The Bond Lending Channel of Monetary Policy

Olivier Darmouni
Columbia Business School

Oliver Giesecke
Columbia Business School

Alexander Rodnyansky
University of Cambridge

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Abstract

An increasing share of firms' borrowing occurs through bond markets. We present high-frequency evidence from the Eurozone that bond-reliant firms are more responsive to monetary shocks: in contrast to standard bank lending channel predictions, unexpected ECB policy changes affect their stock prices by more, even conditional on total debt and industry fixed-effects. We develop an organizing framework to decompose the stock price and investment response of large firms. We emphasize the role of corporate liquidity management: firms react to rate hikes by being prudent in good times, reducing investment in favor of hoarding liquid assets. Since bond financing is less flexible in bad times than relationship banking, this effect can rationalize why the mix of bank and bond financing matters for monetary transmission. A mitigating force is that bonds generally have longer duration and lower interest-rate pass-through relative to loans. Our findings suggest that the recent global growth in bond debt following quantitative easing could interact with conventional interest rate policy going forward.

Keywords: Monetary policy, ECB, Debt Structure, Bank loans, Corporate bonds, liquidity management, liquidity premium
JEL codes: E44, E52, G21, G23

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' financial liabilities play an important role.[1] A (multiform) "bank lending channel" is the predominant view to understand the financial transmission of monetary policy. However, bond debt has been rising at the expense of bank lending in recent years, possibly in part because of stricter bank regulation.[2] 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 almost doubled between 2000 and 2016. Whether monetary transmission depends on the bond-bank share is thus an open and consequential issue—indeed, the stock of bond debt has become a major concern for central bankers.[3]

Importantly, bond financing and bank loans are not perfect substitutes: the corporate finance literature emphasizes that market debt is more rigid and harder to renegotiate relative to bank loans, or "relationship financing" (Bolton and Scharfstein, 1996). Unlike bonds, bank loans are provided by levered intermediaries with significant liquidity mismatch and tend to have different contractual characteristics, such as maturity, interest rate fixation, or seniority among others. Even though bond financing reduces the exposure of the economy to problems in the banking sector, little is known about the role it plays in the transmission of other aggregate shocks, and, in particular, monetary policy. On the empirical front, investigating this channel is challenging because monetary policy is endogenous and correlated with many drivers of firm choices, which obfuscates identification (Nakamura and Steinsson, 2018b). The conceptual front is equally challenging: there are multiple channels for which the difference between bonds and loans can matter for monetary transmission.

[1] Indeed, a growing number of papers have emphasized the role of firm liabilities in shaping the response of the economy to aggregate shocks (Jiménez, Ongena, Peydró, and Saurina (2012), Giroud and Mueller (2017), Crouzet (2017), Gomes, Jermann, and Schmid (2016) or Ottonello and Winberry (2018)).

[2] For example, Eber and Minoiu (2016) show that regulation can lower bank lending.

[3] 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 maybe at risk of being downgraded, creating dislocations."

This paper makes two contributions. First, it provides high-frequency evidence on the role of firms' debt composition in the transmission mechanism of monetary policy in the Eurozone. Using stock market reactions to monetary policy shocks, we show that firms with more bond debt are disproportionately affected by unexpected ECB interest rate changes. This fact survives a myriad of robustness checks and holds within sectors and controlling for total debt. Interestingly, this pattern is difficult to rationalize with existing theories of the bank lending channel, or with explanations based on duration since bonds are predominantly long-term, fixed-rate liabilities. The second contribution is, therefore, to provide an organizing framework to decompose the response of large firms. We argue that adopting a rich corporate finance perspective is necessary to understand the role of debt composition. Firms have long-term debt obligations and face uncertain cash-flow shocks, leading to a demand for holding liquid assets ("money demand"). In addition to classical bank lending and cost of capital channels, we emphasize the role of corporate liquidity management: firms react to rate hikes through prudence in good times, reducing investment in favor of hoarding liquid assets. Since bonds are harder to renegotiate in bad times relative to relationship banking, this effect can rationalize our main finding. The recent growth in corporate bond issuance following quantitative easing can thus impact the transmission of conventional monetary policy.

To investigate empirically the role of debt composition in the transmission process, we construct a panel that combines information on ECB announcements, asset prices, firm balance sheets and financing choices in the Eurozone. Our empirical strategy is based on high-frequency identification that leverages both time series and cross-sectional variation. We focus on conventional monetary policy between 2001 and 2007, from the early years of the Euro to the beginning of the financial crisis. We follow Corsetti, Duarte, and Mann (2018) and construct identified monetary policy shocks using quasi-intraday data on interest swaps. These shocks capture the surprise content of ECB announcements and are hence little affected by general macro-economic information that did not fall on that specific time window of the day. We combine this time series of identified monetary shocks with cross-sectional variation at the firm level, relying on the firm's short-term stock market response as a measure of its exposure to monetary policy. Balance sheet information is merged with comprehensive corporate bond issuance data to measure the reliance of firms on bond financing.

We find strong evidence that debt composition matters for the transmission of monetary policy: firms with more bond debt are relatively more affected by surprise interest rate changes. This finding holds true when we control for total debt and sector-specific sensitivities to monetary policy.[4] Quantitatively, after a one percentage point increase in interest rates, firms in the bottom quartile of the bonds over assets distribution have a 2.3 percentage point lower stock return relative to firms in the top quartile.[5] This echoes Crouzet and Mehrotra (2017) who show that firms with access to public debt markets display a higher sensitivity to recessions. A number of robustness tests confirm this fact. Moreover, the strong forecasting power of bond debt for the cross-sectional response is not attenuated by the inclusion of traditional balance sheet covariates that are thought to drive bond financing or the response to monetary policy.

What economic mechanism can explain this special role of bond debt in transmitting monetary policy? Two canonical explanations have trouble rationalizing this finding. The first relates to the (multiform) bank lending channel, often phrased in terms of an *interest rate pass-through* to borrowers (Wang, Whited, Wu, and Xiao, 2018). Because banks are levered intermediaries issuing liquid deposits to fund illiquid loans, they are affected by monetary policy in specific ways.[6] However, irrespective of the exact channel, this type of explanation would imply, in contrast to our main findings, that bond-reliant firms are relatively less responsive. A second set of explanations focuses on *duration*: market values are forward looking and thus sensitive to changes in the discount rate. Duration is key to the asset pricing literature (Gormsen and Lazarus, 2019), as well as to the standard "balance sheet channel", in which rate hikes depress collateral values and reduce borrowing capacity. Once again, this force goes in the opposite direction of our findings, as bonds have longer duration relative to loans, and are far less likely to be collateralized.

To understand the role of debt composition, we provide an organizing framework that highlights the role of corporate liquidity for the transmission of monetary policy.[7] Firms

[4]A number of potential transmission channels of monetary policy can affect firms indirectly, independently of their liabilities. Important examples include changes to consumer demand or labor supply. However, it is likely that those channels operate mainly at the sectoral level and are netted out in a within-sector, across-firm specification.

[5]The sample standard deviation of stock returns on monetary announcement days is 2.5%.

[6]Classical views stress the role of reserves and capital, whereas more recent theories emphasize market power (Drechsler, Savov, and Schnabl, 2017), floating loan rates (Ippolito, Ozdagli, and Perez-Orive, 2018), or interest coverage covenants (Greenwald, 2019).

[7]Corporate liquidity has been recognized a salient force in recent work on the monetary transmission process (Rocheteau, Wright, and Zhang, 2018; Kiyotaki and Moore, 2018; Acharya and Plantin, 2019; Al-

have long-term debt obligations while uncertainty about future cash-flow shocks creates a demand for hoarding liquid assets at the expense of investment. Debt composition is pivotal because bonds are held by a dispersed base of investors, which makes renegotiation difficult due to a coordination problem across creditors (Bolton and Scharfstein, 1996). Relative to banking relationships, market financing is less flexible in bad times and leaves firms more exposed to temporary cash-flow shocks and the risk of financial distress or illiquidity (Crouzet, 2017; Bolton, Freixas, Gambacorta, and Mistrulli, 2016; De Fiore and Uhlig, 2015).[8] While extensive evidence shows that monetary shocks affect crucial macroeconomic variables such as the real risk-free rate, the cost of credit, or the liquidity premium, our analysis focuses on how those macro-elasticities are transmitted heterogeneously across firms. We argue that a full understanding of the role of debt composition requires the unification of three forces in the monetary transmission process: a cost of capital channel (*duration*), a credit channel (*interest rate pass-through*), and a liquidity management channel.

The framework delivers three results. First, we decompose a firm's response to changes in interest rates as three terms representing each of the aforementioned channels. The decomposition holds for the stock price, as well as investment and liquid assets. The intuition behind the liquidity management channel is as follows: rate hikes raise the cost of debt and the price of liquid assets, which increases exposure to potential future temporary shocks. Firms react to this increase in liquidity risk by being prudent in good times, reducing investment in favor of hoarding liquid assets. Importantly, this type of liquidity management takes place even when firms are far from their borrowing constraints and financial distress. Second, we use this decomposition to explain why the effect of monetary policy can vary across firms with different sources of financing. In terms of stock price reactions, the duration and interest rate pass-through mechanisms suggest that bond-reliant firms should be less responsive whereas the liquidity management channel predicts oth-

tavilla, Burlon, Giannetti, and Holton, 2019). Looking beyond the corporate sector, other papers argue that liquidity management in the financial sector 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 drive the effect of monetary policy in a quantitative HANK model.

[8]The rigidity of bond debt is the backbone of existing theories of bank loans versus bonds, or relationship versus market financing. Moreover, there is ample evidence that bank loans are significantly easier to renegotiate than bonds (Gilson, John, and Lang, 1990; Asquith, Gertner, and Scharfstein, 1994; Denis and Mihov, 2003).

erwise. Indeed, since bonds are harder to renegotiate in bad times relative to relationship banking, bond-reliant firms have, *ceteris paribus*, a higher shadow value of liquidity. The total effect is conceptually ambiguous, but our evidence suggests that the latter dominates in the Eurozone. Finally, we show how debt composition matters for the response of real variables to monetary policy. While liquidity concerns amplify the standard reduction in investment, the effect on liquid assets and credit risk is less sharp. Prudent firm behavior implies that a deterioration in financial positions is *endogenously* contained via preventive measures. Interpreting reduced-form evidence on slow-moving variables can, therefore, be difficult without the lens of a model.

The chief implication of our findings is that macroeconomic models would benefit from featuring debt structure more prominently, and, in particular, the mix of bonds and bank loans. Sources of external financing are not perfect substitutes and the underlying tradeoffs affect the pass-through of monetary policy. For large firms, investment, debt and liquidity policies are jointly determined. "Financial frictions" are best modeled as a liquidity management problem, in which firms plan ahead in order to avoid future financial distress, as opposed to simple borrowing constraints that are binding every period. Recognizing the multidimensional nature of long-term debt obligations is, therefore, vital to assessing the effectiveness of monetary policy. Meanwhile, debt structure is driven by past financing patterns, which are in turn determined by past policies. This implies a path-dependence to the actions of central banks: episodes of quantitative easing and low interest rates bring about a larger reliance on corporate bond financing, a trend that influences how conventional monetary policy operates going forward.

Related literature

This paper relates to literature on the macroeconomic implications of corporate debt structure, and, more specifically, on the choice between bond and bank debt. Crouzet (2017) and Crouzet (2014) show that the optimal mix of bonds versus loans varies in the cross-section of firms and that this fact has implications for investment dynamics. Crouzet and Mehrotra (2017) find that U.S. bond issuers are more sensitive to recessions. De Fiore and Uhlig (2015, 2011) also study the choice of debt type in a macroeconomic context and show that it played a role in Europe during the financial crisis. Kashyap, Stein, and

Wilcox (1996) and Bolton and Freixas (2006) suggest that monetary policy pass-through depends on the composition of external finance, although the mechanism is very different. Lhuissier and Szczerbowicz (2018) provide recent evidence on monetary policy influencing firms' choice of debt structure.

We emphasize the role of bond debt rigidity, following classical theoretical (Bolton and Scharfstein, 1996; Diamond, 1991; Rajan, 1992) and empirical contributions. We further complement papers that show how 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). We relate to an extensive literature on corporate liquidity management (see Almeida, Campello, Cunha, and Weisbach (2014) for a survey), and particularly to recent work stressing the role of corporate finance in monetary transmission (Rocheteau, Wright, and Zhang, 2018; Acharya and Plantin, 2019; Cloyne, Ferreira, Froemel, and Surico, 2018).

In terms of its findings, this paper aligns with the growing consensus that monetary policy transmission is heterogeneous across firms, and specifically that financial positions play a role. For instance, Ottonello and Winberry (2018) show that leverage and distance to default drives U.S. firm investment reactions to monetary shocks, while Jeenas (2018) emphasizes the role of cash holdings. Ippolito, Ozdagli, and Perez-Orive (2018) provide evidence on a floating rate channel of monetary policy in the United States. 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. Greenwald (2019) describes a covenant channel of monetary transmission. Our paper is also related to the literature on the bank lending channel of monetary policy (Kashyap and Stein, 2000; Jiménez, Ongena, Peydró, and Saurina, 2012), the link between corporate default with the macroeconomy (Giesecke, Longstaff, Schaefer, and Strebulaev, 2014; Bhamra, Kuehn, and Strebulaev, 2010), reach for yield in the bond market (Becker and Ivashina, 2015) as well as the risk-taking channel of monetary policy (Paligorova and Santos, 2017).

In term 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). The most related work in this area describes heterogeneous reactions of stocks to high-frequency monetary shocks based on a broad set of balance sheet characteristics (Ozdagli (2018), Ozdagli and Velikov (2019) and Haitsma, Unalmis, and de Haan (2016)), while Andreson and Cesa-Bianchi (2018) studies the response of credit spreads. In contrast, we focus on the role of bond financing.

2 Background and Data

2.1 Monetary policy in the Eurozone

The main focus of our empirical analysis is on conventional monetary policy in the Eurozone between 2001 and 2007. During this period, the Euro is well-established as a currency and the financial turmoil preceding the Great Recession has not yet reached the continent.[9] Moreover, the period covers a full monetary cycle, as can be seen in Figure 1 which displays the ECB's main refinancing rate.

Needless to say, the stance of monetary policy is influenced by economic conditions and interest rates are correlated with many macroeconomic aggregates. Therefore, to estimate the effect of monetary policy on firms, we construct identified monetary policy shocks using high-frequency data on asset prices.

Construction of monetary shocks: We follow Corsetti, Duarte, and Mann (2018) and construct a time series of monetary policy shocks using quasi-intraday data on overnight interest swaps (OIS swaps). OIS swaps exchange the overnight rate, EONIA, against a fixed rate for an agreed period. At the point of contracting, the fixed rate represents the geometric average of the expected overnight rate over the contract period. 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

[9]The Euro was formally introduced on 01/01/1999 which locked all national currencies at a fixed rate to the Euro. Contemporaneously, the ECB started to set its target rate. The initial period was associated with great 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. The end of the sample period, July 2007, is dictated by OIS swap rate becoming increasingly uninformative about monetary policy with the onset of the financial crisis. For a discussion of monetary transmission below the zero lower bound, see Heider, Saidi, and Schepens (2019).

months in the Eurozone until 09/2007.[10] Following Corsetti, Duarte, and Mann (2018), we exploit the closing times of the Tokyo and London stock exchange to obtain changes in the OIS swap rate in a narrow time frame around the monetary policy announcement. Specifically, we construct the monetary policy shock as the difference in the fixed rate of the 1-month OIS swap in the 6 hour (13.00–19.00 CET) window surrounding the ECB monetary policy announcement. Using this procedure, a positive shock corresponds to a surprise increase, i.e., a monetary tightening. Closing data from the Tokyo and London stock exchange are obtained via Bloomberg.

