1M × Age	0.0373**							
	(0.0149)							
Δ OIS1M × Log assets		-1.002**						
		(0.425)						
Δ OIS1M × Log Enterprise Value			-1.917***					
			(0.426)					
Δ OIS1M × Fixed assets over assets				-4.163				
				(4.691)				
Δ OIS1M × Cash over assets					-8.248			
					(13.70)			
Δ OIS1M × Earnings over interest expenses						-0.0476***		
						(0.0146)		
Δ OIS1M × Equity std.							-4.669	
							(147.1)	
Δ OIS1M × Operating profitability								9.782
								(13.30)
R^2	0.392	0.375	0.376	0.375	0.375	0.375	0.375	0.375
Duration control	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓	✓	✓	✓
Lev. Quintile Interaction	✓	✓	✓	✓	✓	✓	✓	✓
Observations	9652	12717	12717	12717	12717	12717	12717	12717

Table IA.5 – Eurozone Debt Structure - Additional Robustness

*Notes: This table presents regression results for estimating Equation 3 using the bond debt over assets measure as bond share. The dependent variable is daily stock return, and MP Shock are taken from Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019). The sample consists of an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 91 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date-times-sector fixed effects, and time varying firm controls (all lagged to preceding year): log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. The sector is defined based at the 2 digit SIC code level. Balance sheet data come from Worldscope, bond debt from Capital IQ, defined as the sum of all bonds plus commercial paper, and stock market information comes from Datastream. Additional controls in columns (1) - (8) include age, defined as the number of years since incorporation and if missing the number of years since foundation; size (interacted), defined as log assets; enterprise value, defined as market value of equity plus net debt; fixed assets over assets (interacted); cash over asset (interacted); earnings over interest expenses (interacted); equity return standard deviation; and operating profitability, defined as ebitda over market value of assets. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

	mean	p25	p50	p75	count
Low bond debt					
Assets (in bn)	17.529	3.314	7.701	18.072	4,312
Cash over assets	0.161	0.047	0.106	0.236	4,312
Earnings over assets	0.148	0.097	0.159	0.220	4,312
Fixed assets over assets	0.238	0.109	0.176	0.322	4,312
Equity duration proxy	13.925	10.500	13.860	17.000	4,312
Market-to-Book	3.941	2.006	2.956	4.574	4,312
Debt over earnings	1.267	0.212	0.692	1.399	4,312
Earnings over interest expenses	90.450	9.939	25.104	57.896	4,312
Debt over assets	0.134	0.053	0.113	0.171	4,312
Debt due within year over debt	0.257	0.022	0.145	0.389	4,312
Bond debt over assets	0.052	0.000	0.039	0.099	4,312
Bond debt over debt	0.518	0.000	0.674	0.926	4,312
Medium bond debt					
Assets (in bn)	19.942	4.597	8.918	21.148	4,506
Cash over assets	0.105	0.029	0.066	0.145	4,506
Earnings over assets	0.144	0.096	0.150	0.198	4,506
Fixed assets over assets	0.301	0.144	0.244	0.377	4,506
Equity duration proxy	12.463	10.000	12.000	15.000	4,506
Market-to-Book	3.527	1.788	2.813	4.134	4,506
Debt over earnings	1.844	0.938	1.390	2.166	4,506
Earnings over interest expenses	15.181	6.479	11.543	19.224	4,506
Debt over assets	0.223	0.178	0.214	0.256	4,506
Debt due within year over debt	0.167	0.023	0.102	0.239	4,506
Bond debt over assets	0.179	0.155	0.183	0.209	4,506
Bond debt over debt	0.837	0.752	0.901	0.971	4,506
High bond debt					
Assets (in bn)	29.707	4.825	11.358	23.594	4,482
Cash over assets	0.086	0.016	0.039	0.103	4,482
Earnings over assets	0.134	0.092	0.141	0.183	4,482
Fixed assets over assets	0.332	0.172	0.297	0.474	4,482
Equity duration proxy	11.307	8.000	10.750	14.500	4,482
Market-to-Book	4.069	1.620	2.668	4.422	4,482
Debt over earnings	2.821	1.652	2.380	3.689	4,482
Earnings over interest expenses	8.518	3.918	6.558	10.242	4,482
Debt over assets	0.372	0.289	0.345	0.429	4,482
Debt due within year over debt	0.142	0.016	0.092	0.212	4,482
Bond debt over assets	0.334	0.262	0.307	0.385	4,482
Bond debt over debt	0.908	0.862	0.947	0.989	4,482
Total					
Assets (in bn)	22.451	4.162	9.286	20.599	13,300
Cash over assets	0.117	0.025	0.068	0.158	13,300
Earnings over assets	0.142	0.095	0.149	0.199	13,300
Fixed assets over assets	0.291	0.138	0.232	0.400	13,300
Equity duration proxy	12.548	10.000	12.000	15.000	13,300
Market-to-Book	3.844	1.774	2.830	4.390	13,300
Debt over earnings	1.986	0.774	1.488	2.539	13,300
Earnings over interest expenses	37.339	5.569	10.474	22.285	13,300
Debt over assets	0.244	0.147	0.235	0.321	13,300
Debt due within year over debt	0.188	0.021	0.107	0.262	13,300
Bond debt over assets	0.190	0.097	0.185	0.265	13,300
Bond debt over debt	0.758	0.691	0.897	0.975	13,300

