The Bond Lending Channel of Monetary Policy

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Abstract

An increasing share of firms' borrowing occurs through bond markets. How does debt structure affect the transmission of monetary policy? We present a high-frequency framework that combines identified monetary shocks with a cross-sectional firm-level stock price reaction. An envelope argument shows that, since firms maximize equity value subject to constraints, stock price reactions reflect how monetary policy affects constraints. We find that, contrary to standard bank lending channel predictions, bond financing does not attenuate monetary transmission in the Eurozone: firms with more bonds are more affected by surprise monetary tightenings relative to other firms. This is consistent with significant bond-specific frictions that limit the benefits of disintermediation.

Keywords: Monetary policy, debt structure, stock market, banking relationships, corporate bonds *JEL codes*: E44, E52, G21, G23

*Preliminary, comments welcome.

1 Introduction

Most macroeconomic aggregates—such as investment, output, or employment—are determined by firm decisions and influenced by monetary policy. Given that changes to the policy rate directly affect the cost of external financing, it is plausible that firms' debt plays an important role. A (multiform) "bank lending channel" is the predominant view to understanding the financial transmission of monetary policy.[1] However, bond financing has been rising at the expense of bank lending in recent years. Europe is a striking example of this rapid growth: although its bond markets were historically 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]

As long as bonds and loans are not perfect substitutes, how the pass-through of monetary policy changes with debt composition is theoretically unclear. The classical bank lending channel predicts that a higher bond share attenuates pass-through: bond markets are often thought to be a largely frictionless "spare tire" that insulate firms from a tightening of financial constraints. However, bond-specific frictions can alter this conclusion. For instance, market debt is more rigid and harder to renegotiate relative to bank loans, or "relationship financing" (Bolton and Scharfstein, 1996; Crouzet, 2017) or provide less screening and monitoring (Holmstrom and Tirole, 1997; De Fiore and Uhlig, 2011). Credible empirical investigations are thus crucial to make progress on this question. 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

[1] Because banks are levered intermediaries issuing liquid deposits to fund illiquid loans, they are potentially affected by monetary policy in specific ways. Classical views stress the role of reserves and capital, whereas more recent theories emphasize market power (Drechsler, Savov, and Schnabl, 2017; Wang, Whited, Wu, and Xiao, 2018), bank liquidity management (Bianchi and Bigio, 2014; Drechsler, Savov, and Schnabl, 2018), the composition of bank interest income (Wang, 2018) or interest coverage covenants (Greenwald, 2019), among others.

[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 the real economy is nevertheless challenging as firm-level outcomes tend to adjust at a much lower frequency.

To address those challenges, this paper presents a high-frequency approach that combines identified monetary shocks with cross-sectional firm-level stock price reactions in the Eurozone. An envelope argument shows that, since firms maximize equity value subject to constraints, stock price reactions are directly influenced by how monetary policy affects constraints. We illustrate this idea in a simple framework of debt structure, investment, and stock price and show that the effect of a higher share of bond financing is ambiguous. While the (multiform) bank lending channel implies a smaller shift in credit supply for bond-financed firms, the existence of bond-specific frictions dampens and can even reverse this effect. Indeed, we find that bond financing does not attenuate monetary transmission in the data: firms with more bonds are more affected by surprise monetary tightenings relative to other firms. This stands in contrast to standard bank lending channel predictions and shows that bond-specific frictions are important for monetary transmission and limit the benefits of disintermediation.

The first part of the paper explains how to interpret stock market reactions to learn about the effect of monetary policy on firms. We highlight a general envelope argument: to a first order, since firms maximize equity value subject to constraints, their stock price reaction is not driven by changes to the firm's optimal policies. Instead, it consists of the sum of (i) a "direct" effect and (ii) a "constraint" effect. The direct effect captures the revaluation of the present value of future profits *keeping the firm's policies unchanged*. Concretely, it can work through a change in discount rates (equity duration), as well as, beliefs about the future state of the economy[3] or price changes in general equilibrium. The constraint effect, on the other hand, captures how monetary policy tightens or relaxes financial constraints, a force at the heart of recent macro-finance models of monetary transmission. The main appeal of our approach is that it allows us to learn about this object within a high-frequency identification framework. 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

[3]See the growing literature on the "information effect" of monetary policy, such as Nakamura and Steinsson (2018a), Jarocinski and Karadi (2018) or Laarits (2019).

relative to the unconstrained optimum.

To show that the effect of bond financing on monetary transmission depends on the magnitude of bond-specific frictions, we apply our envelope decomposition to a few illustrative models. Firms optimally choose debt structure by solving a trade-off between bank and market financing. Moreover, debt structure matters for how monetary policy affects financial constraints. To emphasize that our point is fairly general, we let the details vary across models.[4] The "direct effect" is equivalent to the unconstrained firms' stock price reaction and its magnitude is not directly informative about their real responses, by a standard envelope argument.[5] On the other hand, the "constraint effect" is informative. When bond-specific frictions are low, the stock price reaction is greatly attenuated by a higher bond share of firm financing. When these frictions are high, the reduction is lower and can possibly reverse: constraints tighten relatively more for bond-financed firms.

In the second part of the paper, we apply this 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.[6] 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 hence are little affected by 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.

[4]Developing a unified quantitative model of debt structure and monetary transmission is nevertheless an important next step. Crouzet (2019), Ippolito, Ozdagli, and Perez-Orive (2018), Crouzet (2017) or Chang, Fernández, and Gulan (2017) provide some building blocks.

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

[6]Our high-frequency identification strategy relies on stock prices adjusting rapidly, and firms maximizing equity values. Similar to existing work in the United States, such as Gorodnichenko and Weber (2016), we focus on index constituents of the EURO STOXX sectoral indices to capture the most-liquid stocks and best-governed firms. Our sample nevertheless captures about 80% of total bonds outstanding in the Eurozone. We acknowledge that the frictions at play for smaller firms are potentially different. Complementary to our approach, work studying low-frequency firm-level response tends to use a broader sample, although typically still within the Compustat universe (Crouzet, 2019; Ottonello and Winberry, 2018; Cloyne, Ferreira, Froemel, and Surico, 2018).

There are at least two econometric challenges to be addressed in this setting. First, our high-frequency approach using a narrow window helps to alleviate the concern that firm reactions are driven by news unrelated to monetary policy. An advantage of using high-frequency stock price reaction as an outcome variable is that asset prices quickly adjust to reflect the effect of monetary surprises.[7] 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 try to rule out alternative interpretations. To account for changes in discount rates, we control for equity duration as defined in Gormsen and Lazarus (2019) and Weber (2018), 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. Besides, robustness tests can rule out several widespread alternative explanations based on existing work. Still, we acknowledge that the lack of exogenous variation means we cannot completely exclude that unobserved heterogeneity within sectors accounts for our findings.

We find strong evidence that debt structure matters for the transmission of monetary 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 60 basis point lower stock return relative to firms in the top quartile. This finding is hard to square with a (multiform) bank lending channel. Irrespective of the exact micro-foundation, this type of explanation 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 bond-specific frictions 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

[7] In a similar spirit, Anderson and Cesa-Bianchi (2020) looks at the high-frequency response of credit spreads in a cross-section of U.S. rated firms.

policy, such as leverage, default risk, 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.[8] 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 bond-specific frictions 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 compare our Eurozone findings with the case of the United States. In the sample of constituents of the S&P 500 index over the same period, we find no difference across firms with different debt structures once we control for equity duration. This result is consistent with Ippolito, Ozdagli, and Perez-Orive (2018), who show that bank-reliant firms' stock price reactions are larger, but that the difference disappears when conditioning on whether firms hedge interest rate risk. Crouzet (2019) finds that a higher bond share reduces the pass-through, although he focuses on a broader sample and low-frequency outcomes. All those findings imply significantly smaller bond-specific frictions, if any, in the United States relative to the Eurozone. Several stylized facts and institutional details support this view. 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 even 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

[8]See, for example, Becker and Ivashina (2014), Kashyap, Stein, and Wilcox (1996), Crouzet (2019), Lhuissier and Szczerbowicz (2018) or Elliott, Meisenzahl, Peydró, and Turner (2019). Balloch (2018), Grosse-Rueschkamp, Steffen, and Streitz (2019), Arce, Gimeno, and Mayordomo (2018) and Ertan, Kleymenova, and Tuijn (2019) study quantitative easing and bond liberalization episodes.