There are 92 ECB meetings between January 2001 and July 2007. The shock is summarized in Figure 2 and Table 1. Many shocks are a few basis points, suggesting that monetary policy announcements were anticipated by the market. On the other hand, there were a significant number of occasions when the ECB conference 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. The rate cut following the September 11th attack is an outlier, with a surprise of forty basis points. While there is reason to believe that this was a genuine monetary shock in Europe, our results are robust to excluding this particular day. Our results are also robust to using other definitions of monetary shocks, such as, daily differences in the EURIBOR or OIS rate.

Aggregate and sector-level evidence: To validate the economic significance of our shock for firms, we show that it significantly impacts stock markets. We run daily regressions of different stock market indices on our monetary shock series. We consider Eurozone-wide, national, as well as sectoral indices. Table 1 presents summary statistics for index returns on monetary policy announcement days and other days. Panel A of Table 2 shows evidence at the aggregate stock market level. Overall, Eurozone and national indices react strongly to surprise monetary announcements. Panel B of Table 2 shows that the effect is heterogeneous across industries, an effect we explore in more detail in our main firm-level analysis below.

Firm-level data: We combine different data sources in order to create a panel of European firms during our period of interest. Balance sheet items come from Thomson

[10] The Eurozone money market underwent significant stress post 09/2007; we have chosen the sample period such that the identified monetary shocks are unaffected by this.

Reuters Worldscope and stock information from Datastream. Information on bond issuance comes from SDC Platinum. An alternative to the balance sheet information from Worldscope is the Capital IQ database. Capital IQ contains more granular information regarding the debt structure of firms than what is present in Worldscope.[11] One drawback of Capital IQ is that it gained increasing popularity more recently which makes its coverage limited and somewhat unreliable towards the beginning of our sample. We use it primarily as an additional source to validate the construction of some of the debt variables.[12]

From a methodological point of view, investigating the transmission of monetary policy through firms is further complicated by the fact that both the ECB and firm choices are affected by overlapping aggregate factors. The solution we take in this paper is to follow a high-frequency identification strategy and study short-term changes in asset prices. Specifically, a stock price reaction to unexpected ECB announcements can be used to measure how affected a company is by monetary policy, while limiting the effects of confounding factors. By design, the analysis, therefore, focuses on publicly listed firms whose stocks are traded in an exchange. Moreover, it is necessary for the analysis to have enough power so that the stocks of those firms are sufficiently liquid. Otherwise, information from ECB announcements might be slowly incorporated into prices, compromising identification. This is an important concern in Europe, where many publicly listed stocks are traded infrequently.

For this reason, we construct our sample of firms in the following way. For each date, we restrict attention to firms which are part of one of the EURO STOXX sectoral stock indices, excluding financials and utilities. Together these indices constitute over three quarters of the market capitalization of listed firms in the Eurozone. Because the constituents list of each index is outside of the researcher's control, using this criterion for inclusion in the sample has at least two advantages. First, it leads to an unbalanced panel to automatically account for mergers and acquisition, as well as the rise of new industry leaders or the demise of former incumbents. Second, it guarantees that those firms are perceived as the largest actors of their respective sectors and are monitored carefully by

[11] Note that we cannot measure bank debt directly. For clarity of exposition, we nevertheless refer to non-bond debt as bank debt. In practice, most non-bond long-term debt issued by corporation is relationship financing, in the forms of credit lines, term loans or capital leases.

[12] Our measure of bond debt from SDC is over 85% correlated with that of Capital IQ.

analysts and market participants during the day. In both dimensions, we do not have to rely on an arbitrary cut, say, on firm size or price volatility to select our sample of firms.[13] This leaves us with an unbalanced panel of 260 firms between 2001 and 2007.[14] As further evidence that our firm panel captures the relevant macro variation, Table 9 in the Online Appendix shows that we can replicate the aggregate stock market results in weighted firm-level regressions.

2.2 Summary Statistics

Four striking patterns emerge, as can be seen in the summary statistics in Table 3 and the corresponding histograms in Figure 4. The first fact is that there is considerable heterogeneity in financial positions and debt mix across firms. Even within our sample of large European public firms, the debt to assets ratio ranges from 16% at the 25th percentile to 36% at the 75th percentile. Similarly, the fraction of debt that is due within one year varies analogously: from 16% to 48% moving from the first to the third quartile.

Second, the median bond debt to asset ratio is relatively low at 5% in the Eurozone. This is a well-documented fact, sometimes referred as a European "bank bias" (Langfield and Pagano, 2016). The low level persists today in spite of some recent upward trend and convergence to the United States.[15] Institutional and historical reasons have been put forward to explain those differences. In this paper, we take it as given and exploit the fact that a substantial fraction of large European firms rely on bank financing. Note also that credit ratings have a significantly smaller penetration relative to the United States. For instance, the ECB estimates that in 2004 only about 11% of firms with turnover over €50m have an S&P rating, compared to 92% in the United States.[16]

Going forward, it is convenient to classify firms in the Eurozone into three even-sized categories that correspond to the three terciles of bond debt over debt ratios. The first group has (virtually) no bond debt: the 75th percentile has zero bond debt, and the mean

[13]Nevertheless, although avoiding injecting researchers' subjectivity into the analysis is beneficial, it does not mean that the selection procedure is absolutely free of bias.

[14]As an alternative to the preceding selection based on indices, we selected the top 500 firms by market capitalization in each year. This yields a broader sample with 635 distinct firms. The main results are very similar and can be requested from the authors.

[15]Between 2000 and 2016, the share of bond financing for nonfinancial corporations increased from 9 to 17 percent in Europe, versus 19 to 34 percent in the United States (McKinsey, 2018).

[16]For more details, see Von Beschwitz and Howells (2016).

holds only two percent of its debt in bonds. The middle category has low bond debt: the median bond debt over debt is 25%. The last category has high bond debt: for the median firm, bonds represents 64% of its total debt.

Finally, all firms, including those with high bond debt, are potentially exposed to changes in interest rates. In addition to the mechanical pass-through of interest rates for floating rate debt, firms' valuation is affected by potential discount rate changes induced by monetary policy. Duration is a summary statistic of how sensitive the valuation of debt liabilities is to interest rate changes. Interestingly, floating rate debt securities tend to have shorter duration; and hence are less sensitive to interest rate changes, since the cash flow effect and the discount rate effect offset each other partially. As a consequence, floating rate debt tends to have a larger cash flow effect but interest rate changes affect the debt valuation less. Overall, we see a rich debt structure in our sample: that is, firms have significant amounts of short-term and long-term debt and bank and bond debt. Figure 5 illustrates the median debt structure for each of the three categories of bond dependence. For instance, even in the high bond debt category, almost a quarter of debt is due within a year and roughly 40% of its debt is not in the form of bonds. This suggests that bond financing does not insulate firms from the cash flow risk induced by changes in interest rates.[17] This an important ingredient of the bond debt rigidity channel we discuss in the framework below.

2.3 Drivers of bank versus bond financing

It is important to note that in our setting, a firm's debt mix is not randomly assigned: the decision to access bond or bank debt is a choice. Figures 6 and 12 present some statistics on the cross-sectional determinants of debt mix. Empirically, the best predictor of bond debt is total debt: larger firms with more leverage are more likely to have a larger share of bond debt. This is not surprising given that bond markets are designed to raise large amounts of external finance, and bond issuance often exceeds amounts that are typically raised from banks or syndicates of lenders. Second, the share of bond debt (as well as leverage) varies considerably across sectors, likely reflecting different liquidity needs or

[17]Of course, firms can sign derivative contracts to hedge interest risk if they choose. However, Ippolito, Ozdagli, and Perez-Orive (2018) show that many firms do not hedge their floating rate bank debt in the United States.

asset characteristics. Even conditional on sector, there is a positive association of bond debt, for the extensive as well as intensive margin, with fixed asset investment (property plant and equipment) and cash; a negative association with profitability.

Finally, debt mix appears significantly sticky in the data, as shown in Figure 11 in the Online Appendix. Moreover, its time series correlation with the monetary cycle is limited, as shown below.

Nevertheless, the non-random assignment of bond debt creates an identification challenge that we discuss in detail in Section 3. The concern is that a firm's response to monetary policy is not driven by its bond debt directly, but indirectly by another channel that is correlated with bond debt. This is a classical omitted variable bias. Foreshadowing the discussion in section 4.5, our model predicts that the estimated response to bond debt is, if at all, positively biased. Given the negative response that we find in the Eurozone, the presence of a bias suggests that the estimates are likely to be an upper bound. To mitigate some of the identification concerns, we rely on the granularity of our micro-data: firm fixed effects control for time-invariant propensities to issue bond debt, whereas other firm controls capture time varying characteristics.

3 Empirical Methodology and Results

3.1 Identification

The key empirical difficulty that researchers face is that the stance of monetary policy reflects current conditions and/or anticipated developments in the economy. More precisely, there are three identification challenges.

1. Monetary policy shocks: It is necessary to separate the expected from the unexpected stance of monetary policy. The expected component of monetary policy is problematic as it is correlated with many third factors driving firms' decisions. To address this issue, we use high-frequency movement in interest rates derivatives around ECB announcements. The approach posits that asset prices—here, OIS swap rates—reflect all publicly available information before the monetary policy announcement and that the change in asset prices reflects the newly revealed information. As the underlying of OIS swaps is the EONIA,[18] the change in the OIS swap rate reflects the unexpected change at the short end of the yield curve. Measuring changes in the OIS swap rate in a short time window around the policy announcement makes any change likely to be disproportionately affected by an unexpected change in monetary policy.[19]

2. Firm outcomes: Even with well-identified monetary shocks, measuring firm responses to those shocks is challenging. Indeed, many firm-level outcomes are reported at much lower frequency than our intra-day monetary shock—for instance, sales, investment or employment. The necessary identifying assumption would be extremely strong as it would require the monetary shock to be orthogonal to other economic forces that occur in the reporting horizon. Moreover, these variables are typically slow-moving and react very gradually to a change in policy, which amplifies this issue further. The scope of the outcome variable is also limited by the well-documented small magnitude of monetary shocks identified through high-frequency data (the standard deviation in our sample is 5.5 basis points).[20]

To address this challenge, to measure the cross-sectional response of firms, we use daily changes in their stock prices as our main outcome variable.[21] Stock prices have the advantage that they can be measured at a much higher frequency relative to other firm-level outcomes. Moreover, stock prices are forward looking, which brings two additional benefits. First, asset pricing theory posits that all previous information is incorporated in prices, and hence changes in prices reflect the effect of new information only. Second, stock returns "capitalize" changes in the economic environment, thus capturing both short-term and long-term effects of monetary policy. The key identifying assumption in those return regressions requires that the monetary policy shock be truly orthogonal to other factors driving stock returns on that same day.[22]

3. Firm heterogeneity: Finally, even with well-identified monetary shocks and a good

[18] This is the counterpart to the effective federal funds rate in the U.S. Note also that the ECB target rate and the EONIA have historically tracked each other closely as the ECB target rate can be understood as the target that is intended to be implemented by open market operations.

[19] This approach has been used by Cook and Hahn (1989), Kuttner (2001), Bernanke and Kuttner (2005b), Cochrane and Piazzesi (2002), Nakamura and Steinsson (2018a).

[20] For a discussion see, e.g., Nakamura and Steinsson (2018a).

[21] Daily changes in the outcome variable have become somewhat of a convention in the literature, see: Bernanke and Kuttner (2005b), Cochrane and Piazzesi (2002), Nakamura and Steinsson (2018a).

[22] The measurement of monetary policy shocks around a short time window also helps with identification; only unaccounted factors that are correlated with the change in the swap rate in the short time window and simultaneously affect stock prices can threaten identification.

firm outcome variable, a firm's debt mix 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. The question is whether there is a covariate that both drives debt mix and firm reactions to monetary policy.[23]

One prominent firm characteristic that comes to mind is total leverage, which is a strong predictor for bond debt exposure and a likely driver of the response to monetary policy by firms: leverage increases risk, sensitivity to interest rates and it is elevates real frictions through debt financing (i.e., debt over-hang). Therefore, we include leverage as a control in our main specification along with firm fixed effects that absorb time-invariant firm characteristics. Furthermore, we control for time varying observable balance sheet 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. (Ozdagli, 2018; Ottonello and Winberry, 2018; Jeenas, 2018; Ippolito, Ozdagli, and Perez-Orive, 2018).

One might also be concerned about potential transmission channels of monetary policy that affect firms through consumer demand, labor supply or exchange rate movements. However, those channels are often specific to product type, production technology, or market and hence they are likely to vary at the industry level.[24] Therefore, we include interactions of industry fixed effects with monetary policy shocks as controls.

Foreshadowing the results of the next section, those covariates seem to have limited forecasting power in our setting, especially in comparison to debt mix. Admittedly, we cannot rule out that our estimates are entirely free of any confounders, although the strength and robustness of the effects suggest that bond financing plays an important role in the transmission of monetary policy.

3.2 Firm-level stock market regressions

To understand the heterogeneity of the cross-sectional response and to shed light on the transmission mechanism, we explore the richness of the micro-data. Specifically, we use

[23]The theoretical literature at the intersection of debt mix and monetary policy is thin, and, therefore, provides little definitive guidance.

[24]Valuation ratios within industry tend to be strongly aligned and industry peers are often used for a variety of benchmarking exercises.

longitudinal data to estimate models of the form:

$$\Delta \log P_{i,t} = \alpha_i + \nu_t + \gamma MPShock_t \times X_{i,t} + \delta Z_{i,t} + \eta MPShock_t \times Sector_i + \epsilon_{i,t} \tag{1}$$

The panel structure allows for a rich set of fixed effects and controls which act as a defense against confounding factors. We use firm fixed effects, α_i, as well as date fixed effects, ν_t. We also include time-varying firm level controls, $Z_{i,t}$, from the balance sheet;[25] in the main specification these encompass cash-over-assets, earnings-over-assets, debt-over-earnings, fixed assets-over-assets, and log market-to-book ratio. Importantly, we include interactions of the firm's sector with the monetary policy shock. This set of interactions controls for sector specific sensitivities of firms to monetary policy—those interactions act as a first defense against unobserved sector specific and time-invariant factors that affect firms' response to monetary shocks, such as, a change in consumer demand, labor supply or exchange rates.