Table IA.6 – US Firm Balance Sheets and Summary Statistics

Notes: The table presents summary statistics for an unbalanced panel of the American firms that were part of S&P 500 index, excluding financials and utilities. Dates include 52 Federal Open Market Committee announcements days between 2001 and 2007. The subsamples "Low bond debt", "Medium bond debt" and "High bond debt" correspond to the terciles of the bond debt over assets distribution, recalculated yearly. Bond debt includes senior bonds, subordinated bonds, and commercial paper. Balance sheet data come from Worldscope, bond debt comes from Capital IQ.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ FFR × Bond debt over assets	-4.209*					-1.390	-1.895	
	(2.454)					(3.899)	(3.310)	
Bond debt over assets	5.030					4.058	-3.646	
	(36.35)					(35.60)	(33.17)	
Δ FFR × bond outstanding		-0.836						
		(1.125)						
Bond outstanding		-14.30						
		(11.29)						
Δ FFR × Tercile of bond debt over assets			-0.555					
			(0.503)					
Tercile of bond debt over assets			-2.257					
			(4.723)					
Δ FFR × Bond debt over debt				-1.194				
				(1.049)				
Bond debt over debt				-18.81				
				(11.38)				
Δ FFR × Tercile of bond debt over debt					-0.437			
					(0.444)			
Tercile of bond debt over debt					-4.832			
					(3.076)			
Δ FFR × Debt over assets				-4.575*	-4.849*	-4.121		-5.034**
				(2.404)	(2.424)	(3.939)		(2.285)
Debt over assets				14.93	10.70	6.815		9.043
				(40.27)	(39.86)	(41.07)		(39.89)
R^2	0.388	0.388	0.388	0.389	0.388	0.388	0.389	0.388
Duration control	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓	✓	✓	✓
Lev. Quintile Interaction							✓	
Observations	12998	12998	12998	12998	12998	12998	12998	12998

Table IA.7 – US Sample and Monetary Policy Shocks

*Notes: This table presents regression results for estimating Equation 3 using different measures for the bond share. Bond debt includes senior, subordinated bonds and commercial paper. The dependent variable is daily stock return, and the monetary policy shock comes from Nakamura and Steinsson (2018a). The sample consists of an unbalanced panel of the American firms that were part of S&P 500 index, excluding financials and utilities. Dates include 52 Federal Open Market Committee announcements days between 2001 and 2007. Controls include firm fixed effects, date-times-sector fixed effects, and time varying firm controls (all lagged to preceding year): log assets, cash over assets, earnings over assets, debt over earnings, earnings over interest expenses, fixed assets over assets, log market-to-book. The sector is defined based at the 2 digit SIC code level. Balance sheet data come from Worldscope, bond debt from Capital IQ and stock market information comes from Datastream. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