Europe are often unprepared for the rising importance of bond markets (Ehmke, 2018). Active policy efforts to mitigate bond market frictions are necessary for firms to benefit fully from credit substitution.[9]

The chief implication of our findings is that macroeconomic models would benefit from featuring heterogeneity in debt structure more prominently. In particular, they need to account for the mix of bonds and bank loans. 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 other shocks, such as unconventional monetary policy, are important areas for future research.

Related literature

This paper builds on an extensive body of work at the intersection of corporate finance and macroeconomics. First, it relates to the literature on the mix of bonds and bank loans. Crouzet (2017, 2014), De Fiore and Uhlig (2011, 2015) and Acharya, Almeida, Ippolito, and Perez-Orive (2018) 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. Crouzet and Mehrotra (2017) find that U.S. bond issuers are more sensitive to recessions. We emphasize the role of bond-specific frictions following classical theoretical (Bolton and Scharfstein, 1996; Diamond, 1991; Rajan, 1992; Holmstrom and Tirole, 1997; Gersbach and Uhlig, 2007; Bolton and Freixas, 2000) and empirical contributions (Denis and Mihov, 2003; Asquith, Gertner, and Scharfstein, 1994; Hoshi, Kashyap, and Scharfstein, 1990, 1991; Schwert, 2018b,a).

Our Eurozone findings complement two recent papers on debt structure and monetary transmission in the United States. Crouzet (2019) studies how monetary pass-through changes as firms become less reliant on intermediated debt. He introduces a model in which firms choose investment and their debt structure by trading off higher loan flexibility with the lower cost of bonds and provides low-frequency firm-level evidence consistent with these predictions. Ippolito, Ozdagli, and Perez-Orive (2018) document a floating rate channel of monetary policy. Because bank loans have floating rates mechanically tied to the policy rate, monetary shocks can directly affect the liquidity and

[9]Indeed, this is the explicit objective of the Expert Group on European Corporate Bond Markets that started reporting to the European Commission in 2017.

balance sheet strength of firms through existing loans. They show that firms with more unhedged loans display a stronger sensitivity of their stock price, cash holdings, inventory, and fixed capital investment to monetary policy.

In terms of its approach, this paper relies on high-frequency identification of monetary policy shocks (Cook and Hahn, 1989; Kuttner, 2001; Cochrane and Piazzesi, 2002; Bernanke and Kuttner, 2005a; Nakamura and Steinsson, 2018a; Corsetti, Duarte, and Mann, 2018; 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 (Gorodnichenko and Weber, 2016; Ozdagli, 2018; Ozdagli and Velikov, 2019; Haitsma, Unalmis, and de Haan, 2016; Weber, 2015; Ozdagli and Weber, 2017; Chava and Hsu, 2015; Lakdawala and Moreland, 2019; Gürkaynak, Karasoy-Can, and Lee, 2019), while Chodorow-Reich (2014) investigates the effect of unconventional monetary policy on financial institutions. Anderson and Cesa-Bianchi (2020) studies the response of credit spreads in the cross-section of U.S. bond issuers and shows that monetary policy has heterogeneous effects on firms, depending on their level of leverage. There is also an extensive literature showing that monetary policy affects the risk premium (Drechsler, Savov, and Schnabl, 2018; Kekre and Lenel, 2019; Cieslak, Morse, and Vissing-Jorgensen, 2019; Lucca and Moench, 2015; Laarits, 2019; Gertler and Karadi, 2015).

We further add to the literature showing that monetary policy impacts credit flows and that firms move towards market financing following a monetary tightening (Becker and Ivashina, 2014; Lhuissier and Szczerbowicz, 2018; Elliott, Meisenzahl, Peydró, and Turner, 2019; Kashyap, Stein, and Wilcox, 1996; Bolton and Freixas, 2006). This credit substitution is in line with papers on the bank lending channel of monetary policy (Drechsler, Savov, and Schnabl, 2017; Kashyap and Stein, 2000; Jiménez, Ongena, Peydró, and Saurina, 2012; Wang, 2018; Greenwald, 2019; Wang, Whited, Wu, and Xiao, 2018). More generally, policies stimulating bond markets can have aggregate effects through the substitution of bank loans toward bonds (Balloch, 2018; Grosse-Rueschkamp, Steffen, and Streitz, 2019; Arce, Gimeno, and Mayordomo, 2018; De Santis and Zaghini, 2019).

In terms of its findings, this paper aligns with the growing consensus that heterogeneity is key to monetary policy transmission. For instance, Ottonello and Winberry (2018), Jeenas (2018) and Lakdawala and Moreland (2019) emphasize heterogeneous response of firms with different financial positions, while Cloyne, Ferreira, Froemel, and Surico (2018) stress the role of firm's age. Gomes, Jermann, and Schmid (2016) and De Fiore, Teles, and Tristani (2011) present macroeconomic models of monetary policy with a focus on firms' external financing. 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.

2 High-Frequency Approach

2.1 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 a setting that potentially fits many macro-finance models of firms facing financial constraints. The 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:

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

In particular, the change in optimal policy $\frac{\mathrm{d}y^*}{\mathrm{d}r^f}$ induced by monetary policy is of a second order. 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.[10] 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. Recent papers have argued that duration is an influential driver of the cross-section of stock returns (Gormsen and Lazarus, 2019; Weber, 2018), and we use their measures in our empirical analysis. 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 once we control for equity duration. This is remarkable since an empirical detection of constraints is very challenging. Note 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.

Our empirical approach leverages this insight by combining time-series and cross-

[10] 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).

sectional high-frequency variation. Monetary policy shocks can be recovered from a change in market interest rates over short windows around policy announcements (Kuttner, 2001; Nakamura and Steinsson, 2018a; Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa, 2019). We focus on the role of debt structure in monetary transmission and ask whether firms with more bond financing respond differently to monetary policy. The envelope argument above suggests that this cross-sectional stock market response uncovers how monetary policy affects constraints *differentially* across firms with varying debt structures.[11] It also makes clear what could potentially confound the analysis: it is essential to control for direct effects whose magnitudes vary with debt structure.

2.2 Bank vs. Bonds and Monetary Transmission

Before moving to the empirical specification, it is vital to understand the economics behind debt structure and monetary transmission. There are several differences between bank loans and market financing, which can matter for monetary policy. Theoretically, it is unclear how the share of bond financing affects pass-through.

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 have argued 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; 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 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.

Bond-specific frictions: An equally large body of work emphasizes that relationship

[11] Cross-sectional estimates can only capture constraints for which debt structure matters. If monetary policy relaxes constraints uniformly across firms with different debt structures, our estimates will be zero.

banking and market financing are not perfect substitutes. 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 (Bolton and Scharfstein, 1996). This coordination (free-rider) problem across bond creditors means that market financing is typically perceived to be less flexible than bank loans. This lower flexibility implies that banks are better able to help their relationship borrowers to avoid financial distress (Crouzet, 2017; Bolton, Freixas, Gambacorta, and Mistrulli, 2016; De Fiore and Uhlig, 2015; Crouzet, 2019). Another related friction pertains to information: intermediaries are typically seen as being more willing to screen and monitor borrowers (Holmstrom and Tirole, 1997; Diamond, 1991; Rajan, 1992; De Fiore and Uhlig, 2011), while market lenders tend to rely on public information that is often provided by rating agencies. The informational environment is thus a salient driver of the magnitude of bond-specific frictions. In these models of optimal debt structure, loans are often viewed as more expensive, for example, because intermediaries have to incur monitoring costs.[12]

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. Similarly, Asquith, Gertner, and Scharfstein (1994) find that firms are less likely to restructure debt out of court if they have a large amount of publicly held debt. 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) find that close ties with banks drive firms' investment behavior and explain their response to liquidity shocks.