The coefficient of interest is γ as it captures the heterogeneity in the treatment effect of monetary policy associated with firms' characteristic X. For $\gamma \neq 0$, characteristic X can forecast the cross-sectional responses to monetary shocks and plausibly plays a role in the transmission channel. In the analysis below, we first consider standard firm characteristics from the balance sheet before focusing on the role of bond financing. Given our set of controls and fixed effects, the coefficient γ is identified from within-day and within-sector variation. A negative γ implies that firms with larger value of variable X respond more strongly to a surprise monetary contraction relative to other firms in their sector (remember that the average effect is negative), over and above the average response on that particular day.

3.3 Results: the role of bond financing

Balance sheet characteristics: Table 4 shows how a wide array of firm characteristics predict the cross-sectional response to monetary shocks. In our setting, it appears that simple balance sheet items have limited forecasting power. Although firm size has a

[25]We use lagged balance sheet characteristics for two reasons. First, the majority of firms report at the end of the calendar year. We want analysts and investors to observe the firm's capital structure before evaluating the impact of monetary policy on the firm. Second, lagging the controls can alleviate some of the problems with bad controls as described by Angrist and Pischke (2008).

detectable effect, other variables, including cash-over-assets, earnings-over-assets, debt-over-earnings, earnings-over-interest, asset tangibility or market-to-book ratio do not.

The role of debt mix: On the other hand, debt mix seems to be a strong driver of firms' response to monetary policy. Table 5 shows that firms with a larger share of bond debt are robustly more affected by monetary shocks. Column 1 shows that leverage (measured by debt over assets) itself has some predictive power. The bonds-over-assets ratio also significantly increases firms' sensitivity to interest rate shocks as shown in column 2. The economic significance of this effect is not trivial: following a one percentage point increase in interest rates, firms in the top quartile of the bonds over assets distribution have a 2.3 percentage point lower stock return relative to firms in the bottom quartile. 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 and 6 control for the firm's total leverage and use levels and terciles of bond debt-over-debt, respectively. In both 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. Collectively, those results point to the special role of bond debt.

3.4 Additional Findings

Robustness: Additional robustness results are gathered in the Online Appendix. Table 12 shows that the main result is unaffected to excluding the outlier announcement of September 17th, 2001. Table 13 shows little change when observations are weighted by assets or market capitalization, whereas Table 14 uses alternative monetary shocks based on daily changes in the Euribor 1M or the daily changes of the OIS swap rate. Table 11 and Table 15 show that the main results are robust to the inclusion of rating dummies that represent the rating categories and default probability as proxied by the "distance-to-default" framework by Merton (1974) and subsequently adopted by, among others, Gilchrist and Zakrajšek (2012). We also check whether our main result is specific to the constituents of the EURO STOXX indices. As an alternative to the preceding selection we selected the top 500 firms by market capitalization in each year. This yields a broader sample with 635 distinct firms. The main results are very similar in size and significance.

We have a slight preference for the sample based on the EURO STOXX indices as it has a comparable size distribution to the historical constituents of the S&P 500 index in the United States.

Relative prices and credit flows: A large class of models emphasizes that monetary policy affects credit flows by altering the relative cost of different debt instruments, that is, by changing the interest rate differential between bond and bank debt with the same maturity and same creditworthiness of the borrower (Bolton and Freixas, 2006). Such a change can have real effects as long as debt instruments are not perfect substitutes—it can alter firms' debt burden and induce changes in equilibrium financing, investment or hiring policies (Crouzet, 2017; De Fiore and Uhlig, 2015). Our findings could be explained by monetary policy having a differential pass-through across debt instruments and, specifically, bonds becoming more expensive relative to bank loans following a monetary contraction. This would penalize bond-financed firms relatively more compared to companies with less bond debt. In most existing models, such changes in relative prices would also propel new bank debt issuance and a reshape a firm's debt mix.

The evidence to support this pricing channel appears to be relatively weak. To begin with, in the raw aggregate data it is difficult to detect a differential pass-through between bank and bond debt pricing. Figure 9 displays corporate bond yields and interest rates on bank loans across the monetary cycle. It is apparent that bond yields and loan rates follow very similar trajectories as the ECB target rate changes. But since aggregate data cannot be used to reach definitive conclusions, we turn to more careful analysis using our time series of monetary shocks. However, bank interest rates are measured at a lower frequency (monthly) relative to asset prices and potentially take time to adjust.[26] At the cost of stronger identification assumption, we use a local projection to trace out the change in the interest rate differential between bank debt and bonds subsequent to a monetary policy announcement. It is important to keep in mind that the identified monetary policy shocks are relatively small and, thus, provide limited statistical power.

Figure 7 displays suggestive evidence against the hypothesis that rate hikes make bond debt relatively more expensive. If anything, bank loans appears to have a larger pass-through. Panels A and B shows that bank loans become more expensive relative

[26] We do no observe loan interest rates in the micro-data and, thus, have to resort to aggregate loan interest rates as published monthly by the ECB.

to bonds immediately following a monetary contraction, although the effect is noisy and seems to revert after a few months. Panel C and D shows that firms adjust their debt mix marginally toward bonds following a monetary contraction. The direction of that effect is in line with existing evidence (Lhuissier and Szczerbowicz, 2018; Becker and Ivashina, 2014). Note that we do not take a stance on why the pass-through of monetary policy could be different across loans and bonds, and the empirical determinants of this spread are still an open question (Schwert, 2018). Moreover, while the quantity effect aligns with the price response, we cannot be certain that changes in debt mix are driven only by the change in relative spreads.

Effects on firm dynamics: To estimate the impact of monetary policy on firms over time, we use a local projection following Jordà (2005). The objective is to measure the adjustment path of slow-moving firm outcomes from balance sheet data while controlling for effects at the industry $\times$ year level. Specific to our setting is the interest to estimate the response of firms that have a high bond debt over assets share vs firms that do not; we do so by ranking firms into terciles with respect to the industry $\times$ year mean. This effectively defines three subsamples that we estimate separately. Keeping the regression model close to our high frequency approach, we estimate the following specification for horizons $h \in \{1, \ldots, 8\}$:

$$\Delta y_{t+h,t,i} - \Delta \bar{y}_{t+h,t,s(i)} = \beta^h_{Shock} MPShock_t + X_i' \gamma + \epsilon_{t+h,t,i} \tag{2}$$

where $\Delta y_{t+h,t,i} - \Delta \bar{y}_{t+h,t,s(i)}$ denotes the difference of outcome y demeaned by the industry $\times$ year mean over h quarters in either log quarterly total assets or log net property, plant and equipment. As in similar studies (Corsetti, Duarte, and Mann (2018); Cloyne, Ferreira, Froemel, and Surico (2018)), the monetary policy shocks is aggregated to a quarterly frequency.

Figure 8 contains the estimated impulse response functions (IRFs) for the entire sample along with the estimates for the subsamples defined by the top and bottom tercile of the bond debt over assets share. Total assets contract in response to a contractionary monetary policy shock; interestingly, more so for firms in the top tercile of the bond debt over asset distribution. A similar reaction can be observed for net property, plant and equipment (fixed assets), which suggests that companies are reducing their levels of investment in response to tighter monetary policy. Despite the fact that we lack statistical power to differentiate the effect for firms that are in the top vs. bottom tercile of the bond debt over asset distribution, the estimates by subsample provide suggestive evidence that firms reliant on bond debt adjust more strongly.

US sample: Ultimately, we are interested in setting up a unifying framework that sheds light on the response of firms to monetary policy. It is often difficult to determine the exact channels through which firms are affected empirically, as one has to distinguish between many competing hypotheses with limited moments in the data. One source of additional variation is more data: in our case, from the United States, for which we construct a sample analogous to the one for the Eurozone.

We focus once again on the period between 2001 and 2007.[27] We resort to the same source for balance sheet data as in Europe: Thomson Reuters Worldscope, to ensure comparable variable definitions. The construction of the monetary policy shock identified at high frequency is based on the (scaled) daily changes of federal funds futures at FOMC announcement days and follows the seminal work of Kuttner (2001) and Bernanke and Kuttner (2005b).[28]

Some interesting patterns arise from comparing summary statistics between the Eurozone and the United States. First, the size distribution between the two samples is very similar based on the quartiles, as shown in Table 6. Second, the overall bond debt level is considerably lower in the Eurozone than in the United States, as evidenced by medians of 17% and 5%, respectively. Third, apart from the level difference between the Eurozone and the United States, the bond debt-over-debt distributions show a glaring contraast: the bond debt-over-debt distribution is right skewed in the Eurozone whereas left skewed in the United States. In other words, not only have firms in the United States more bond debt they also tilt their financing mix heavily towards bond debt. For firms in the Eurozone, in contrast, the 25th percentile is 0% and the 75th percentile 59%. This finding is well known and mentioned here to the extent that it may help substantiate our results.

[27] This is motivated by the relatively good coverage of the Capital IQ capital structure database after 2000 and our attempt to make the two samples comparable despite a lower number of event days due to the lower meeting frequency of the FOMC.

[28] We checked the robustness of our main results with respect to the use of monetary policy shocks identified in a tight announcement window, as in Nakamura and Steinsson (2018a). In contrast to Bernanke and Kuttner (2005b), Nakamura and Steinsson (2018a) use only regularly scheduled FOMC meetings which reduces the number of announcement days. The magnitude of the coefficient remains almost unchanged but the statistical power decreases due to fewer event dates.

In contrast to companies in the Eurozone, Table 7 shows that the heterogeneity in the response to monetary policy shocks is systematically related to the firms' cash holding, earnings over interest, and fixed assets over assets.

Replicating the debt variable analysis in the United States, as shown in Table 8, unveils some seemingly surprising results. The amplified response to monetary policy shocks by leverage and; in particular, bond debt financing, in the Eurozone turns into an attenuated response. In other words, firms with higher leverage—whether financed by bank debt or bond debt—respond less strongly to monetary policy shocks. A variety of factors could help reconcile this finding. For now, we postpone the discussion on how these results can be reconciled to section 4.6, after introducing the conceptual framework.

4 An Organizing Framework

4.1 Overview

It is clear from the discussion above that there are many potential forces at play and that interpreting the empirical evidence is not straightforward. This section presents a framework to conceptually understand the determinants of firms' response to monetary shocks. The objective is to nest three important forces. The first two, duration and interest rate pass-through, are canonical. The duration effect reflects the sensitivity of market values to changes in the discount rate, and is central to the asset pricing literature (Gormsen and Lazarus, 2019). Importantly, bonds and loans tend to have different maturity and interest rate fixation, hence different duration. Second, interest rate pass-through is key to the (multiform) bank lending channel literature, which studies how the special characteristics of banks affect how they pass on monetary shocks to their borrowers. Irrespective of the specific mechanism, these theories suggest that bonds have a lower interest rate pass-through relative to loans.

The third force is motivated by extensive work in corporate finance that stresses the importance of firms' liquidity management: investment, debt and cash hoarding policies are jointly determined in a forward-looking manner to avoid financial distress. Corporate liquidity has been recently recognized a key force for monetary transmission (Rocheteau, Wright, and Zhang, 2018; Kiyotaki and Moore, 2018; Acharya and Plantin, 2019; Altavilla, Burlon, Giannetti, and Holton, 2019).[29] This liquidity management channel sheds light on how debt composition can affect monetary transmission in a novel way. A key characteristic of bond financing is its rigidity: relative to banking relationships, market financing is harder to renegotiate in bad times and leave firms more exposed to temporary cash-flow shocks and the risk of financial distress (Bolton and Scharfstein, 1996; Crouzet, 2017; Bolton, Freixas, Gambacorta, and Mistrulli, 2016; De Fiore and Uhlig, 2015).

We use the framework to inform our empirical evidence in two ways. First, we decompose the firms' response to a change in interest rates into three terms that represent the duration, interest rate pass-through and liquidity management channel, respectively. The decomposition holds for the stock price, as well as investment, liquid assets and credit risk. Second, we use this decomposition to explain why the effect of monetary policy can vary across firms with different sources of financing. The setup includes legacy long-term debt and study how debt rigidity influences firms' investment policies jointly with their holdings of liquid assets in the presence of idiosyncratic cash-flow shocks.

4.2 Setup

A firm has a legacy project (assets in place) that pays cash flows in each period, long-term debt obligations that must be paid in each period. We model three dates explicitly: t=0, 1 and 2. Figure 10 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 the 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 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

[29]To understand the way financial frictions affect large firms, a number of stylized facts suggest that liquidity management is a more appropriate framework than simple models with binding one-period borrowing constraints. Specifically, debt structure in the data is rich, in particular long-term debt constitutes the lion's share and includes both bonds and bank loans. In addition, debt adjustments are rare and often carefully planned Korteweg, Schwert, and Strebulaev (2019). Finally, retained earnings and cash are typically the marginal sources of financing for new projects, not borrowing.

temporal structure of the cash-flows and captures the new project duration, that plays an important role in the analysis.[30]

Liquidity shock: Following Holmström and Tirole (1998), we model liquidity shocks at the interim period t=1. We say the firm faces a liquidity shock if current financial resources are too small relative to current debt service payments[31]. We model the source of liquidity shock as a temporary cash-flow shock at t=1: π_1 can be unexpectedly low, without any implication for terminal cash-flows.

Textbook models often take an extreme view in which this liquidity shock can lead to default and bankruptcy: the firm is liquidated if income π_1 is below R_1 if the firm takes no preventive measures. In practice, liquidation is much less frequent than other types of "credit events" that are associated with liquidity problems. For instance, a temporary cash flow shock can put a firm at risk of a rating downgrade, covenant violation or delinquencies. We can therefore think of a credit event in a broad sense: if the ratio of all current financial resources over current debt service is below $l \geq 1$, the firm incurs a dead-weight loss and loses a fraction λ of all its current and future profits. This dead-weight loss can be interpreted as the indirect costs of financial distress. The simplest case corresponds to $l = \lambda = 1$: if financial resources are below debt service, the firm is liquidated with no salvage value. For ease of exposition only, we focus on this simple case below. However, we stress that our framework is well suited to understand how firms manage their credit rating or plan in advance to prevent covenant violations, over and above avoiding conventional defaults.

The central question that we study in this framework is the decision of firms to withstand a liquidity shock in equilibrium. To withstand a liquidity shock, the firm has two sources of additional funds. First, it can renegotiate down debt obligation R_1 by $\tilde{\pi}$ at t=1 (equivalently, raises $\tilde{\pi}$ from capital markets). However, this is unlikely to be enough to raise enough liquidity to withstand all shocks because of two frictions, that are well understood in the literature. The first is the lack of pledgeability of future cash flows, due for example to moral hazard or lack of enforcement.