Alternative Model

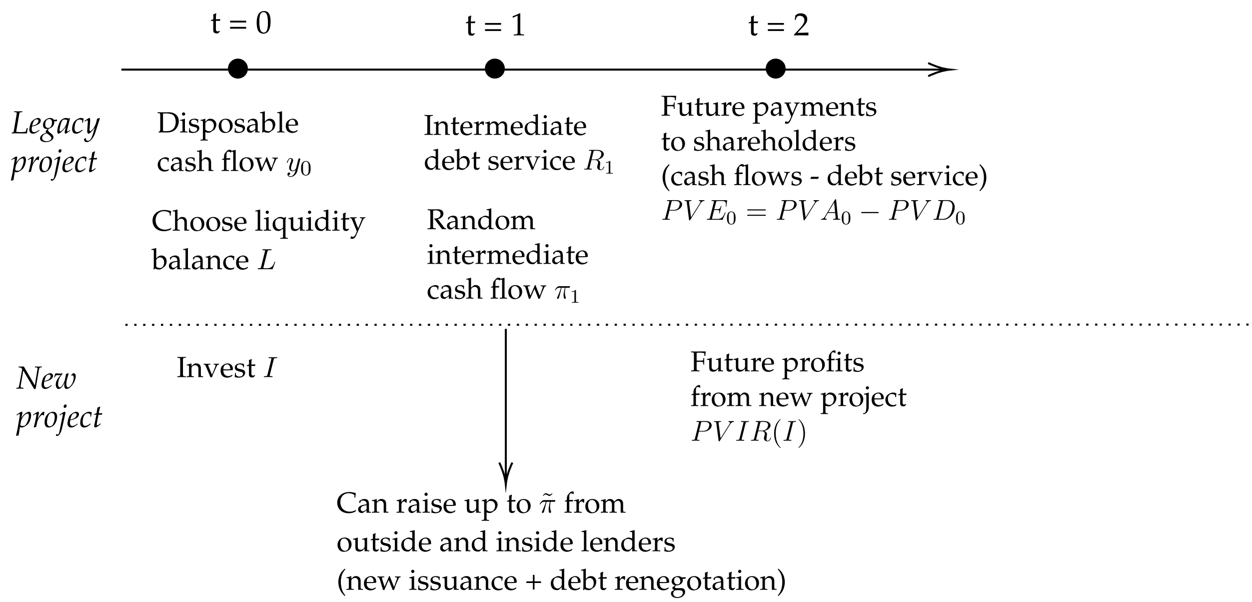


Figure IA.8 – Timeline

Overview and Link to Literature: In this alternative model, renegotiation frictions associated with bond financing matter through a liquidity management channel, even if firms do not default. In the presence of financial frictions, firms self-insure against temporary cash-flow shocks by hoarding liquid assets (Holmström and Tirole, 1998; Bolton, Chen, and Wang, 2011; Almeida, Campello, Cunha, and Weisbach, 2014). Additional investment is thus limited by "liquidity constraints." Interestingly, liquidity constraints depend on debt structure. While it is often efficient for lenders to agree on a mutually beneficial renegotiation to prevent financial distress,[37] coming to such an agreement is more difficult with dispersed bond investors relative to concentrated bank lenders. An increase in the policy rate raises debt burden and tightens liquidity constraints differentially across firms with varying shares of bond financing. As in the baseline model, rigidity frictions in bond financing attenuate the predictions of the bank lending channel and affect the pass-through of monetary policy.

Another advantage of that modeling approach is that it connects naturally with recent work on the role of corporate liquidity in monetary transmission (Rocheteau, Wright,

[37] A renegotiation outcome can take the form of a reduction in debt payments, a maturity extension, or a dilution to raise new funds.

and Zhang, 2018; Kiyotaki and Moore, 2018; Ajello, 2016; Altavilla, Burlon, Giannetti, and Holton, 2019; Jeenas, 2018).[38] The framework can also be extended to incorporate the effect of monetary policy on the cost of liquid assets, i.e., the liquidity premium (Rocheteau, Wright, and Zhang, 2018; Drechsler, Savov, and Schnabl, 2018; Nagel, 2016). Finally, it accounts for a critical idea in Ippolito, Ozdagli, and Perez-Orive (2018): the characteristics of outstanding debt matter for monetary transmission beyond the issuance of new debt.