Moreover, the ability to renegotiate or to restructure is determined by the legal framework that governs private contractual agreements. Ehmke (2018) outlines one legal fric-

[12]See Schwert (2018b) for clean evidence that loans are more expensive than bonds, controlling for firm characteristics and seniority.

tion in the case of Germany: "[...] the German legal framework for corporate bond debt restructuring is caught between two stools: the public ordering law was reformed after the model of the US rescue regime of Chapter 11 while the reform of the bond law followed the UK example and opened the door for private players to fashion a contractual regime for bond debt restructuring themselves; however, only within the legal constraints set by the German bond law itself."

Because of these bond-specific frictions, debt structure can affect monetary transmission in a novel way. A monetary tightening can lead to a higher debt burden or a slowdown in economic activity, which raises the risk of financial distress for firms, whether it is through default risk or more frequent outcomes such as a covenant violation or a rating downgrade. The lack of flexibility of market financing can thus be costly for bond-dependent firms. If bond-specific frictions are large enough, firms with more bond financing will be relatively more affected by monetary policy.

Other differences: Empirically, there are further differences between loan and bond contracts. A key difference is that bonds and loans tend to have different *duration* (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: while a rate hike decreases the present value of debt obligations, this decrease is less pronounced for loans relative to bonds. 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.

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. This duration effect is one of the direct effects that we highlighted in the envelope decomposition above. Duration is a central concept in asset pricing, and recent works have stressed the role of equity duration to explain the cross-section of stock returns (Weber, 2018; Gormsen and Lazarus, 2019). In our empirical specification, we, therefore, use the measures those authors introduce to control for equity duration.

Finally, another distinction is that bonds are less likely to be collateralized relative to loans, and, in general, they tend to be junior to bank debt. It is well known that monetary policy can raise asset values and thus give rise to a collateral channel (Kiyotaki and Moore, 1997). Hence both the duration and collateral channel would tend to predict that bond-financed firms are less affected by monetary policy.

2.3 Illustrative Model

The last section shows that the effects of debt structure and monetary transmission are complicated. 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. Instead, the goal of this section is to illustrate the role that bond market frictions play in monetary transmission and apply our envelope decomposition to understanding what the cross-sectional stock price reaction reveals. To this end, we present a stripped-down 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 Section 2.3.3 and in the Appendix.

2.3.1 Setup

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 (2014), 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 case of success and χRI otherwise, with $\chi \in [0, 1)$. If the entrepreneur behaves well, the project succeeds with probability p_H. If they misbehave, it succeeds 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 case of success 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 pledgeable income per unit of investment:

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

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. The payoff χ in case of failure thus depends on the debt structure, with $\partial\chi/\partial\beta < 0$: bond financing implies less efficient liquidation or restructuring.[13] On the other hand, banks occur 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, with $\partial\rho/\partial\beta < 0$. 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. It also implies a higher interest-rate pass-through on bank loans which captures the (multiform) bank lending channel in a reduced-form way.[14] In equilibrium, the firm optimal bond share trades-off a lower cost of debt with less pledgeable income because of inefficient liquidation.

Monetary policy: We model monetary transmission in a simple reduced-form way. A higher policy rate r has two effects. First, it increases lenders' cost of funds ρ, such 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, it has a contractionary effect on the real economy by lowering the probability p_H that the project succeeds such that $\partial p_H/\partial r <$

[13]An alternative modeling choice would be to 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 very similar in terms of the economics, as what matters is that more bonds can reduce pledgeable income.

[14]Figure IA.1 in the 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.

0.[15] 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 larger liquidation losses. 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 in the case of success that preserves its incentives:

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

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

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

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

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

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, it has two components. First, a change in discount rates that captures "equity duration," as emphasized in the recent asset pricing literature (Weber, 2018; Gormsen and Lazarus, 2019). Second, a rate hike alters the 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.

2.3.2 Cross-sectional effects of debt structure

This simple model provides a framework to understand how debt structure and the role of bond-specific frictions matter for monetary transmission. In this section, we focus on the constraint effect. In this setting, properties of the multiplier $m(\beta, r)$ drive cross-sectional stock price reactions across firms with different debt structures. Recall from equation 1 that the multiplier is high when lenders' cost of fund $\rho(\beta, r)$ is low and when pledgeable income $\mathcal{P}(\beta, r)$ is high. While a rate hike tightens constraints for all firms (i.e., $\partial m(\beta^*, r)/\partial r$ is negative), the magnitude and sign of the cross-sectional estimates depends on the *differential* effect across firms with different debt structures, i.e., $\frac{\partial}{\partial \beta} \partial m(\beta^*, r)/\partial r$. To make the economics behind cross-partial derivatives transparent, 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:

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

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

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

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 bond-specific frictions is a countervailing force. Intuitively, a rate hike increases the probability of financial distress. This effect is especially pronounced for firms with more bonds as they face larger liquidation frictions (lower χ). When bond market frictions are present, i.e., when $\chi'(\beta) \neq 0$, 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.

2.3.3 Alternative models

For tractability, the model above makes some stark assumptions. Intuitively, the idea that bond-specific frictions can attenuate the prediction of the bank lending channel is rather general. Nevertheless, we present an alternative model that addresses potential limitations in the Appendix. In particular, renegotiation frictions associated with bond financing were modeled as lower liquidation values in case of default, following Crouzet (2014). However, liquidation is somewhat rare in practice, especially for larger firms that are more likely to issue bonds.

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,[16] 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, bond-specific frictions 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, and Zhang, 2018; Kiyotaki and Moore, 2018; Ajello, 2016; Altavilla, Burlon, Giannetti, and Holton, 2019).[17] 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.[18] We nevertheless acknowledge that any model has its shortcomings and that many other important forces could play a more prominent role, including nominal long-term debt (Gomes, Jermann, and Schmid, 2016), bond supply (Becker and Ivashina, 2015), default risk (Ottonello and Winberry, 2018), or the Fed put (Cieslak and Vissing-Jorgensen, 2017). We also do not explicitly model the general equilibrium effects on inflation, input prices or consumer demand, and much work remains to be done to understand how those forces interact with firms' debt structures.[19]

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

[17] 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.

[18] This appears to be a salient monetary transmission factor through household debt. For instance, Auclert (2019), Di Maggio, Kermani, Keys, Piskorski, Ramcharan, Seru, and Yao (2017), Wong (2019), and Garriga, Kydland, and Šustek (2017) emphasize the role of the stock of long-term fixed-rate mortgages.

[19] Note that only monetary transmission channels that correlate with debt structure are potential confounders in our cross-sectional empirical analysis. Any effect working at the sector level will be absorbed in sector-time fixed effects.

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 extends it to 2018. The period covers a full monetary cycle, as can be seen in Figure 1.

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[21]. OIS swaps exchange the overnight rate, EONIA[22], 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. 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 accurately measure expectations of future short-term interest rates at a horizon between 1 and 24 months in the Eurozone until 09/2007.[23]

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

[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]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.

[22]This 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.

[23]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.

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 primarily drive our result.

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 bond issuance comes from Capital IQ, which contains more granular information regarding the debt structure of firms than what is present in Worldscope. Because the coverage of Capital IQ is sparse at the beginning of the sample, we collect data for 2001 manually.