The second is debt rigidity which plays a crucial role in our comparison of bonds

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

[31]Note the difference with solvency concerns in which the present value of *all future cash flows* is too low relative to the present value of future debt services.

and bank financing. Following a large temporary cash-flow shock, rather than letting the firm enter financial distress, it is often in the creditors' best interest to renegotiate their claims or let themselves be diluted by the issuance of new claims. However, renegotiation frictions can create a "debt overhang" problem at the continuation stage. Indeed, existing creditors might refuse to be diluted by new issuance or fail to coordinate on a mutually beneficial renegotiation. This can explain why market debt, which is held by a dispersed investor base, is more rigid relative to relationship banking (Bolton and Scharfstein, 1996).[32]

The shortfall that cannot be covered by $\tilde{\pi}$ therefore has to be planned in advance, and comes from the liquidity 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. Optimally the firm will not withstand all liquidity shocks. We will see that hoarding liquidity is costly and hence the firm will sometimes incur a dead-weight loss. The firm's "continuation policy" is to choose a threshold π^* such that it withstand the liquidity shock at t=1 only if interim cash-flows are large enough: $\pi_1 > \pi^*$. The probability of a credit event is thus $F(\pi^*)$. Because the firm can only raise $\tilde{\pi}$ from renegotiating its debt at t=1, it must accumulate liquidity at t=0 of at least $L = R_1 - \pi^* - \tilde{\pi}$. Denote by q the price of hoarding liquid assets, in the sense that ensuring 1 unit of liquidity at t=1 implies spending $(1+q)$ at t=0. This direct price can correspond to a "liquidity premium" on near-money assets (Nagel, 2016) or can be a metaphor for the risk that a credit line is revoked at a later date (Acharya, Almeida, Ippolito, and Perez-Orive, 2018). For simplicity, we also assume that the firm always raises $\tilde{\pi}$ at t=1, although this can be generalized.

At t=0, the firm decides how much to invest in the new project. The key decision we want to analyse is how much to keep inside the firm to withstand future liquidity shocks vs how much to invest in this project. The legacy project implies disposable income y_0 at t=0 (i.e. earnings after subtracting debt obligations and maintenance of legacy assets). Disposable income is either invested in new project I or stored in liquid assets L, the rest being paid out as dividends d such that $I + (1+q)L + d = y_0$. That is the key real decision

[32] Tirole (2010) provides an overview. More explicit microfoundations for $\tilde{\pi}$ would go as follows. In a frictionless world, the firm could raise at t=1 the entire present value of its future income. However, assume that only a fraction $1-\theta$ can be pledged to investors, for example to preserve the insiders' incentives to work. Moreover, because of imperfect renegotiation only a fraction $1-\phi$ of pledgeable income can in fact be raised. This leads to $\tilde{\pi} = (1-\theta)(1-\phi)\times$ future income. The coefficients (θ, ϕ) measure the magnitude of these two frictions.

we want to study. When interest rates increase, how does the scale of investment I in the new project change? This is a way to model the real effects of monetary policy through its effect on firms' liquidity demand *in good times* (i.e. "rating management").[33] Throughout, we assume that the firm has enough internal funds at t=0 to not have to borrow in order to finance the new project. While it can straightforwardly be relaxed, this is the most empirically relevant case for large firms.

The firm chooses its optimal continuation policy π^* at t=1 jointly with its investment I^*, liquid asset holdings L^* and dividends d^* at t=0. It maximizes its expected payoff given two constraints:

$$\max_{\pi^*,I^*,L^*,d^*} \underbrace{[1-F(\pi^*)][PVE_0+R(I^*)PVI]}_{\text{Expected terminal profits}} + \underbrace{\int_{\pi_1\geq\pi^*}(\pi_1-R_1+\tilde{\pi}+L^*)dF(\pi)}_{\text{Expected profits at t=1}} + \underbrace{d^*}_{\text{Profits at t=0}}$$

s.t. $R_1=\pi^*+\tilde{\pi}+L^*$ and $I^*+(1+q)L^*+d^*=y_0$

The first constraint says that there is just enough liquidity at t=1 to service debt in the worst continuation scenario ($\pi_1=\pi^*$). The second is the accounting of cash-flows at t=0. Inspecting the constraints reveal some intuition. First, when π^* is high, L^* can be low: if the firm does not want to withstand many liquidity shocks, it does not have to hoard much liquidity. Second, if π^* is high, I^* can also be high: there is no need to hoard liquidity and it invests more in new project.

Equilibrium Liquidity Demand and Investment: The trade-off behind the optimal continuation policy π^* is also intuitive. Decreasing π^* (withstanding more liquidity shocks) has the benefit of preserving the returns of the legacy project and the new project, as the shareholders occur a dead-weight loss after a credit event. However, it necessitates liquidity hoarding, which reduces the scale of investment of new project (opportunity cost). The first FOC implies the following optimality condition:

$$\underbrace{(1+q)}_{\text{price of liquid assets}} \underbrace{R'(I^*)PVI}_{\text{return of new project}} -1 = \underbrace{\frac{f(\pi^*)}{1-F(\pi^*)}}_{\text{hazard rate of credit event}} \underbrace{[PVE_0+R(I^*)PVI]}_{\text{loss in case of credit event}}$$

This expression clearly summarize the intuition above: withstanding liquidity shocks

[33]See Fracassi and Weitzner (2019) for direct evidence that firms actively manage their credit rating using an unexpected change to Moody's methodology.

has an opportunity cost of investing less in the new project, in addition to the direct cost q. The second FOC characterizes how liquidity not kept in the firms is optimally divided between investment and payouts:

$$\underbrace{R'(I^*)PVI(1-F(\pi^*))}_{\text{risk-adjusted return of new project}} = \underbrace{1}_{\text{marginal value of dividends}}$$

Bank vs. bond and liquidity demand: The model can nest some of the important differences between bonds and bank financing. Bond debt is more "rigid" in the sense that creditors are dispersed and might oppose a mutually beneficial renegotiation at the intermediate stage t=1, either by blocking additional issuance via covenants or by opportunistically refusing to reduce or delay their debt obligations. In the model, that can be formalized as a lower value of $\tilde{\pi}$ that can be raised at t=1 to withstand the liquidity shock. Everything else equal, more bond financing implies larger liquidity risk. Larger liquidity risk increases the value of hoarding liquidity at t=0 and therefore raise the opportunity cost of investing in the new project. The following proposition summarizes the intuitive difference in investment and liquidity demand across bank and bond financing:

Debt rigidity and liquidity management: *When debt is more rigid ($\tilde{\pi}$ is lower), the firm faces a credit event more often (π^* increases). Moreover, the firm increases its liquidity demand and invests less in the new project (I^* falls).*

Effect of rising interest rates: Our key results decompose how firm's value and optimal behavior change when interest rates increase. In this setting, rates hikes affect firm behavior in two ways. First through *duration* effects that change the present value of shareholders' equity akin to a discount rate channel prevalent in asset pricing.[34] Moreover, rate hikes heighten liquidity risk because (i) higher debt burden drains interim cash-flows, which is closer to a cash flow channel prevalent in the banking or corporate finance literature, or (ii) the price of securing liquid assets can rise, as emphasized by recent work in monetary economics (Rocheteau, Wright, and Zhang, 2018; Drechsler, Savov, and Schnabl, 2018). We have purposely set up the model such that periods t=1 and t=2 play different roles and distinguish clearly between these two effects. Indeed, payoffs are deterministic at t=2, and an increase in rates only reduces the present value of firm's

[34]Equivalently, a "cost of capital" channel.

owners payoff, and does not create liquidity risk. On the other hand, a change in intermediate debt service R_1 or price of liquid assets q come with an increase in liquidity risk, which has more subtle implications. The next sections decompose the effects of monetary policy on stock prices and real variables along the three forces of *duration*, *interest rate pass-through* and *liquidity management*.

4.3 Stock Price Reaction to Monetary Policy

Duration gap: Monetary policy has an effect through this channel as long as it affects the terminal value through discounting. The key variable behind the duration channel of monetary policy is equity duration $\partial PVE_0/\partial r^f$, which is nothing but the "duration gap" between assets and liability $\partial PVA_0/\partial r^f - \partial PVA_0/\partial r^f$. This gap is often thought to be related to the life-cycle of firms: growing cash-flows imply larger duration gap. Firms with larger duration gap see their terminal payoff fall more after interest rates hikes relative to other firms. For completeness, one should also include the duration of the new project cash-flows $R(I)\partial PVI/\partial r^f$, as they add to existing equity.

How does this duration channel helps to understand the differential response of bank- and bond-dependent firms? For a given asset duration, bond-dependent firms have larger debt duration, hence lower duration gap. This implies that bond-dependent firms react less to interest rate changes. However, if bond-dependent have in fact larger duration gaps (because their asset duration is significantly longer), this effect could be reversed.

Interest rate pass-through: In addition, a policy hike can also affect cash-flows to the extent that it increases debt service payments, increasing liquidity risk. However, the firm's exposure to this channel depends on its debt structure: different debt instruments have different "interest rate pass-throughs". This pass-through is at the core of existing views of the (multiform) bank lending channel of monetary policy. Classical views emphasized the role of reserves or bank capital, while recent views have argued that banks' market power or loan covenants are quantitatively important (Drechsler, Savov, and Schnabl, 2017; Wang, Whited, Wu, and Xiao, 2018; Greenwald, 2019). Independent of their exact nature, because they rely on bank-related frictions, all these views suggest the pass-through should be smaller for bond-dependent firms. In addition, Ippolito, Ozdagli, and Perez-Orive (2018) document a "floating rate channel of monetary policy" that goes in a similar direction. Bond debt is more likely to be fixed rate and long maturity, and that mechanically dampens the increase in debt service following a rate hike relative to other firms. However, recall the evidence that all firms have rich debt structure with significant amount of short-term or floating rate debt, such that no firms is completely shielded from rate hikes. Full hedging might also not be optimal or feasible.

In the model, this is equivalent to making different assumptions on how intermediate debt service R_1 moves with the risk-free rate. Denote this interest rate pass-through as $\partial R_1/\partial r^f = \omega \geq 0$. For multiple reason, bond-dependent have less interest rate pass-through (smaller ω) relative to other firms, which would imply that bond-reliant firms are less sensitive to monetary policy.

The shadow value of liquidity: To understand fully how monetary policy affects liquidity risk, it is useful to define first the *shadow value of liquidity* (SVL). By definition $SVL := \frac{\partial Equity}{\partial y_0}$, where y_0 is disposable income at t=0. Given that firms maximize equity value under the liquidity constraints, this shadow value can be computed directly using the envelope theorem :

$$SVL := \frac{\partial Equity}{\partial y_0} = (1 - F(\pi^*))R'(I^*)PVI$$

A key result is that, in equilibrium, the shadow value of liquidity is equal to the risk-adjusted return on the new project. That's intuitive: the new project is the opportunity cost of every dollar of liquidity hoarded at t=0. In equilibrium, firms that face greater liquidity risk have a larger shadow value of liquidity. Indeed, they invest less and, due to decreasing returns to scale, have higher marginal return on investment.

The cost of liquid assets: There is evidence that monetary policy influences the cost of holding liquid assets (Nagel, 2016; Drechsler, Savov, and Schnabl, 2018). 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. Below, we take the slope $\partial q/\partial r^f$ to represent the total sum of these different channels.

Decomposing stock price reaction: Given that firms maximize their equity value given constraints, the stock price reaction to a change in interest rates can be computed directly using the envelope theorem:

$$\frac{\partial Equity}{\partial r^f} = \underbrace{(1 - F(\pi^*)) \left\{ \frac{\partial PVE_0}{\partial r^f} + R(I^*) \frac{\partial PVI}{\partial r^f} \right\}}_{\text{duration gap}}$$

$$- \underbrace{(1 - F(\pi^*)) R'(I^*) PVI}_{\text{shadow value of liquidity}} \left\{ \underbrace{\frac{\partial R_1}{\partial r^f}(1+q)}_{\text{interest rate pass-through}} + \underbrace{\frac{\partial q}{\partial r^f} L^*}_{\text{change in price of liquid assets}} \right\}$$

The stock price reaction is larger for firms that have a higher shadow value of liquidity. The response to monetary policy is, *ceteris paribus*, larger for firms with higher debt rigidity. This is consistent with our high-frequency findings that bond-dependent firms are more affected by monetary policy in the Eurozone.

In general, this decomposition makes clear that the response is driven by the parametrization of the environment. For a given asset duration, bond-dependent firms have larger debt duration, hence lower duration gap. This implies that bond-dependent firms react less to interest rate changes. However, if bond-dependent have in fact larger duration gaps (because their asset duration is significantly longer), this effect is reversed. Second, existing views of the bank lending channel (bank capital, market power, floating rate loans) also emphasize that bond debt has a lower interest rate pass-through relative to loans.

4.4 Real Effects

In this section, we decompose the real effects of monetary policy through its effect on optimal liquidity management and investment. We follow the logic on the previous analysis, and study sequentially the duration and liquidity effects, before combining them.

Investment: The duration effect of monetary policy can be modeled as a fall of the present value of the firm's final payoff. This payoff has two components: new project PVI and the existing legacy project PVE_0. First, rate hikes reduce PVI leading to a standard "cost of capital" channel: a fall in the project value reduces investment demand.

Moreover, there is an additional effect working through the change legacy project PVE_0. It can be understood as a standard "default option" logic. A lower firm's payoff in the case of continuation increases the incentives to pay out, instead of hoarding liquidity or investing. In total, both components of the duration channel therefore go in the same intuitive direction: investment falls following a rise in interest rates.

The second channel is that rate hikes alter the optimal liquidity management of the firm. An increase in intermediate debt service R_1 drains cash-flows and implies that more liquidity needs to be hoarded at t=0, at the expense of the new project. Moreover, rate hikes increase the direct cost of liquid assets q, which favors pay out over investing and hoarding liquidity. We therefore get an intuitive liquidity channel of monetary policy in which rates hikes lead to a rise in liquidity demand and payouts, and a fall in investment. Combining all forces, we can decompose the change in investment from monetary policy as follows:

$$\frac{\partial I}{\partial r^f} = \underbrace{\frac{\partial I}{\partial PVI}\frac{\partial PVI}{\partial r^f} + \frac{\partial I}{\partial PVE_0}\frac{\partial PVE_0}{\partial r^f}}_{\text{duration = cost of capital channel}} + \underbrace{\frac{\partial I}{\partial R_1}}_{\text{debt burden}} \times \frac{\partial R_1}{\partial r^f} + \underbrace{\frac{\partial I}{\partial q}}_{\text{price of liquidity}} \times \frac{\partial q}{\partial r^f}$$

The liquidity management channel therefore amplifies the standard cost of capital channel.

Credit risk and liquid assets: On the other hand, the effect on the firm credit risk is not as straightforward as one would initially believe. Recall that the probability of a credit event is $F(\pi^*)$ which is simply the probability that intermediate cash-flows are below the continuation threshold π^* chosen by the firm in equilibrium. The liquidity constraint at t=1 implies that credit risk depends on both investment, interest rates and the price of liquid assets. In equilibrium, $\pi^* = R_1 - (y_0 - I^*)/(1+q) - \tilde{\pi}$ in equilibrium, and thus credit risk increases to the extent that $I^*/(1+q) + R_1$ increases.

Importantly, the prudent behavior of firms tampers the rise in credit risk. Following a rate hike that raises debt burden and the price of liquid assets, the firm optimally reduces its investment to partly counteract these changes. In other words, while credit risk rises, it rises much less relative to a setting in which investment scale is fixed and liquidity management taken to be exogenous. It is therefore key to account for the fact that investment and liquidity management are determined jointly and endogenously.