Setup: A firm has a legacy project (assets in place) that pays cash flows in each period, as well as debt obligations that must be paid in each period. We model three dates explicitly: t=0, 1 and 2. Figure IA.8 illustrates the timeline. The last period t=2 summarizes all future cash-flows. The existing assets in place generate a payoff stream for the firm with present value $PVE_0 = PVA_0 - PVD_0$, which is the difference between all future cash-flows and debt service payments. We allow the structure of these payoff streams to be arbitrary, and their duration (how their present value changes with discount rates) is the only summary statistics needed for the analysis below. At t=0, the firm has disposable cash-flow y_0 as well as a new investment opportunity. This new project generates a stream of cash-flows starting from t=2. An amount I invested at t=0 generates a present value of $R(I)PVI$ at t=2. Assume decreasing returns to scale, so that R is increasing and concave. The term PVI summarizes the temporal structure of the cash-flows and captures the new project duration, that plays an important role in the analysis.[39]

At $t = 1$, the firm faces some debt repayment of R_1. As in the baseline model, how R_1 varies with monetary policy depends on debt structure: the bank lending implies a large pass-through for loans relative to bonds. Following Holmström and Tirole (1998), we model liquidity shocks as uncertain cash-flow at t=1: π_1 can be unexpectedly low, without any implication for terminal cash-flows. For simplicity, assume interim cash-flows can take two values $\pi_1 \in \{0, \pi\}$. In the bad state, the firm cannot afford its debt payment and must then access extra funds to prevent financial distress. There are two sources of extra funds. First, the firm can renegotiate down debt obligation R_1 and lower them by up to $\tilde{\pi}$ at t=1 (equivalently, raises up to $\tilde{\pi}$ from capital markets or draws down a credit

[38] Looking beyond the corporate sector, other papers argue that liquidity management in the financial industry is likewise vital for monetary policy (Bianchi and Bigio, 2014; Drechsler, Savov, and Schnabl, 2018; Choi, Eisenbach, and Yorulmazer, 2015). Moreover, Kaplan, Moll, and Violante (2018) show that household liquidity constraints determine the impact of monetary policy in a quantitative HANK model.

[39] For example, if the project pays a first cash-flow $R(I)$ that grows a rate g every period and the discount rate is ρ, $R(I)PVI = R(I)/(\rho - g)$.

line). However, Holmström and Tirole (1998) show that this is unlikely to be enough to withstand large enough shock because of two frictions: lack of pledgeability and debt rigidity. The second friction is key to the effect of debt structure: as explained in the main text, bonds are harder to renegotiate because they are held by dispersed creditors. While it is often in the creditors' best interest to renegotiate their claims or let themselves be diluted by the issuance of new claims after a temporary shock, renegotiation frictions create a "debt overhang" problem at the intermediate stage. In the model, that can be formalized as a lower value of $\tilde{\pi}$ that can be raised at t=1 for firms with more bond debt.

The shortfall that cannot be covered by $\tilde{\pi}$ therefore has to be planned in advance, and comes from the liquid assets L hoarded at t=0. In practice, liquid assets can come in the form of cash, marketable securities like bonds, or access to credit lines granted by banks. The firm thus face a "liquidity constraint" and must hold enough liquidity to withstand the interim cash-flow shock, i.e., $L + \tilde{\pi} - R_1 \geq 0$. (For simplicity, assume a liquidity premium of zero). This liquidity constraints matters because we assume that financial frictions limit the amount of liquid assets that can be purchased at $t = 0$. For simplicity, assume the firm cannot raise new funds at $t = 0$ and thus disposable income is allocated between new investment and liquid assets: $y_0 = I + L$ (alternatively, y_0 could be re-interpreted as debt capacity at $t = 0$).