Our high-frequency cross-sectional approach requires a focus on a subset of large firms. The envelope argument relies on firms maximizing equity values, and on stock markets accurately reflecting 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 high frequencies.[24] The second advantage of this procedure is that it leads to an unbalanced panel that automatically accounts for mergers and acqui-

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

sitions, 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.4 shows that it accounts for about 75% 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 8%[25], 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 67% 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%.

3.2 Model Specification and Identification

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

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

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

[25]This can be compared with about 18% 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 historical reasons have been put forward to explain those differences De Fiore and Uhlig (2011).

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 bond-specific frictions 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 firm 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 variables that affect both debt structure and monetary policy. 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, 2005b; 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. Importantly, a bias arises only from covariates that drive *both* debt structure and firm reactions to monetary policy. Indeed, because our approach is cross-sectional, any channels of monetary policy that are not correlated with debt structure do not affect our estimates. 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.[26]

Our envelope argument shows that a first important confounder is the effect of

[26]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.

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., $\gamma > 0$.[27] To control for this, we lean on recent developments in the asset pricing literature that measure equity duration at the firm level Gormsen and Lazarus (2019) and Weber (2018) 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 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.[28] 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; Lakdawala and Moreland, 2019; Auer, Bernardini, Cecioni, et al., 2019). 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 discuss the role of 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 U.S. Our baseline regressions include log assets, profitability, cash over assets, tangibility, log market to book, debt to income, coverage ratio. Section 3.3 discuses further alternatives.

One might likewise be concerned about potential transmission channels of monetary

[27]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 3.6 is in line with these findings.

[28]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.

policy that affect firms beyond a credit channel, such as consumer demand, labor supply, price stickiness, or exchange rate movements. 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.

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 2, shows that the bonds-over-assets ratio also 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 60 basis points lower stock return relative to firms at the 75th percentile. Column 3 and 4 confirm this result when estimated non-parametrically, by using a bond outstanding dummy and terciles of bonds-over-assets, respectively. Importantly, columns 5 to 8 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. Column 7 shows that the effect on bonds-over-assets remains significant and robust when total leverage is included.[29]

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 bond-specific

[29]This echoes Crouzet and Mehrotra (2017) who show that firms with access to public debt markets display a higher sensitivity to recessions.

frictions in the Eurozone.

Robustness: The results are robust to a variety of model alterations. First, we explore using different definitions of monetary shocks. Table 4 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 7 which excludes information shocks as a separate robustness test of our results. It turns out that the sign, magnitudes, and statistical significance are in line with our baseline results.

Another concern might be that the results are confounded by firm risk and that this risk is correlated with debt structure. Ottonello and Winberry (2018) show that in the United States safer firms are less responsive to monetary policy. Tables 5 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). 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 6.

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 market financing rises relative to bank lending after a rate hike (Becker and Ivashina, 2014; Kashyap, Stein, and Wilcox, 1996; Crouzet, 2019; Lhuissier and Szczerbowicz, 2018; Elliott, Meisenzahl, Peydró, and Turner, 2019).[30] 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

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

monetary tightening. We find similar effects in our sample.

Because firms' debt structure is only observable from financial statements, it means moving away from a pure high-frequency approach. This implies 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 to a quarterly frequency (Ottonello and Winberry, 2018; Corsetti, Duarte, and Mann, 2018; Cloyne, Ferreira, Froemel, and Surico, 2018; Crouzet, 2019). Keeping the regression model close to our high-frequency approach, we estimate local projections following Jordà (2005) for horizons $h \in \{1, \ldots, 8\}$:

$$\Delta y_{i,t+h,t} = \alpha_i + \gamma_{s(i),t} + \beta^h_{Shock} MPShock_t \times TercileBondLev_{i,t-1} + \delta X_{i,t-1} + u_{i,t+h,t} \quad (4)$$

where $\Delta y_{i,t+h,t}$ is the difference over h quarters of the firm specific outcome variable, α_i is a firm fixed effect, $\gamma_{s(i),t}$ is a sector-times-date fixed effect and $MPShock_t \times TercileBondLev_{i,t-1}$ is the monetary policy shock in time t interacted with the tercile of bond leverage at the end of the previous fiscal year. $X_{i,t-1}$ contains firm specific control variables, such as, log assets, cash over assets, ebitda over assets, property plant and equipment over assets, debt-to-income and interest coverage ratio, as well, as two lags of asset growth to proxy for investment opportunities.

Bond issues for firms are observed at a higher frequency. In this case we aggregate the data at a monthly frequency and estimate following model:

$$y_{i,t+h,t} = \alpha_i + \gamma_{q(t)} + \beta^h_{Shock} MPShock_t + u_{i,t+h,t} \quad (5)$$

where $y_{t+h,t}$ is a dummy that equals one if a bond has been issued after h months, α_i is a firm fixed effect and $\gamma_{q(t)}$ is a time (in quarters) fixed effect.

Panel (a) of Figure 4 shows that firms tend to issue more bonds after 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 bond-specific frictions and reduces investment through a precautionary motive. Quantitatively, this channel can explain up to a third 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. To see this, we estimate local projections as in equation 4 with the difference of log quarterly net property, plant, and equipment as the outcome variable, and add an interaction with the firm's bond to assets tercile. Panel (b) of Figure 4 displays the differential effect by moving from one tercile to the next on investment. 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 differences are at best marginally significant. Nevertheless, the point estimates are not small. One year out, a firm in the third tercile of the bonds to assets distribution experiences an about 8 ppt reduction in investment relative to a firm in the first tercile for a shock equivalent to one standard deviation. We take these 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 bond-specific frictions.

3.5 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.[31]

Table 8 shows that bond-financed firms are more affected by monetary tightening in

[31] 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.

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 3.7.

3.6 Comparison with the United States

In the context of external validity, this section draws a comparison with the United States. Existing work has shown somewhat different results. Crouzet (2019) finds that a higher bond share reduces monetary pass-through on investment. Ippolito, Ozdagli, and Perez-Orive (2018) documents a floating-rate channel of monetary policy. Bank-reliant firms' stock price and investment responses are larger, and that difference appears to depend on whether firms hedge their interest rate risk, and how financially constrained they are. All of those findings imply significantly smaller bond-specific frictions, if any, in the United States relative to the Eurozone (De Fiore and Uhlig, 2011).

3.7 Discussion and Implications

We have provided some evidence consistent with bond-specific frictions 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 informational environment is radically different from the United States. 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 over €50M had an S&P rating in Europe, compared to 92% in the U.S. The sparseness of public information makes it difficult for a firm to access capital markets in bad times, which plausibly makes banking relationships more valuable in Europe. Second, we also show that rating downgrades have a stronger effect on Eurozone firms. Figure 5 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 reveals that the difference is large and significant: about five percentage points lower in Europe relative to the United States.[32] 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 not prepared for the rising importance of bond debt (Ehmke, 2018):

> 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.

A key implication is that mitigating bond-specific frictions are necessary for firms to benefit fully from disintermediation. While bond issuance has been rising fast, thanks in no small part to expansionary monetary policy, there is little evidence that the functioning of bond markets has improved at nearly the same speed. This situation creates a genuine concern for Eurozone policymakers, and active efforts to mitigate bond market frictions seem in order. Indeed, this is the explicit objective of the Expert Group on European Corporate Bond Markets that started reporting to the European Commission in 2017. Improving Eurozone corporate bond markets is a crucial component for a successful Capital Markets Union going forward.[33]

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

[32] There is also some concern of secondary market liquidity: evidence suggests that transactions cost indicators exhibit noticeable upward trends since 2014 and those costs have not subsequently decreased. See the EU Commission report on "Drivers of Corporate Bond Market Liquidity in the European Union": https://ec.europa.eu/info/sites/info/files/171120-corporate-bonds-study_en.pdf

[33] For more details, see https://ec.europa.eu/info/publications/171120-corporate-bonds-report_en.