However, once the additional effect of duration and interest rate pass-through are taken into account, the total effect on credit risk is less clear. Indeed, the duration effect reduces investment, which on its own reduces credit risk. Moreover, interest rate pass-through can be low reducing liquidity risk, and thus credit risk. In principle, it is possible that these forces dominate and that credit risk falls if investment falls drastically after a rate hike. For the similar reasons, the dynamics of liquid assets following rate hikes are not straightforward. While additional liquidity risk increases incentives to hoard liquid assets, the duration effect goes in the opposite direction: the present value of future cash-flows falls, making continuation less valuable and reducing incentives to hoard liquid assets.

The role of debt rigidity: How does the rigidity of debt mediate the real effects of monetary policy? Intuitively, one would expect that firms with more rigid debt reduce investment more following a rate hike because they are more exposed to liquidity risk. Mathematically, one can show that the debt burden component of the investment response $\frac{\partial I}{\partial R_1}$ is increasing in:

$$\underbrace{\frac{\partial}{\partial \pi^*} \frac{f(\pi^*)}{1 - F(\pi^*)}}_{\text{slope of hazard rate}} \underbrace{[PVE_0 + R(I^*)PVI]}_{\text{loss in case of credit event}}$$

If the hazard rate is convex, the intuition holds. Firms with rigid debt have higher credit risk, which implies that there their hazard rate rises fast with interest rates for a given investment level. They thus have stronger incentives to reduce investment relative to other firms. Everything else equal, we therefore expect stronger real effects for bond-reliant firms. However, as before duration and interest-rate pass-through represent mitigating forces. Following a rate hike, bond-reliant firms face a larger fall in the market value of their liabilities and a smaller increase in their intermediate debt payments.

The differential effect on credit risk across firms with different debt composition is however much less clear. As noted above, it is possible that credit risk endogenously falls in the face of a rate hike. It is also possible that, since their investment response is potentially larger, bond-dependent firms experience a fall in credit risk relative to other firms, rather than an increase.

4.5 Selection and the Choice of Bond vs Bank Financing

In the simple model, we take the rigidity of debt $\tilde{\pi}$ as given. In reality, debt composition is not randomly assigned and is a choice that the firm makes. This "selection" can potentially lead to a bias in our empirical estimates and question the interpretation of our findings. We can use the model to answer related questions: (i) which firm characteristics drive the value of debt flexibility? (ii) are these characteristics also related to a firm's sensitivity to monetary policy? In other words, this is an attempt to "sign the bias". A more complete model of equilibrium debt composition is proposed in Crouzet (2014).

In our model, the marginal value of increasing debt flexibility can be computed directly from the envelope theorem. In fact, in our simple model this marginal value is directly related to the shadow value of liquidity (SVL) described above:

$$\frac{\partial Equity}{\partial \tilde{\pi}} = (1+q) \times SVL = (1+q)(1-F(\pi^*))R'(I^*)PVI$$

Consistent with our main argument, the marginal value of debt flexibility is related to the marginal returns on the initial project, since more rigid debt implies less investment in favor of hoarding liquid assets. This is a very useful result to discuss the two questions we are interested in. First, intuitively riskier, cash-poor and less productive firms tend to invest less, and hence have a higher marginal returns. This implies that they place a larger value on debt flexibility relative to firms that are safer, cash-rich or more productive.[35] To a first order, this is intuitive and matches many accounts on which firms relies on bonds as opposed to bank loans. Nevertheless, we note that some careful theoretical and empirical works often argue that the full picture is a little more subtle.

Second, there is clearly a relation between the choice of bank and bond financing and sensitivity to monetary policy. This is because, through the lens of our model, the shadow value of liquidity is a key quantity that crucially affects both. This comparative static result can provide some guidance on how to sign the bias in our cross-sectional estimates. In fact, this selection on debt composition works against us finding our main result that Eurozone firms with more bonds are more responsive to monetary shocks. Indeed, bond-dependent firms are selected on characteristics that predict a low shadow value of liq-

[35]This discussion ignores the fact that the cost of debt flexibility (for instance through intermediation cost being passes through to higher spread) might vary across firms. In many of the existing models, this cost is often thought to be relatively stable across firms, such as a constant bond-loan spread (Crouzet, 2014).

uidity. This in turn should make them less responsive to monetary policy, according to our main decomposition. "Selection" is therefore plausibly a mitigating factor in Europe, while it might lead to too large an estimate in the United States.

4.6 Discussion

Low-frequency response: The last section shows that interpreting some of the low-frequency response can be difficult without the lens of a model. Whether a certain type of firms are "more responsive" to monetary policy is not always unambiguous: real investment, credit risk or stock price can respond in different proportions. Predicting the relative difference across groups, such as in a typical difference-in-difference framework, is not easy: the sign might flip depending on which outcome is considered. For example, after a rate hike, all firms withstand fewer liquidity shocks, but bond-dependent firms moderate this increase by more strongly reducing their investment in new projects. Their credit spreads might therefore increase less relative to bank-financed firms, although their investment falls relatively more. The joint endogeneity of investment and liquidity management is a key economic force that complicates the interpretation of purely reduced-form evidence.

Other channels of monetary transmission: Our framework was purposefully stark in order to illustrate clearly the role of liquidity management and debt rigidity for monetary transmission. We acknowledge that the framework could be extended in multiple directions. For instance, we take the empirical evidence at face value and simply assume that monetary policy moves real interest rates (Nakamura and Steinsson, 2018b) without explicitly modeling pricing frictions and inflation dynamics. Moreover, we abstract from explicit general equilibrium effects caused by monetary tightening but some of these effects only amplify our channel. For instance, rate hikes can depress consumer demand and reduce firms' earnings, which only exacerbates the liquidity management problem. Note also that, while their general equilibrium model is much richer than our framework, Kaplan, Moll, and Violante (2016) also emphasize that, quantitatively, the effectiveness of monetary policy depends on the investment response of firms. Finally, Ottonello and Winberry (2018) shows that credit spreads on new financing endogenously react to firm's investment policy through default risk. Our framework assumes that long-term debt is in place and that the marginal source of financing is retained earnings, but new debt issuance at intermediate stages could be added to capture this additional force. There is also evidence that firms actively manage their maturity and refinancing decisions (Mian and Santos, 2018), a margin that we do not model explicitly.

Comparing the Eurozone with the United States: What can explain the difference between the Eurozone and the United States? Our framework offers some possible leads in understanding this difference. The model makes two main predictions where differences may originate from: (i) difference in duration and (ii) differences in rigidity. There is some evidence that the debt securities' characteristics differ between the Eurozone and the United States: Ippolito, Ozdagli, and Perez-Orive (2018) shows that the overwhelming share of bank debt is floating rate for firms in the United States. Vickery (2008) shows that this is particularly true for large firms—as the ones in our sample. In the core of the Eurozone, in contrast, the predominant share of bank debt is fixed-rate.[36] In addition, the distribution of bond debt maturities is shifted rightwards implying longer average bond maturity. These two facts suggest that the duration difference between bond and bank debt may partly explain some of the observed difference. In fact, Table 8 column 7 suggests that the positive effect is stronger and more significant for bond leverage. The following thought example illustrates what role the maturity difference plays. For two firms with a given asset duration, the bank financed firm exhibits a large duration mismatch, whereas the bond financed firm is exposed to a smaller duration gap and hence less affected by interest rate shocks; the difference in sensitivity is picked up by the coefficient on the share of bond debt. Finally, the larger development of bond markets and rating agencies in the United States might have lead to lower rigidity of market debt relative to Europe in the same period. While this is suggestive evidence, it appears possible to reconcile the results of the two samples within a single framework.

5 Conclusion

This paper studies the role of firms' debt composition for the transmission mechanism of monetary policy in the Eurozone. Using stock price reactions to identified monetary policy shocks, firms with more bond debt are disproportionately affected by unexpected

[36] cf. ECB Statistical Data Warehouse: Risk Assessment Indicators

ECB interest rate changes. This pattern is difficult to rationalize with existing theories of the bank lending channel, as well as with explanations based on duration. We therefore present an organizing framework to decompose the response of large firms. We argue that the rigidity of outstanding bond debt, as emphasized in models of bank versus market financing, matters for monetary transmission via corporate liquidity management. Rate hikes drain cash-flows and increase exposure to temporary shocks. Firms react by being prudent in good times, and reduce investment in favor of hoarding liquid assets. Because bonds are harder to renegotiate in bad times relative to relationship banking, this effect can rationalize our main finding.

This is a large scope for future research to understand better the macroeconomic implications of firms' debt composition. Sources of external financing are not perfect substitutes and the underlying trade-offs affect the pass-through of monetary policy. We also highlight the role of the stock of long-term debt outstanding. Monetary policy does not only change credit flows, it also importantly interacts with characteristics of existing debt contracts.[37] Finally, policy is naturally path-dependent: existing debt structure is driven by past financing patterns, which are in turn driven by past policies. After quantitative easing and a long period 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 going forward.

[37]This also appear to be an important component of monetary transmission through household debt. For instance, Auclert (2019), Di Maggio, Kermani, Keys, Piskorski, Ramcharan, Seru, and Yao (2017) and Garriga, Kydland, and Šustek (2017) emphasize the role of the stock of long-term fixed rate mortgages.

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Appendix: Figures and Tables

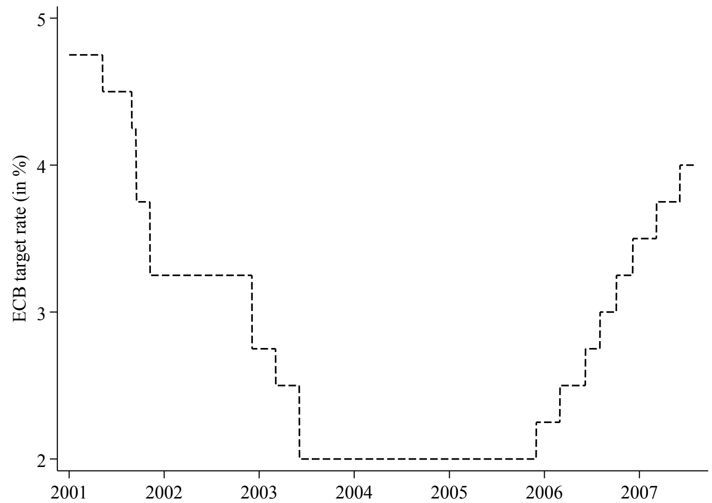


Figure 1 – ECB Target Rate

Note: Figure plots the ECB policy rate for the main refinancing operations (MRO) as decided by the Governing Council. Source: https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html

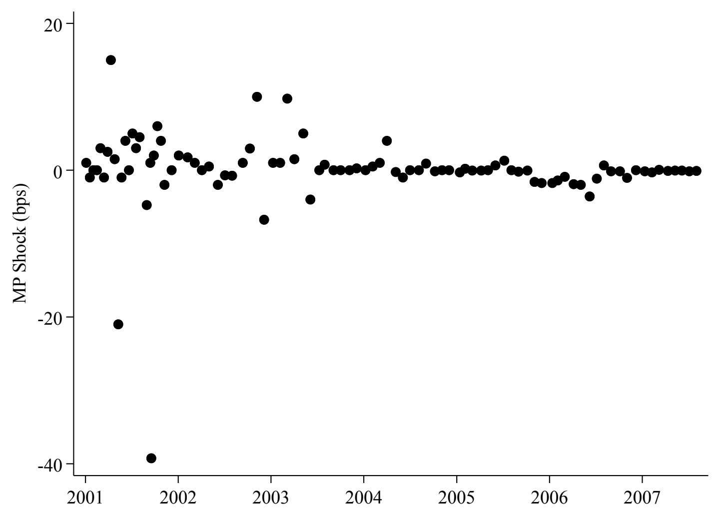


Figure 2 – Time Series of MP Shocks

Note: Identified monetary policy shocks from OIS swaps (in basis points) for the sample horizon-January 2001-July 2007 at monetary policy announcements dates.

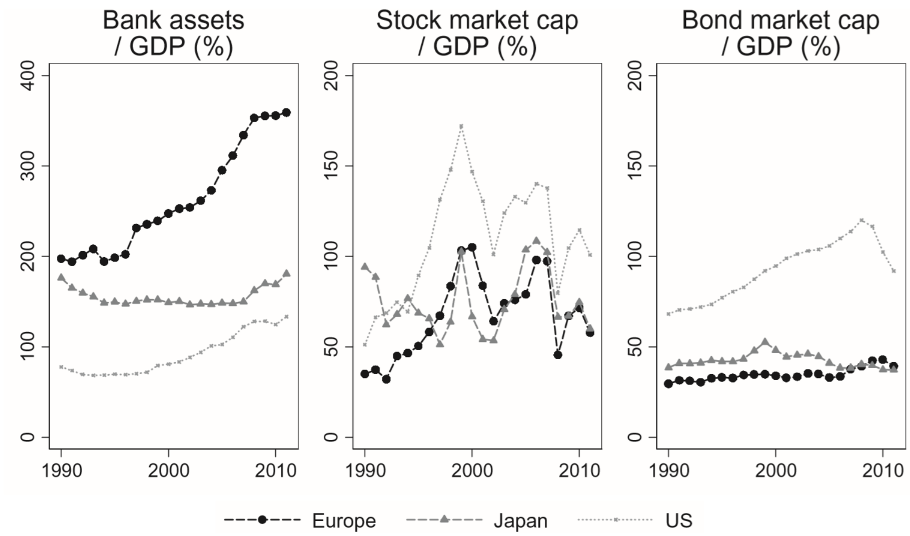


Figure 3 – Firm Financing in Europe vs. Other Countries

Note: Source is Langfield and Pagano (2016)

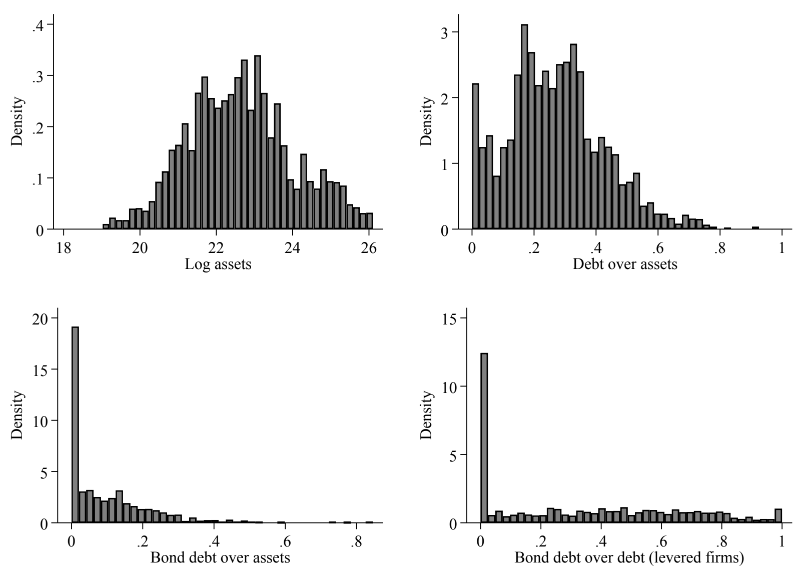


Figure 4 – Distribution of Firm Financing

Note: The sample is an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 92 ECB announcements days between 2001 and 2007. Balance sheet data comes from Worldscope and bond issuance data comes from SDC Platinum.