Equilibrium Liquidity Demand and Investment: The firm jointly chooses I and L in order to maximize expected profits subject to its liquidity constraint. Note first that it is optimal for the firm to use all of its disposable income at $t = 0$ and thus $L = y_0 - I$. This allows to rewrite the maximization problem as a function of I only and the liquidity constraint:

$$\max_I \left\{ \underbrace{PVE_0 + R(I)PVI}_{\text{Expected terminal profits}} + \underbrace{\mathbb{E}[\pi_1] - R_1 + \tilde{\pi} + y_0 - I}_{\text{Expected profits at t=1}} \right\} \quad \text{s.t.} \quad \tilde{\pi} + y_0 - I - R_1 \geq 0$$

Denoting by λ the multiplier on the liquidity constraint, the FOC implies the following optimality condition:

$$\underbrace{R'(I^*)PVI - 1}_{\text{net return of new project}} = \underbrace{\lambda}_{\substack{\text{shadow value} \\ \text{of liquidity}}}$$

Liquidity consideration distorts investment from its unconstrained optimum. Mathematically, the Lagrange multiplier captures the *the shadow value of liquidity*: the marginal value of an extra dollar of disposable income at $t = 0$ or $t = 1$. If the constraint binds in equilibrium, investment is given by $I^* = \tilde{\pi} + y_0 - R_1$.

Stock Price Reaction to Monetary Policy: For simplicity, we assume an increase in the policy rate r^f has only two effects: (i) it reduces discount rates (duration effects), and (ii) it raises debt burden, and in particular R_1 at the intermediate stage. The stock price reaction is given by the envelope theorem:

$$\frac{\mathrm{dEquity}}{\mathrm{d}r^f} = \underbrace{\left\{\frac{\partial PVE_0}{\partial r^f} + R(I^*)\frac{\partial PVI}{\partial r^f}\right\}}_{\text{equity duration}} - \underbrace{\lambda}_{\substack{\text{shadow value}\\ \text{of liquidity}}} \times \underbrace{\frac{\partial R_1}{\partial r^f}}_{\substack{\text{interest rate}\\ \text{pass-through}}} \tag{5}$$

The first term reflects the equity duration. The second term reveals how monetary policy affects constraints—here, the liquidity constraint faced by the firm. It is the product of two interpretable components. The interest rate pass-through captures how much rate hikes increase debt burden at the intermediate stage. This tightens constraints because a rate hike drains the cash-flow and makes it less likely that the firm withstands a temporary shock, keeping its policy unchanged.[40] The other term is the shadow value of the liquidity constraint. Importantly, firms that face greater liquidity risk have a larger shadow value of liquidity

The Role of Debt Structure: This decomposition makes it clear that debt structure matters for stock market response but that the sign of the total effect is ambiguous. Focusing on the constraint effect, note first that the bank lending channel implies a lower interest rate pass-through for bonds relative to loans. This force predicts that bond-financed firms are less responsive to monetary shock.

On the other hand, the existence of frictions in bond financing is a countervailing force. The rigidity of bonds alters corporate liquidity management as it implies that a smaller amount $\tilde{\pi}$ can be raised at $t = 1$ due to renegotiation frictions. If these bond

[40] Note that incorporation a lqiudity premium would imply an additional term. Indeed, the cost of holding liquid assets can rise with the policy rate, as emphasized by recent work in monetary economics (Rocheteau, Wright, and Zhang, 2018; Drechsler, Savov, and Schnabl, 2018; Nagel, 2016). Numerous mechanisms have been proposed, such as the change in the opportunity cost of near-money assets or the change in supply of public money through open market operations. Moreover, in practice private money creation by the financial sector is also important: many firms use credit lines granted by banks to insure against future liquidity shocks or hold bank debt directly. A tightening of monetary policy can also reduce private money creation, leading to a fall in the aggregate supply of liquid assets.

frictions are large enough, more bonds tighten the liquidity constraint faced by the firm everything else equal, i.e., $\tilde{\pi} - R_1$ increases with the bond share. This implies a higher shadow value of liquidity in equilibrium. This force predicts that bond-financed firms are more responsive to monetary shock. In general, which effect dominates depends on details of the environment and the relative magnitude of the different frictions.