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 bond-specific frictions in the Eurozone, relative to the United States. Alleviating bond market frictions is vital to allowing maximal firm benefits from disintermediation.

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 economy now borrows from the bond market, a trend that influences conventional interest rate policy transmission going forward.

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Appendix A: Figures and Tables

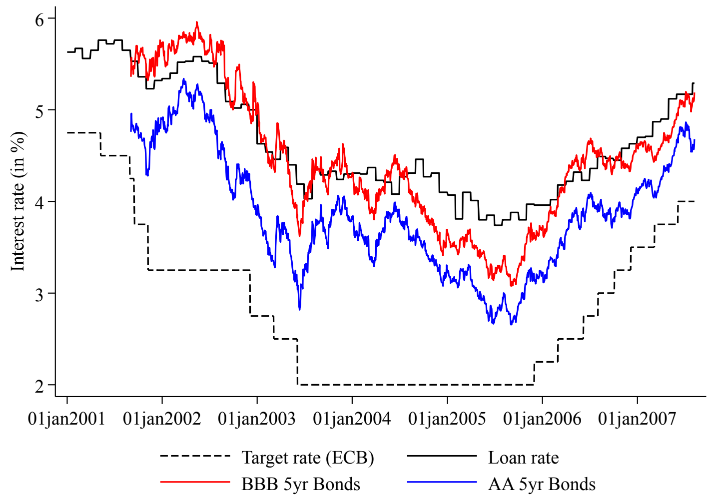


Figure 1 – Debt Yields across Monetary Cycle

Note: Eurozone: ECB target rate from: https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb _interest_rates/html/index.en.html); average loan rate in the Eurozone from the ECB statistical data warehouse: https://sdw.ecb.europa.eu/ quickview.do?SERIES_KEY=124.MIR.M.U2.B.A2A.J.R.1.2240.EUR.N; and yields to maturity for bond portfolios with remaining maturity of 5yr and BBB and AA rating from Bloomberg: BFV 5yr EUR Eurozone Industrial BBB Bond Yield and BFV 5yr EUR Eurozone Industrial AA Bond Yield.

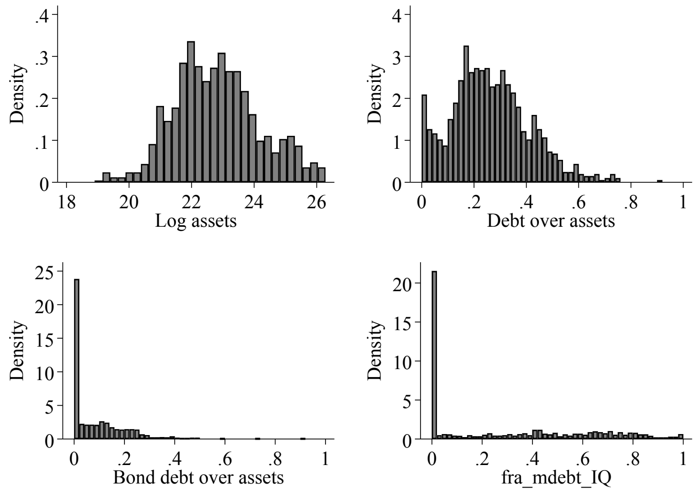


Figure 2 – Histograms

Note: Eurozone: 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 comes from Worldscope and bond debt from Capital IQ.

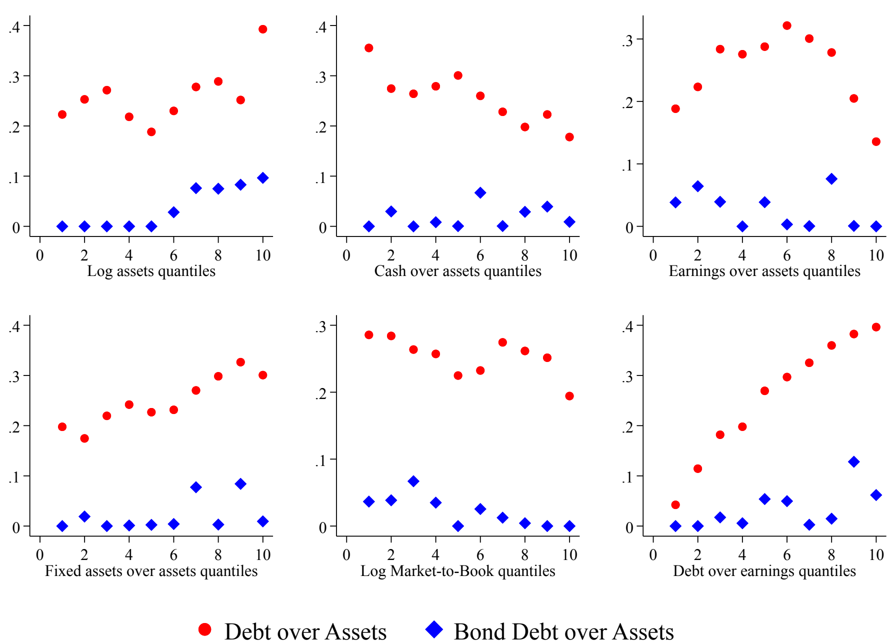
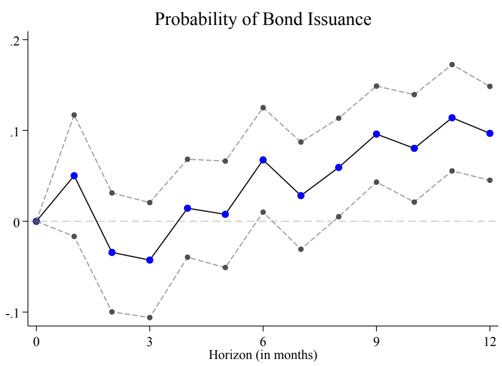
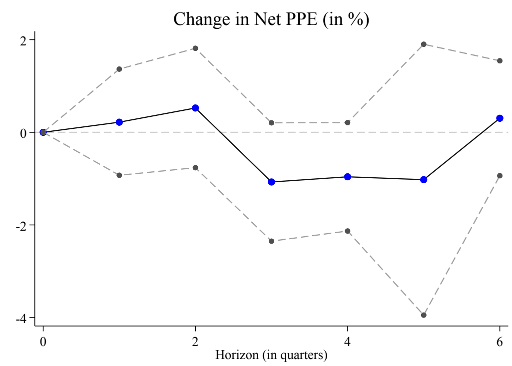


Figure 3 – Cross-sectional Capital Structure

Note: Eurozone: 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 comes from Worldscope and bond debt from Capital IQ.