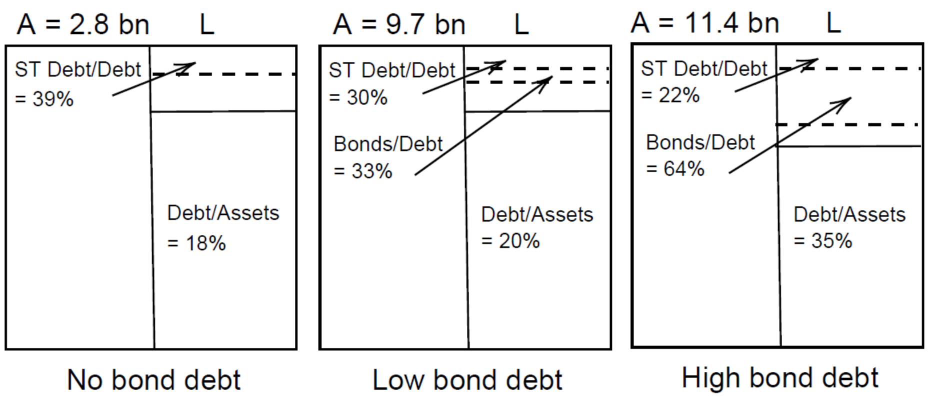


Figure 5 – Mix of Firm Debt Liabilities

Note: The sample is an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 92 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. The figure display the median of each ratio. Balance sheet data comes from Worldscope and bond issuance data comes from SDC Platinum.

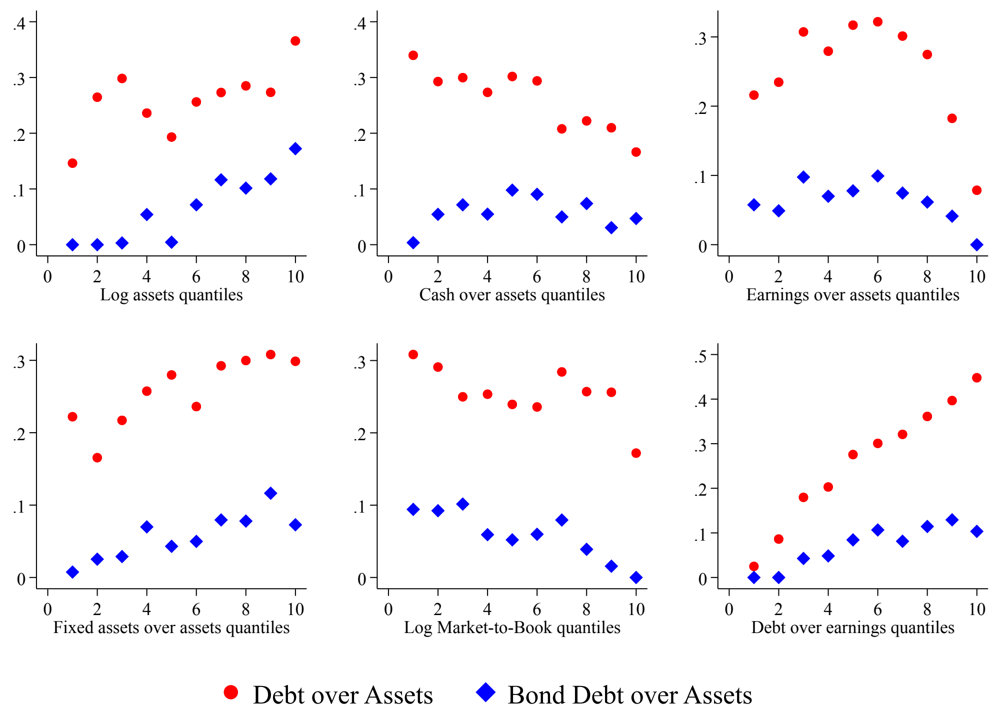
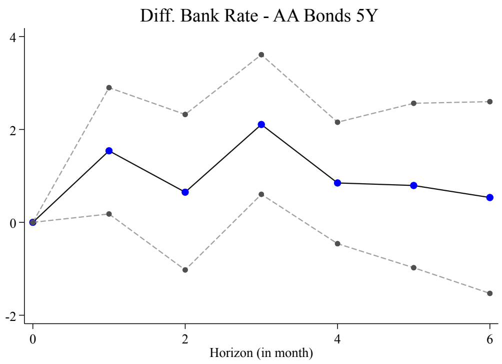
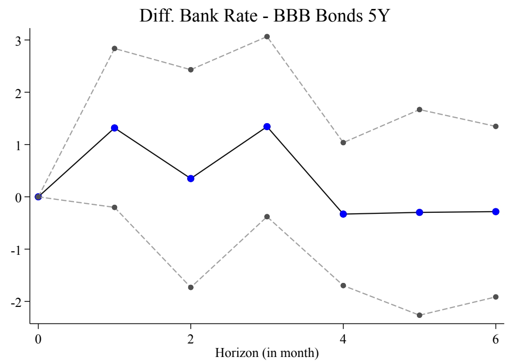


Figure 6 – Bond Debt and Firm Characteristics

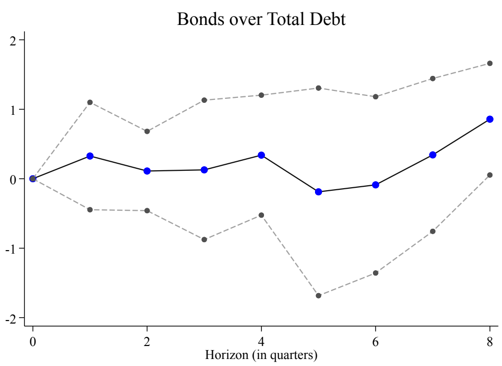
Note: This figure presents summary statistics for an unbalanced panel of the European firms that were part of EURO STOXX Supersector Eurozone indices, excluding financials and utilities. Dates include 92 ECB announcements days between 2001 and 2007. Each subfigure plots the median debt-over-assets and bonds-over-assets ratio for firms in each deciles of the following firm characteristics (left to right, top to bottom): log assets, cash-over-assets, EBITDA-over-assets, fixed assets-over-assets, market-to-book and debt-over-EBITDA. The deciles of each variables are calcualted over the entire sample. Balance sheet data comes from Worldscope, bond issuance data comes from SDC Platinum, and stock market information comes from Datastream.



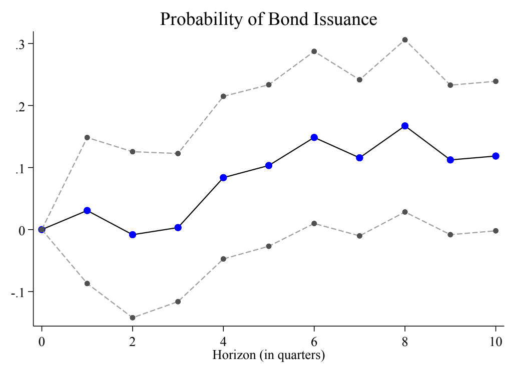
(a) Loan rates vs. AA bond yields



(b) Loan rates vs. BBB bond yields



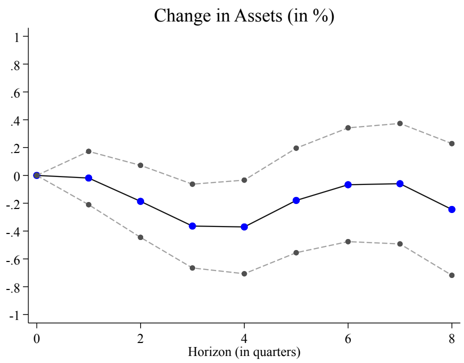
(c) Change in Bond Debt over Debt



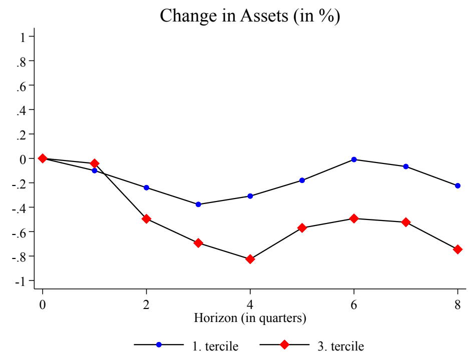
(d) Change in Probability to Issue Bond

Figure 7 – Monetary Policy Shocks and Price and Quantity of Bank vs. Bond Debt

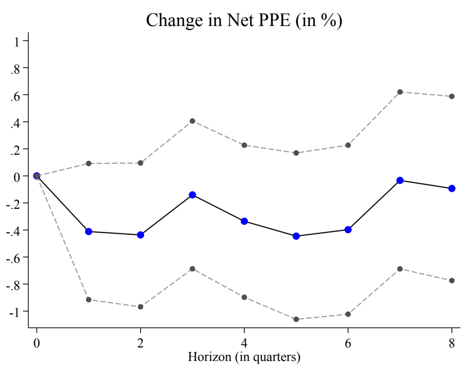
Notes: The panels show estimates from a local projection following Jordà (2005). Panel (a) and (b) uses monthly times series data for which following baseline model is estimated $\Delta y_{t+h,t} = \alpha + \beta^h_{Shock} MPShock_t + \Gamma X_t + u_t$; where $\Delta y_{t+h,t}$ denotes the difference over h months, α is a constant, and X_t contains multiple lags of the dependent variable. The dashed lines indicate the 95% confidence interval for the parameter estimates with Newey-West standard errors to account for overlapping observations. Panel (c) and (d) 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: $\Delta y_{i,t+h,t} = \alpha_i + \beta^h_{Shock} MPShock_t + u_{it}$; 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, and $MPShock_t$ is the monetary policy shock in time t. Standard errors are clustered at the firm level. The dashed lines indicate the 95% confidence interval for the parameter estimates.



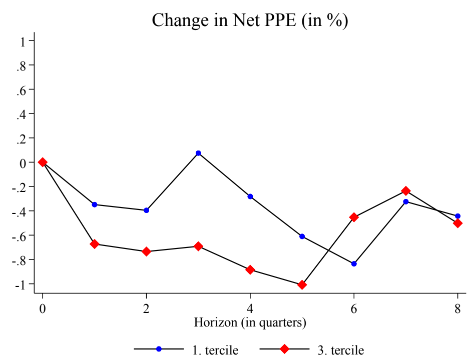
(a) Total Assets



(b) Total Assets by Tercile



(c) Net PPE



(d) Net PPE by Tercile

Figure 8 – Dynamic Effects of Monetary Policy Shocks

Notes: The panels show estimates after a contractionary shock from a local projection following Jordà (2005). All panels use quarterly times series data for which following baseline model is estimated $\Delta y_{t+h,t,i} - \Delta \bar{y}_{t+h,t,s(i)} = \beta^h_{Shock} MPShock_t + X_i'\gamma + \epsilon_{t+h,t,i}$; where $\Delta y_{t+h,t,i} - \Delta \bar{y}_{t+h,t,s(i)}$ denotes the difference of outcome y demeaned by the industry $\times$ year mean over h quarters. For panel (b) and (d) the firm-time are ranked into terciles by their bond debt over asset share within an industry $\times$ year. The dashed lines indicate the 95% confidence interval for the parameter estimates.

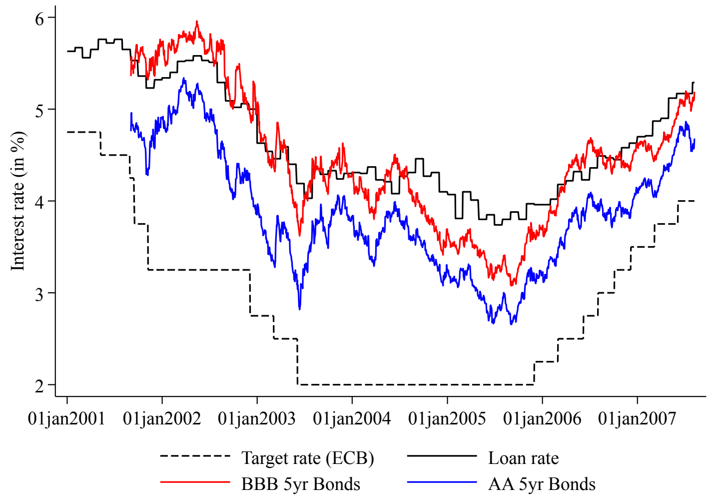


Figure 9 – Debt Yields across Monetary Cycle

Note: The figure plots the raw data for the ECB target rate (Source: https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html), the average loan rate in the Eurozone as published by the ECB (Source: 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 (Source: Bloomberg BFV 5yr EUR Eurozone Industrial BBB Bond Yield and BFV 5yr EUR Eurozone Industrial AA Bond Yield)

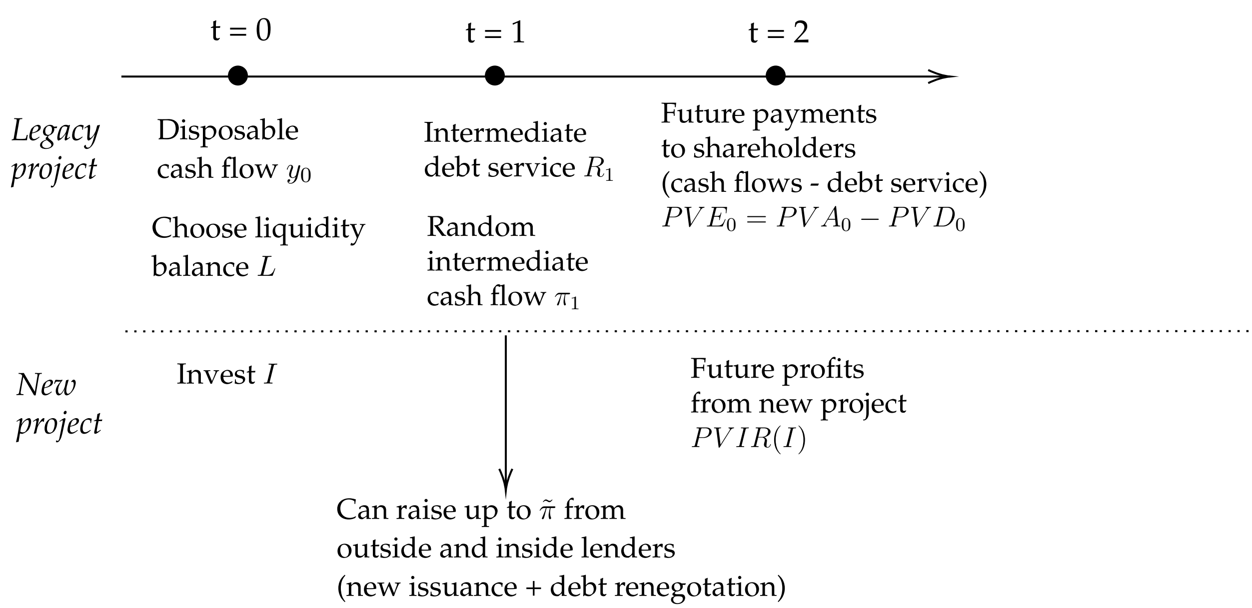


Figure 10 – Timeline

	N	Mean	SD	Min	Max
Panel A: Market Returns (in pp)					
MP announcement days					
Δ MSCIEMU	92	-0.032	1.37	-4.16	3.12
Δ DAX30	92	-0.094	1.68	-4.65	5.08
Δ IBEX35	92	0.040	1.36	-3.78	4.22
Δ CAC40	92	-0.096	1.49	-5.25	3.77
Δ FTSEMIB	92	-0.080	1.31	-3.47	3.28
Other days					
Δ MSCIEMU	1631	0.004	1.26	-6.53	6.17
Δ DAX30	1631	0.016	1.57	-8.87	7.55
Δ IBEX35	1631	0.028	1.24	-5.99	5.79
Δ CAC40	1631	0.004	1.37	-7.68	7.00
Δ FTSEMIB	1631	0.000	1.20	-7.87	7.63
Panel B: Shocks (in bps)					
MP announcement days					
Δ OIS	92	-0.047	5.49	-39.25	15.00
Δ EURIBOR 1M	92	-0.000	5.80	-41.80	15.40
Δ OIS (daily)	92	-0.127	5.30	-37.75	10.00
Other days					
Δ OIS	1626	-0.141	2.94	-74.50	20.50
Δ EURIBOR 1M	1631	-0.041	1.30	-11.30	10.80
Δ OIS (daily)	1623	-0.036	1.50	-11.75	15.50

Table 1 – Summary Statistics Returns and Shocks

Note: Summary statistics for the market returns of a broad market index (MSCIEMU), national blue chip indices for Germany (DAX30), Italy (FTSEMIB), Spain (IBEX35), France (CAC40) and shocks derived based on OIS swaps and money market instruments in the sample period January 2001-July 2007.

Panel A: Market Regressions

	(1) Δ MSCIEMU	(2) Δ DAX30	(3) Δ IBEX35	(4) Δ CAC40	(5) Δ FTSEMIB
Δ OIS	-5.148**	-5.843*	-5.132**	-5.580**	-1.467
	(1.893)	(2.625)	(1.789)	(2.069)	(2.041)
R^2	0.043	0.036	0.043	0.042	0.004
Observations	92	92	92	92	92

Panel B: Industry Regressions

	(1) Δ Food	(2) Δ Health	(3) Δ Media	(4) Δ Techn.	(5) Δ Telecom	(6) Δ Autoparts	(7) Δ Basic Mat.
Δ OIS	-5.649**	-2.545+	-8.563+	-6.195	-9.650**	-5.242*	0.176
	(1.088)	(1.524)	(4.410)	(5.148)	(2.536)	(2.506)	(1.679)
R^2	0.086	0.009	0.079	0.013	0.086	0.033	0.000
Observations	92	92	92	92	92	92	92

Panel B: Industry Regressions Continued

	(8) Δ Construc.	(9) Δ Basic Res.	(10) Δ Chemicals	(11) Δ Oil and Gas	(12) Δ Industrials	(13) Δ Utilities	(14) Δ Industrial Serv.
Δ OIS	-0.849	6.601+	-2.432	-4.521**	1.145	-4.736**	2.604
	(1.239)	(3.473)	(2.091)	(1.349)	(1.441)	(1.342)	(2.097)
R^2	0.002	0.057	0.010	0.025	0.003	0.041	0.011
Observations	92	92	92	92	92	92	92

Table 2 – Stock Price Index Reaction to MP Shocks

Note: This table reports regression estimates of daily returns of the market index / super-sector index on the monetary policy shock in the sample period January 2001-July 2007 at monetary policy announcement dates. All variables are expressed in percentage terms. Market regressions use a broad market index (MSCIEMU), national blue chip indices for Germany (DAX30), Spain (IBEX35), France (CAC40), and Italy (FTSEMIB). Industry regressions use the EURO STOXX Supersector Eurozone Indices; they contain between 10 and 30 firms from the corresponding supersector. The estimated model is $\Delta R_t = \alpha + \beta \times MPShock_t + u_t$. *Standard errors in parentheses are robust to heteroskedasticity. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

	mean	p25	p50	p75	count
No bond debt					
Assets (in bn)	5.752	1.391	2.798	5.894	5152
Cash over assets	0.0641	0.0184	0.0384	0.0787	5152
Earnings over assets	0.163	0.101	0.142	0.230	5152
Fixed assets over assets	0.239	0.0888	0.188	0.343	5152
Market-to-Book	4.315	1.889	3.061	5.467	5152
Debt over earnings	1.532	0.319	1.367	2.603	5152
Earnings over interest expenses	32.37	6.118	11.53	28.68	5152
Debt over assets	0.220	0.0675	0.182	0.318	5152
Debt due within year over debt	0.456	0.210	0.391	0.680	5152
Bond debt over assets	0.00160	0	0	0	5152
Bond debt over debt	0.0206	0	0	0	5152
Low bond debt					
Assets (in bn)	20.33	4.130	9.685	19.49	4135
Cash over assets	0.0515	0.0213	0.0369	0.0632	4135
Earnings over assets	0.135	0.0854	0.129	0.179	4135
Fixed assets over assets	0.277	0.115	0.260	0.399	4135
Market-to-Book	2.535	1.383	2.112	3.011	4135
Debt over earnings	2.043	1.127	1.811	2.755	4135
Earnings over interest expenses	14.01	6.348	10.24	16.43	4135
Debt over assets	0.231	0.160	0.202	0.302	4135
Debt due within year over debt	0.331	0.171	0.302	0.470	4135
Bond debt over assets	0.0702	0.0389	0.0655	0.104	4135
Bond debt over debt	0.365	0.171	0.336	0.524	4135
High bond debt					
Assets (in bn)	28.46	4.615	11.44	37.23	4581
Cash over assets	0.0649	0.0212	0.0377	0.0738	4581
Earnings over assets	0.116	0.0911	0.123	0.159	4581
Fixed assets over assets	0.287	0.151	0.270	0.410	4581
Market-to-Book	2.580	1.240	2.013	3.186	4581
Debt over earnings	2.260	1.895	2.648	3.966	4581
Earnings over interest expenses	9.421	4.586	7.047	11.36	4581
Debt over assets	0.373	0.276	0.347	0.448	4581
Debt due within year over debt	0.245	0.128	0.218	0.342	4581
Bond debt over assets	0.230	0.152	0.205	0.274	4581
Bond debt over debt	0.627	0.476	0.638	0.782	4581
Total					
Assets (in bn)	17.60	2.538	6.389	16.27	13868
Cash over assets	0.0606	0.0204	0.0377	0.0719	13868
Earnings over assets	0.139	0.0920	0.131	0.182	13868
Fixed assets over assets	0.266	0.111	0.233	0.390	13868
Market-to-Book	3.211	1.414	2.358	3.779	13868
Debt over earnings	1.925	0.963	1.962	3.114	13868
Earnings over interest expenses	19.32	5.381	9.280	15.92	13868
Debt over assets	0.274	0.162	0.257	0.361	13868
Debt due within year over debt	0.349	0.157	0.292	0.482	13868
Bond debt over assets	0.0975	0	0.0544	0.153	13868
Bond debt over debt	0.324	0	0.259	0.586	13868

Table 3 – 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 92 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 data comes from SDC Platinum, and stock market information comes from Datastream.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
MP Shock × Log assets	-0.913***						
	(0.142)						
MP Shock × Cash over assets		-4.315					
		(8.053)					
MP Shock × Earnings over assets			5.686				
			(10.12)				
MP Shock × Debt over earnings				-0.0277			
				(0.0619)			
MP Shock × Earnings over interest expenses					-0.0151		
					(0.00977)		
MP Shock × Fixed assets over assets						-0.939	
						(2.079)	
MP Shock × Log Market-to-Book							-1.011
							(1.550)
R^2	0.227	0.226	0.226	0.226	0.226	0.226	0.226
Date FE	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓	✓	✓	✓
Observations	13868	13868	13868	13868	13868	13868	13868

Table 4 – Balance Sheet and Monetary Policy Shocks

*Note: This table presents regression results for estimating Equation 1 using different balance sheet characteristics as interacted variable X. The dependent variable is daily stock return, and MP Shock are constructed as in Corsetti, Duarte, and Mann (2018). 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 92 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum 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)
MP Shock × Debt over assets	-5.803***				-3.805*	-4.028*	-1.267
	(1.882)				(2.104)	(2.110)	(1.701)
Debt over assets	-7.562					-7.063	3.331
	(29.18)					(29.35)	(26.99)
MP Shock × Bond debt over assets		-14.89***					-13.95***
		(3.237)					(3.456)
Bond debt over assets		-29.93					-31.54
		(37.04)					(36.30)
MP shock × Bond Issued			-1.403***				
			(0.533)				
Bond outstanding			-10.90				
			(7.136)				
MP Shock × Tercile of bond debt over assets				-0.970***			
				(0.251)			
Tercile of bond debt over assets				-3.848			
				(4.529)			
MP Shock × Bond debt over debt					-4.690***		
					(1.583)		
Bond debt over debt					0.895		
					(14.30)		
MP Shock × Tercile of bond debt over debt						-1.004***	
						(0.380)	
Tercile of bond debt over debt						-0.655	
						(5.009)	
R^2	0.226	0.227	0.226	0.226	0.227	0.226	0.227
Date FE	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓	✓	✓	✓
Observations	13868	13868	13868	13868	13868	13868	13868

Table 5 – Debt Financing and Monetary Policy Shocks

*Note: This table presents regression results for estimating Equation 1 using different measures of bond debt as interacted variable X. The dependent variable is daily stock return, and MP Shock are constructed as in Corsetti, Duarte, and Mann (2018). 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 92 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum 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.*

	mean	p25	p50	p75	count
No bond debt					
Assets (in bn)	14.59	2.458	5.669	14.50	6794
Cash over assets	0.166	0.0471	0.107	0.246	6794
Earnings over assets	0.152	0.0992	0.159	0.229	6794
Fixed assets over assets	0.239	0.111	0.184	0.305	6794
Market-to-Book	4.079	2.120	3.216	5.423	6794
Debt over earnings	1.112	0.216	0.706	1.374	6794
Earnings over interest expenses	39.87	10.86	25.10	55.09	6794
Debt over assets	0.139	0.0507	0.114	0.192	6794
Debt due within year over debt	0.285	0.0225	0.170	0.452	6794
Bond debt over assets	0.0475	0	0.0370	0.0875	6794
Bond debt over debt	0.459	0	0.419	0.861	6794
Low bond debt					
Assets (in bn)	17.64	3.602	7.445	16.72	6767
Cash over assets	0.0917	0.0225	0.0563	0.125	6767
Earnings over assets	0.147	0.102	0.152	0.198	6767
Fixed assets over assets	0.312	0.154	0.255	0.405	6767
Market-to-Book	3.514	1.905	2.828	4.214	6767
Debt over earnings	1.848	0.995	1.506	2.195	6767
Earnings over interest expenses	13.12	6.450	10.31	16.14	6767
Debt over assets	0.242	0.183	0.229	0.274	6767
Debt due within year over debt	0.160	0.0262	0.106	0.237	6767
Bond debt over assets	0.169	0.144	0.170	0.198	6767
Bond debt over debt	0.756	0.611	0.800	0.950	6767
High bond debt					
Assets (in bn)	19.94	3.825	8.196	18.05	6733
Cash over assets	0.0832	0.0159	0.0387	0.103	6733
Earnings over assets	0.143	0.0896	0.141	0.185	6733
Fixed assets over assets	0.350	0.183	0.309	0.516	6733
Market-to-Book	3.650	1.608	2.674	4.434	6733
Debt over earnings	2.733	1.617	2.394	3.713	6733
Earnings over interest expenses	8.419	3.801	6.234	9.587	6733
Debt over assets	0.375	0.290	0.353	0.431	6733
Debt due within year over debt	0.141	0.0208	0.0915	0.210	6733
Bond debt over assets	0.317	0.254	0.294	0.358	6733
Bond debt over debt	0.861	0.770	0.909	0.978	6733
Total					
Assets (in bn)	17.38	3.231	7.094	16.44	20294
Cash over assets	0.114	0.0234	0.0629	0.155	20294
Earnings over assets	0.147	0.0970	0.150	0.204	20294
Fixed assets over assets	0.300	0.143	0.242	0.419	20294
Market-to-Book	3.749	1.860	2.920	4.635	20294
Debt over earnings	1.895	0.782	1.515	2.540	20294
Earnings over interest expenses	20.52	5.555	10.19	21.29	20294
Debt over assets	0.252	0.154	0.246	0.335	20294
Debt due within year over debt	0.195	0.0234	0.111	0.281	20294
Bond debt over assets	0.178	0.0783	0.170	0.254	20294
Bond debt over debt	0.691	0.527	0.796	0.957	20294

Table 6 – US Firms Balance Sheet Summary Statistics

Note: The table presents summary statistics for an unbalanced panel of the firms that were included in the S&P500 between 2001 and 2007, excluding financials and utilities. Dates include 62 FOMC 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 data comes from SDC Platinum, and stock market information comes from Datastream.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
MP Shock × Log assets	0.0456 (0.399)						
MP Shock × Cash/assets		-20.88** (8.883)					
MP Shock × Earnings/assets			1.411 (3.889)				
MP Shock × Debt/income				-0.120 (0.261)			
MP Shock × Earnings/interest					-0.0562** (0.0257)		
MP Shock × Fixed assets/assets						11.14** (4.491)	
MP Shock × Log Market-to-Book							0.806 (0.525)
R^2	0.277	0.283	0.277	0.277	0.280	0.279	0.277
Date FE	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓	✓	✓	✓
Observations	20275	20275	20275	20275	20275	20275	20275

Table 7 – US Balance Sheet and Monetary Policy Shocks

*Note: This table presents regression results for estimating Equation 1 using different balance sheet characteristics as interacted variable X. The dependent variable is daily stock return, and MP Shock are the (scaled) daily changes in the federal funds future as constructed in Bernanke and Kuttner (2005b). The sample consists of an unbalanced panel of the American firms that were part of S&P 500 index, excluding financials and utilities. Dates include 62 Federal Open Market Committee announcements days between 2001 and 2007. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum 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)
MP Shock × Debt/assets	9.949**				8.738**		5.741
	(4.333)				(3.990)		(4.525)
Debt/assets	45.49				40.47	28.00	16.93
	(47.34)				(45.33)	(41.63)	(49.01)
MP Shock × Bonds/assets		11.03***					7.008*
		(4.118)					(3.744)
Bonds/assets		57.59					41.02
		(42.05)					(43.50)
MP shock × Bond Issued			5.151***				
			(1.560)				
Bond Issued (dummy)			22.48				
			(14.72)				
MP Shock × Tercile of bonds/assets				1.976**			
				(0.776)			
Tercile of bonds/assets				1.796			
				(4.210)			
MP Shock × Bonds/debt					3.763***		
					(1.374)		
Bonds/debt					-0.0120		
					(10.52)		
MP Shock × Tercile of bonds/debt						1.636***	
						(0.567)	
Tercile of bonds/debt						0.691	
						(3.414)	
R^2	0.279	0.279	0.280	0.279	0.280	0.279	0.279
Date FE	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓	✓	✓	✓
Observations	20275	20275	20275	20275	20275	20275	20275

Table 8 – US Debt Financing and Monetary Policy Shocks

*Note: This table presents regression results for estimating Equation 1 using different measures of bond debt as interacted interacted variable X. The dependent variable is daily stock return, and MP Shock are the (scaled) daily changes in the federal funds future as constructed in Bernanke and Kuttner (2005b). The sample consists of an unbalanced panel of the American firms that were part of S&P 500 index, excluding financials and utilities. Dates include 62 Federal Open Market Committee announcements days between 2001 and 2007. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum and stock market information comes from Datastream. Standard errors are double-clustered at the firm and date level. *,**, *** indicates significance at the 0.1, 0.05, 0.01 level, respectively.*

Online Appendix

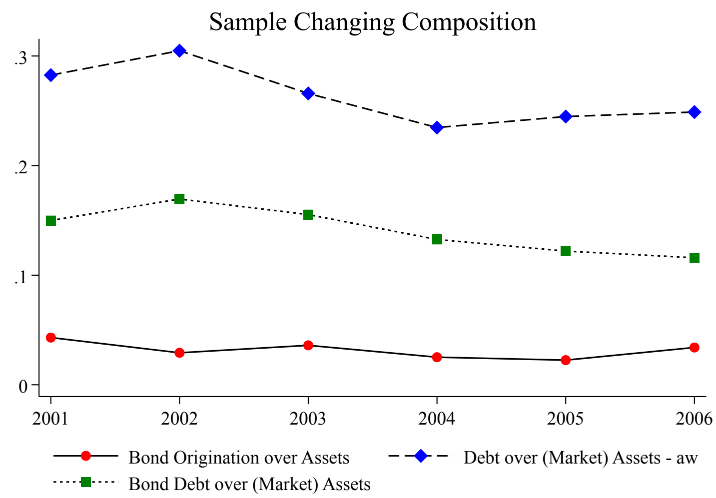


Figure 11 – Bond origination over time

Note: The figure shows aggregate statistics of the capital structure / origination volume in the sample from 2001-2007. Bond origination over assets is the total bond origination volume in one year over total assets of all firms in the corresponding year. Firms' debt over assets (individual leverage) and bond debt over assets (individual market leverage) are asset-weighted in each year.