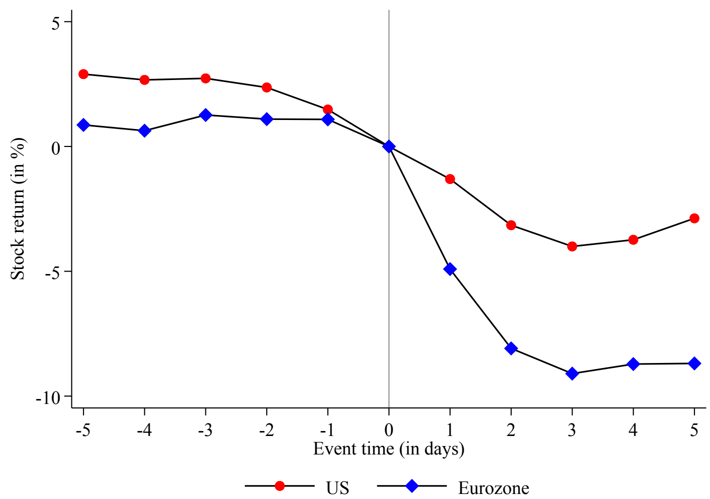
(a) Change in Probability to Issue Bond



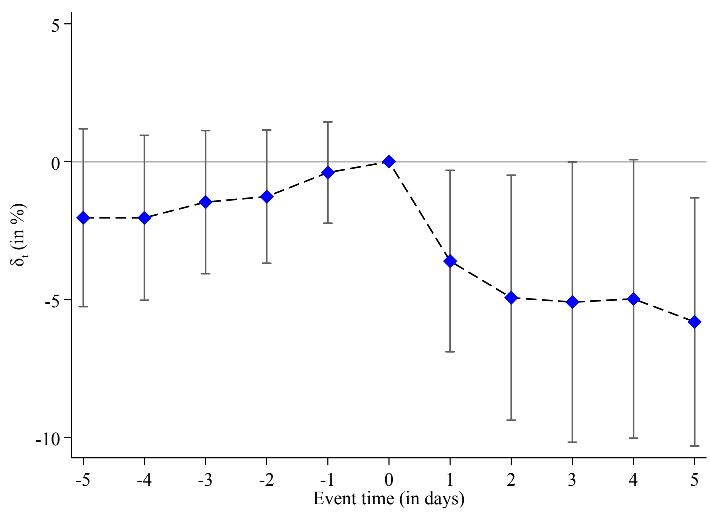
(b) Differential change in Net PPE

Figure 4 – Local Projection Bond Issuance and Net PPE

Notes: The panels show estimates from a local projection following Jordà (2005). Panel (a) uses monthly times series data for which following baseline model is estimated $y_{i,t+h,t} = \alpha_i + \gamma_{q(t)} + \beta^h_{Shock} MPShock_t + \Gamma X_t + u_{t+h,t}$; where $y_{t+h,t}$ is a dummy that equals one if a bond has been issued after h months. Bond issuances data comes from Bloomberg. Panel (b) uses panel-data on the firm-time level. We follow the extension of the local projection method by Mian, Sufi, and Verner (2017) and estimate following model: $\Delta y_{i,t+h,t} = \alpha_i + \gamma_{s(i),t} + \beta^h_{Shock} MPShock_t \times TercileBondLev_{i,t-1} + \delta X_{i,t-1} + u_{i,t+h,t}$; where $\Delta y_{i,t+h,t}$ is the difference over h quarters of the firm specific outcome variable, α_i is a firm fixed effect, $\gamma_{s(i),t}$ is a sector-times-date fixed effect and $MPShock_t \times TercileBondLev_{i,t-1}$ is the monetary policy shock in time t interacted with the tercile of bond leverage at the end of the previous fiscal year. $X_{i,t-1}$ contains firm specific control variables. Standard errors are double clustered at the firm and date level. The dashed lines indicate the 90% confidence interval for the parameter estimates.



(a)



(b)

Figure 5 – Rating Downgrade

Note: 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 $\{\delta_t\}_{t=-5}^{5}$ *of the following model* $(lnP_{it} - lnP_{i0}) * 100 = \sum_{s=-5}^{5} \gamma_s \times \mathcal{I}_{s=t} + \sum_{s=-5}^{5} \delta_s \times \mathcal{I}_{s=t} \times \mathcal{I}_{Europe_i} + \epsilon_{it}$*, where* t *denotes event time and* $\mathcal{I}$ *is the indicator function. Bars indicate the* $\alpha = 0.9$ *confidence intervals.*

	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	53	-0.065	4.67	-20.00	12.50

Table 1 – Summary Statistics Shocks

Note: 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)	15.183	2.544	5.300	12.203	5,413
Cash over assets	0.051	0.020	0.035	0.060	5,413
Earnings over assets	0.145	0.102	0.137	0.187	5,413
Fixed assets over assets	0.260	0.108	0.228	0.381	5,413
Equity duration proxy	11.368	8.220	10.520	13.423	5,413
Market-to-Book	3.419	1.539	2.391	3.913	5,413
Debt over earnings	1.634	0.623	1.822	2.769	5,413
Earnings over interest expenses	21.228	5.617	10.074	18.308	5,413
Debt over assets	0.236	0.128	0.218	0.334	5,413
Debt due within year over debt	0.407	0.190	0.350	0.592	5,413
Bond debt over assets	0.000	0.000	0.000	0.000	5,413
Bond debt over debt	0.000	0.000	0.000	0.000	5,413
Low bond debt					
Assets (in bn)	22.048	3.788	9.336	21.791	3,136
Cash over assets	0.056	0.023	0.041	0.075	3,136
Earnings over assets	0.129	0.078	0.126	0.181	3,136
Fixed assets over assets	0.264	0.112	0.238	0.392	3,136
Equity duration proxy	10.002	5.690	9.150	13.540	3,136
Market-to-Book	2.618	1.338	2.029	3.046	3,136
Debt over earnings	2.878	1.113	1.862	2.817	3,136
Earnings over interest expenses	17.732	6.045	9.894	15.256	3,136
Debt over assets	0.226	0.139	0.207	0.303	3,136
Debt due within year over debt	0.333	0.165	0.309	0.473	3,136
Bond debt over assets	0.062	0.025	0.061	0.098	3,136
Bond debt over debt	0.334	0.143	0.320	0.477	3,136
High bond debt					
Assets (in bn)	33.409	4.494	13.819	37.178	3,461
Cash over assets	0.061	0.023	0.040	0.075	3,461
Earnings over assets	0.109	0.084	0.117	0.153	3,461
Fixed assets over assets	0.276	0.133	0.275	0.390	3,461
Equity duration proxy	10.003	5.600	8.950	13.000	3,461
Market-to-Book	2.555	1.325	2.044	3.141	3,461
Debt over earnings	3.232	1.871	2.684	3.966	3,461
Earnings over interest expenses	9.254	4.485	7.222	11.357	3,461
Debt over assets	0.347	0.252	0.335	0.424	3,461
Debt due within year over debt	0.242	0.130	0.218	0.337	3,461
Bond debt over assets	0.219	0.150	0.202	0.258	3,461
Bond debt over debt	0.642	0.502	0.674	0.790	3,461
Total					
Assets (in bn)	22.228	3.142	8.175	19.982	12,010
Cash over assets	0.055	0.021	0.038	0.068	12,010
Earnings over assets	0.130	0.090	0.127	0.174	12,010
Fixed assets over assets	0.265	0.113	0.244	0.387	12,010
Equity duration proxy	10.618	6.830	9.906	13.230	12,010
Market-to-Book	2.961	1.387	2.219	3.398	12,010
Debt over earnings	2.419	1.112	2.011	3.189	12,010
Earnings over interest expenses	16.864	5.277	8.783	14.518	12,010
Debt over assets	0.265	0.163	0.254	0.357	12,010
Debt due within year over debt	0.340	0.156	0.284	0.470	12,010
Bond debt over assets	0.079	0.000	0.016	0.134	12,010
Bond debt over debt	0.272	0.000	0.080	0.552	12,010

Table 2 – Eurozone Firms Balance Sheet Summary Statistics

Note: The table presents summary statistics for 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. The subsamples "No bond debt", "Low bond debt" and "High bond debt" to corresponds to the terciles of the bonds-over-assets ratio, recalculated every year. Balance sheet data comes from Worldscope, bond issuance comes from Capital IQ, and stock market information comes from Datastream.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ OIS1M × Debt over assets	0.116				1.103	1.391	2.192	
	(3.964)				(4.342)	(3.733)	(4.394)	
Debt over assets	33.16				34.97	37.62	42.64	
	(38.07)				(37.67)	(36.83)	(40.07)	
Δ OIS1M × Bond debt over assets		-18.49***					-19.71***	-21.61***
		(4.936)					(5.169)	(6.198)
Bond debt over assets		-8.986					-19.52	-15.80
		(26.86)					(29.02)	(28.49)
Δ OIS1M × Bond Issued			-2.714**					
			(1.049)					
Bond Issued			-12.64**					
			(4.952)					
Δ OIS1M × Tercile of bond debt over assets				-1.513***				
				(0.545)				
Tercile of bond debt over assets				-3.108				
				(2.792)				
Δ OIS1M × Bond debt over debt					-5.723**			
					(2.820)			
Bond debt over debt					-5.130			
					(7.948)			
Δ OIS1M × Tercile of bond debt over debt						-1.735**		
						(0.729)		
Tercile of bond debt over debt						-4.612*		
						(2.768)		
R^2	0.380	0.380	0.381	0.380	0.380	0.381	0.381	0.381
Duration control	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓	✓	✓	✓
Lev. Quintile Interaction								✓
Observations	11635	11635	11635	11635	11635	11635	11635	11635

Table 3 – Eurozone Debt Structure and Monetary Policy Shocks

*Note: This table presents regression results for estimating Equation 3 using different measures of bond debt as interacted variable X. 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. Balance sheet data comes 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.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ OIS1M $\times$ Bond debt over assets	-18.49***							
	(4.936)							
Δ OIS1M $\times$ Bond debt over debt		-5.723**						
		(2.820)						
Δ OIS1M $\times$ Debt over assets		1.103						
		(4.342)						
Δ OIS3M $\times$ Bond debt over assets			-24.72***					
			(4.193)					
Δ OIS3M $\times$ Bond debt over debt				-6.451***				
				(2.150)				
Δ OIS3M $\times$ Debt over assets				1.502				
				(4.182)				
Δ OIS1M Corsettietal $\times$ Bond debt over assets					-19.85***			
					(2.526)			
Δ OIS1M Corsettietal $\times$ Bond debt over debt						-6.120***		
						(2.211)		
Δ OIS1M Corsettietal $\times$ Debt over assets						0.143		
						(3.734)		
Δ OIS3M JK $\times$ Bond debt over assets							-19.67**	
							(8.185)	
Δ OIS3M JK $\times$ Bond debt over debt								-4.536*
								(2.576)
Δ OIS3M JK $\times$ Debt over assets								-0.596
								(4.749)
R^2	0.380	0.380	0.380	0.380	0.381	0.381	0.380	0.380
Shock								
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector $\times$ Date FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	11635	11635	11635	11635	11635	11635	11635	11635

Table 4 – Eurozone Other MP Shocks

*Note: This table presents regression results for estimating Equation 3 using different measures of bond debt as interacted variable X, 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. Balance sheet data comes 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.*

	(1)	(2)	(3)	(4)
High Yield	18.23	18.62	20.01	20.22
	(12.85)	(12.73)	(12.95)	(13.05)
IG below AA	11.30	11.38	11.43	11.57
	(9.110)	(9.077)	(9.150)	(9.113)
IG AA and above	11.22	10.86	11.28	11.53
	(12.56)	(12.53)	(12.26)	(12.37)
High Yield × Δ OIS1M	9.452*	10.32*	10.37*	10.55*
	(5.316)	(5.717)	(5.796)	(5.363)
IG below AA × Δ OIS1M	-1.639*	-1.173	-1.566	-1.636
	(0.970)	(1.042)	(1.416)	(1.277)
IG AA and above × Δ OIS1M	-3.570**	-3.500**	-3.634**	-3.582**
	(1.510)	(1.544)	(1.742)	(1.698)
Δ OIS1M × Bond debt over assets		-19.52***	-21.33***	
		(5.977)	(6.040)	
Bond debt over assets		-10.31	-21.65	
		(26.62)	(28.89)	
Δ OIS1M × Debt over assets			4.254	3.203
			(5.077)	(5.269)
Debt over assets			44.45	36.12
			(40.54)	(38.48)
Δ OIS1M × Bond debt over debt				-6.446**
				(3.068)
Bond debt over debt				-6.094
				(8.125)
R^2	0.381	0.381	0.381	0.381
Duration control	✓	✓		
Firm FE	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓
Observations	11635	11635	11635	11635

Table 5 – Eurozone Rating Categories and MP Shocks

*Note: This table presents regression results for estimating Equation 3 using different measures of bond debt as interacted variable X, adding interactions with rating categories (Unrated is the excluded category). 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. Balance sheet data comes 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.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δ OIS1M × Debt over assets	-1.973				-1.344	-1.053	-0.534
	(2.862)				(3.739)	(3.065)	(4.452)
Debt over assets	25.98				26.94	30.53	32.54
	(38.69)				(38.36)	(37.84)	(39.84)
Δ OIS1M × Bond debt over assets		-13.71**					-13.43**
		(6.405)					(6.386)
Bond debt over assets		-5.375					-13.31
		(29.48)					(30.69)
Δ OIS1M × Bond Issued			-1.840**				
			(0.859)				
Bond Issued			-13.20**				
			(5.572)				
Δ OIS1M × Tercile of bond debt over assets				-1.078**			
				(0.453)			
Tercile of bond debt over assets				-3.594			
				(3.060)			
Δ OIS1M × Bond debt over debt					-3.613		
					(2.201)		
Bond debt over debt					-2.191		
					(8.203)		
Δ OIS1M × Tercile of bond debt over debt						-1.191**	
						(0.565)	
Tercile of bond debt over debt						-4.740	
						(2.853)	
R^2	0.226	0.226	0.226	0.226	0.226	0.226	0.226
Firm FE	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓	✓	✓
Lev. Quintile Interaction							
Observations	11544	11544	11544	11544	11544	11544	11544

Table 6 – Eurozone - Abnormal Returns

*Note: This table presents regression results for estimating Equation 3 using different measures of bond debt as interacted variable X. 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. Balance sheet data comes 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.*

	(1)	(2)	(3)	(4)	(5)
Δ OIS3M JK × Bond debt over assets	-18.92*				-22.27***
	(9.427)				(6.948)
Bond debt over assets	-40.27				-63.37
	(43.13)				(51.25)
Δ OIS3M JK × Tercile of bond debt over assets		-1.240			
		(0.771)			
Tercile of bond debt over assets		1.367			
		(5.023)			
Δ OIS3M JK × Bond debt over debt			-4.997**		
			(2.442)		
Bond debt over debt			-7.723		
			(14.11)		
Δ OIS3M JK × Debt over assets			4.609	4.840	6.231
			(5.468)	(5.449)	(5.638)
Debt over assets			86.21	87.55	111.9*
			(59.37)	(58.70)	(60.16)
Δ OIS3M JK × Tercile of bond debt over debt				-1.608**	
				(0.643)	
Tercile of bond debt over debt				-3.350	
				(4.482)	
R^2	0.402	0.409	0.409	0.409	0.409
Duration control	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓
Observations	6735	6560	6560	6560	6560

Table 7 – Eurozone Debt Structure - No Information Shocks

*Note: This table presents regression results for estimating Equation 3 using different measures of bond debt as interacted variable X. 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. Balance sheet data comes 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.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ OIS1M × Debt over assets	-24.46				-18.65	-22.02	10.85	
	(19.01)				(19.35)	(19.15)	(25.38)	
Debt over assets	134.8**				126.6**	128.3**	160.9**	
	(57.02)				(55.84)	(56.33)	(67.11)	
Δ OIS1M × Bond debt over assets		-55.36***					-64.35***	-41.63***
		(13.01)					(18.04)	(14.46)
Bond debt over assets		9.109					-66.43	-21.72
		(45.84)					(55.38)	(51.45)
Δ OIS1M × Bond Issued			-14.29**					
			(5.656)					
Bond Issued			-5.454					
			(10.05)					
Δ OIS1M × Tercile of bond debt over assets				-9.569***				
				(1.652)				
Tercile of bond debt over assets				-0.252				
				(5.000)				
Δ OIS1M × Bond debt over debt					-12.45**			
					(4.944)			
Bond debt over debt					-22.91			
					(17.05)			
Δ OIS1M × Tercile of bond debt over debt						-3.630		
						(2.232)		
Tercile of bond debt over debt						-6.182		
						(5.818)		
R^2	0.421	0.421	0.421	0.421	0.421	0.421	0.421	0.421
Duration control	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector × Date FE	✓	✓	✓	✓	✓	✓	✓	✓
Lev. Quintile Interaction								✓
Observations	8668	8668	8668	8668	8668	8668	8668	8668

Table 8 – Eurozone Post Crisis

*Note: This table presents regression results for estimating Equation 3 using different measures of bond debt as interacted variable X. 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. Balance sheet data comes 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.*

Internet Appendix

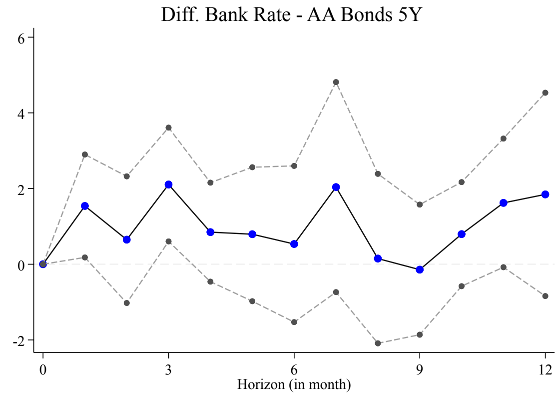


Figure IA.1 – Loan rates vs. AA bond yields

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 multiple lags of the dependent variable. The dashed lines indicate 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.

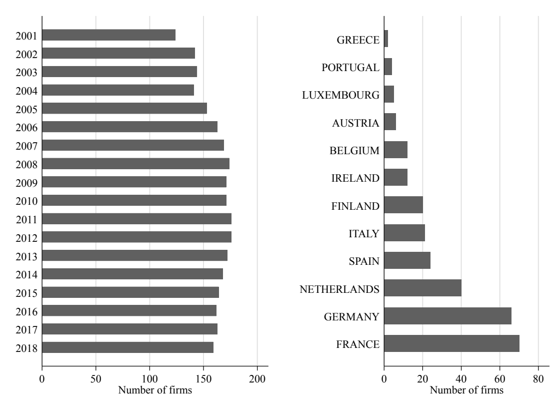


Figure IA.2 – Sample Description

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.

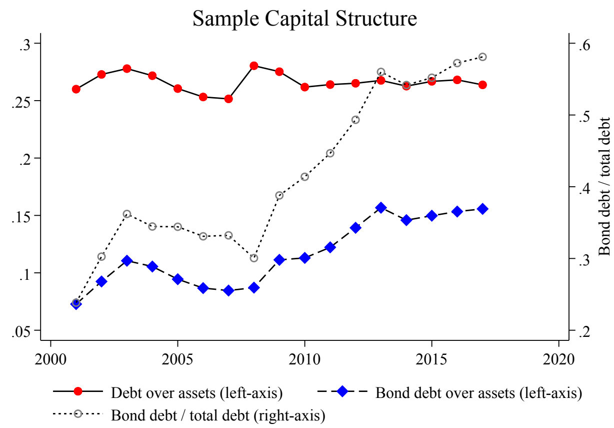


Figure IA.3 – Sample Capital Structure

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.

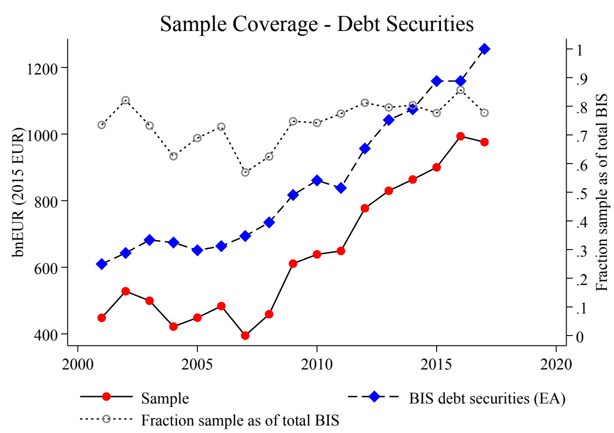


Figure IA.4 – Sample Coverage Debt Securities

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.

Appendix B: Alternative Model

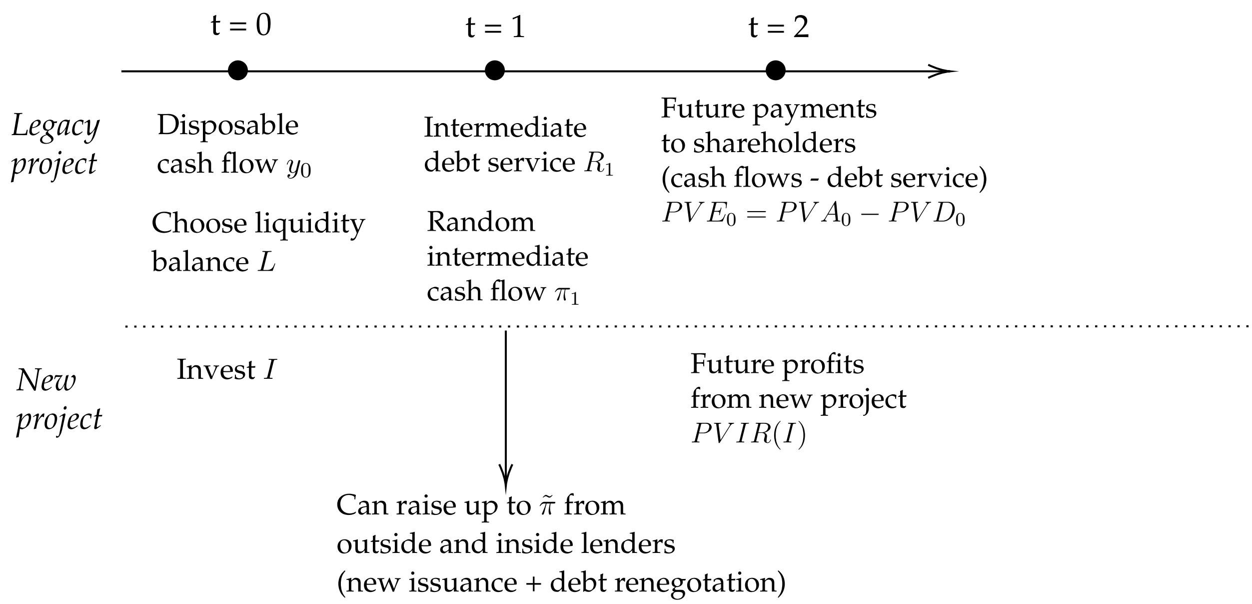


Figure IA.5 – Timeline

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.5 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.[34]

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

[34]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, $R(I)PVI = R(I)/(\rho - g)$.

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 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:

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

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

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

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:

$$\frac{\text{dEquity}}{\text{d}r^f} = \underbrace{\left\{\frac{\partial PVE_0}{\partial r^f} + R(I^*)\frac{\partial PVI}{\partial r^f}\right\}}_{\text{equity duration}} - \underbrace{\lambda}_{\text{shadow value of liquidity}} \times \underbrace{\frac{\partial R_1}{\partial r^f}}_{\text{interest rate pass-through}} \tag{6}$$

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.[35] The other term is the shadow value of the liquidity constraint. Importantly, firms that face greater liquidity risk have a larger shadow value

[35]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.

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 (multiform) 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 bond-specific frictions 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 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.