	(1) return	(2) return	(3) return
MP Shock	-1.014	-4.328**	-4.772***
	(1.581)	(1.914)	(1.794)
Log assets	-10.39	9.870	13.61
	(20.52)	(29.98)	(29.57)
Cash over assets	-87.89	-162.2*	-212.5*
	(88.77)	(83.51)	(118.4)
Earnings over assets	-52.87	19.84	-3.452
	(78.07)	(85.32)	(130.3)
Fixed assets over assets	-44.62	33.27	-104.8
	(80.01)	(103.6)	(105.9)
Log Market-to-Book	42.84*	53.55*	46.88
	(22.45)	(30.91)	(35.95)
Debt over earnings	0.0750	0.249	-0.0580
	(0.270)	(0.559)	(0.297)
Earnings over interest expenses	-0.0348	-0.144	-0.126
	(0.0678)	(0.139)	(0.191)
R^2	0.019	0.039	0.027
Firm FE	✓	✓	✓
Firm controls	✓	✓	✓
Observations	13868	13868	13868

Table 9 – Average effect of MP Shocks

*Note: This table presents estimated coefficients for estimating a regression in which the dependent variable is daily stock return and MP Shock are constructed as in Corsetti, Duarte, and Mann (2018). Column 1 uses no weights, Column 2 weights observations by market capitalization and Column 3 by book assets. 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 92 ECB announcements days between 2001 and 2007. Controls include firm fixed effects and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum 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) return	(2) return	(3) return	(4) return	(5) return
MP Shock × Bond debt over assets	-14.89***		-12.75	-14.55*	-14.42*
	(3.237)		(9.753)	(8.050)	(8.001)
Bond debt over assets	-29.93		-25.68	-22.68	-21.33
	(37.04)		(44.93)	(44.59)	(44.10)
MP Shock × ST debt over assets		-4.110			
		(3.913)			
ST debt over assets		6.772			
		(53.10)			
MP Shock × LT debt over assets		-6.533***			
		(2.179)			
LT debt over assets		-9.993			
		(31.02)			
MP Shock × Share of bond debt due before 1y			-5.578		
			(7.180)		
Share of bond debt due before 1y			-23.08*		
			(12.45)		
MP Shock × Share of bond debt due before 2y				-2.682*	
				(1.553)	
Share of bond debt due before 2y				-6.290	
				(8.410)	
MP Shock × Share of bond debt due before 3y					-2.121
					(1.858)
Share of bond debt due before 3y					0.355
					(7.167)
R^2	0.227	0.226	0.241	0.241	0.241
Date FE	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓	✓
Observations	13868	13868	9627	9627	9627

Table 10 – Debt Maturity and Monetary Policy Shocks

*Note: This table presents regression results for estimating Equation 1 using different measures of bond debt as interacted variable X, adding a measure of the maturity of bond debt. The dependent variable is daily stock return, and MP Shock are constructed as in Corsetti, Duarte, and Mann (2018). 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 92 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum 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) return	(2) return	(3) return	(4) return
Unrated × MP Shock	1.922***	1.064***	0.614*	0.445
	(0.268)	(0.295)	(0.353)	(0.517)
High Yield × MP Shock	2.618	3.046	2.690	2.709
	(3.447)	(3.040)	(2.995)	(3.154)
IG below AA × MP Shock	0.858	1.782**	1.252*	1.039
	(0.616)	(0.776)	(0.691)	(0.674)
IG AA and above × MP Shock	0	0	0	0
	(2.09e-15)	(2.91e-08)	(5.49e-08)	(2.23e-08)
High Yield	-7.323	-4.301	-6.916	-6.489
	(12.43)	(12.38)	(12.35)	(12.21)
IG below AA	7.807	9.216	7.825	8.319
	(8.464)	(8.265)	(8.179)	(8.206)
IG AA and above	-2.712	-1.982	-2.838	-2.505
	(9.814)	(9.572)	(10.28)	(10.26)
MP Shock × Bond debt over assets		-16.67***	-4.491**	-4.557**
		(4.254)	(1.837)	(1.843)
Bond debt over assets		-30.62	-6.351	-5.793
		(36.36)	(29.56)	(29.26)
MP Shock × Bond debt over debt			-5.013**	
			(1.966)	
Bond debt over debt			0.496	
			(14.30)	
MP Shock × Tercile of bond debt over debt				-1.133*
				(0.593)
Tercile of bond debt over debt				-0.985
				(4.984)
R^2	0.227	0.227	0.227	0.227
Date FE	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓
Observations	13792	13792	13792	13792

Table 11 – Rating Categories and MP Shocks

*Note: Note: This table presents regression results for estimating Equation 1 using different measures of bond debt as interacted variable X, adding interactions with rating categories (High Yiedl is the excluded category). The dependent variable is daily stock return, and MP Shock are constructed as in Corsetti, Duarte, and Mann (2018). 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 92 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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, credit rating comes from Capital IQ, bond issuance data comes from SDC Platinum 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) return	(2) return	(3) return	(4) return	(5) return	(6) return
MP Shock × Debt over assets	-7.117**			-5.034	-5.574	-1.006
	(3.304)			(3.753)	(3.738)	(3.485)
Debt over assets	-5.227			-5.167	-4.817	4.572
	(29.41)			(29.88)	(29.57)	(26.56)
MP Shock × Bond debt over assets		-18.70***				-17.96***
		(3.966)				(4.858)
Bond debt over assets		-24.06				-26.48
		(38.30)				(36.53)
MP Shock × Tercile of bond debt over assets			-0.971**			
			(0.455)			
Tercile of bond debt over assets			-3.055			
			(4.542)			
MP Shock × Bond debt over debt				-5.004*		
				(2.806)		
Bond debt over debt				2.645		
				(14.58)		
MP Shock × Tercile of bond debt over debt					-0.961	
					(0.746)	
Tercile of bond debt over debt					-0.231	
					(5.059)	
R^2	0.229	0.230	0.229	0.230	0.229	0.230
Date FE	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓	✓	✓
Observations	13733	13733	13733	13733	13733	13733

Table 12 – Excluding Sept 17th, 2001

*Note: This table presents regression results for estimating Equation 1 using different measures of bond debt as interacted variable X, excluding Sept 17th 2001. The dependent variable is daily stock return, and MP Shock are constructed as in Corsetti, Duarte, and Mann (2018). 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 (excluding Sept 17th, 2001). Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum 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)
	return	return	return	return	return	return	return	return
MP Shock × Bond debt over assets	-15.30***		-8.132***	-8.493***	-17.12***		-9.436	-12.52***
	(2.384)		(2.492)	(2.273)	(3.466)		(6.409)	(4.503)
Bond debt over assets	-8.087		-48.46	-46.71	12.92		-107.1**	-101.9**
	(29.58)		(35.25)	(34.62)	(41.82)		(47.52)	(43.62)
MP Shock × Tercile of bond debt over assets		-2.094***				-1.547***		
		(0.244)				(0.495)		
Tercile of bond debt over assets		-2.959				2.494		
		(4.132)				(6.182)		
MP Shock × Bond debt over debt			-4.753***				-6.305***	
			(1.214)				(2.324)	
Bond debt over debt			12.68				32.33*	
			(11.98)				(18.93)	
MP Shock × Tercile of bond debt over debt				-1.577***				-1.150*
				(0.374)				(0.613)
Tercile of bond debt over debt				2.412				9.653*
				(6.555)				(5.802)
R^2	0.351	0.351	0.352	0.352	0.350	0.349	0.351	0.350
Date FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓	✓	✓	✓	✓
Observations	13868	13868	13868	13868	13868	13868	13868	13868

Table 13 – Weighted Regressions

*Note: This table presents regression results for estimating Equation 1 using different measures of bond debt as interacted variable X, weighing observations by market capitalization (Columns 1 to 4) or book assets (Columns 5 to 8). The dependent variable is daily stock return, and MP Shock are constructed as in Corsetti, Duarte, and Mann (2018). 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 92 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum 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) return	(2) return	(3) return	(4) return
MP Shock (EURIBOR) × Bond debt over assets	-13.07***			
	(2.617)			
Bond debt over assets	-28.73		-29.02	
	(36.30)		(36.01)	
MP Shock (EURIBOR) × Tercile of bond debt over assets		-0.898***		
		(0.227)		
Tercile of bond debt over assets		-3.830		-3.931
		(4.537)		(4.565)
MP Shock (OIS) × Bond debt over assets			-11.92***	
			(3.384)	
MP Shock (OIS) × Tercile of bond debt over assets				-0.679*
				(0.395)
R^2	0.227	0.226	0.226	0.226
Date FE	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓
Observations	13868	13868	13868	13868

Table 14 – Other MP Shocks

*Note: This table presents regression results for estimating Equation 1 using different measures of bond debt as interacted variable X, using alternative measures of monetary policy shock. The dependent variable is daily stock return, and MP Shock are constructed as daily change in EURIBOR 1M contracts (columns 1 and 2) or daily changes in OIS 1M rate (columns 3 and 4). 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 92 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum 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) return	(2) return	(3) return	(4) return
MP Shock × Bond debt over assets	-15.28***	-13.10***		
	(3.116)	(3.705)		
MP Shock × Default probability (KMV)	4.792		5.015	
	(5.289)		(5.467)	
Bond debt over assets	-33.41	-29.19		
	(37.85)	(36.87)		
Default probability (KMV)	33.55		34.90	
	(31.36)		(32.37)	
Quartile Default=1 × MP Shock		3.981*		4.315*
		(2.342)		(2.204)
Quartile Default=2 × MP Shock		2.371**		2.702***
		(1.001)		(0.999)
Quartile Default=3 × MP Shock		0.390		0.452
		(0.995)		(1.018)
MP Shock × Tercile of bond debt over assets			-1.047***	-0.832***
			(0.238)	(0.260)
Tercile of bond debt over assets			-4.053	-3.561
			(4.658)	(4.581)
R^2	0.228	0.229	0.228	0.228
Date FE	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Firm controls	✓	✓	✓	✓
Sector-MP Shock interactions	✓	✓	✓	✓
Observations	13595	13595	13595	13595

Table 15 – Distance-to-Default and Monetary Policy Shocks

*Note: This table presents regression results for estimating Equation 1 using different measures of bond debt as interacted variable X, adding a measure of the default probability. The default probability is derived according to the "distance-to-default" framework by Merton (1974) and subsequently adopted by, amongst others, Gilchrist and Zakrajšek (2012). The dependent variable is daily stock return, and MP Shock are constructed as in Corsetti, Duarte, and Mann (2018). 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 92 ECB announcements days between 2001 and 2007. Controls include firm fixed effects, date fixed effects, sector-times-monetary shocks interactions and time varying firm controls (all lagged to preceding quarter): 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 issuance data comes from SDC Platinum 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.*

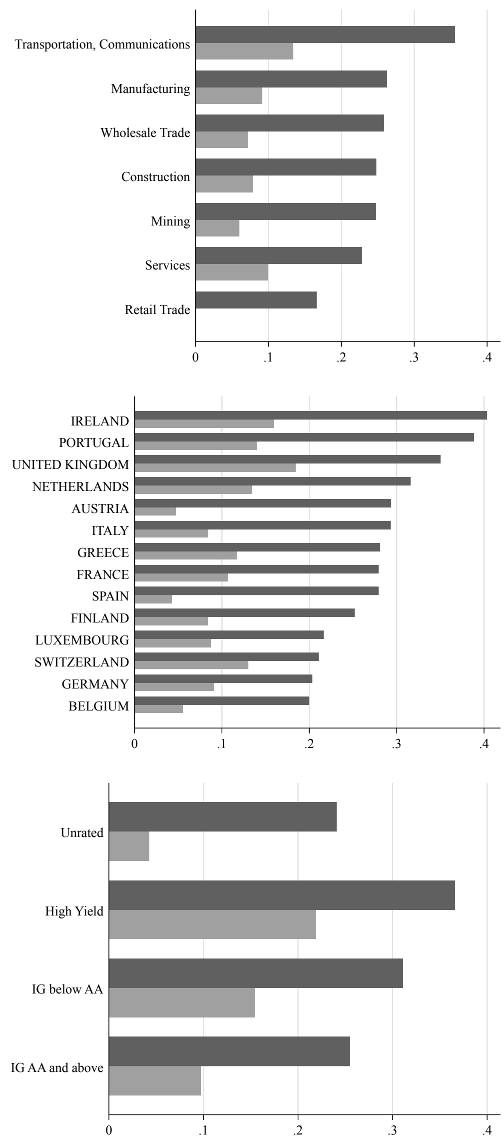


Figure 12 – Debt-over-assets (dark grey) and Bonds-over-assets (light grey) by Sector, Country and Rating

Note: This figure 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 92 ECB announcements days between 2001 and 2007. Each subfigure plots the average debt-over-assets (dark grey) and bonds-over-assets (light grey) ratio for firms in each group. The first panel sorts on sector, the second panel on country of incorporation and the third panel on S&P rating. Balance sheet data comes from Worldscope, bond issuance data comes from SDC Platinum, credit rating data comes from Capital IQ and stock market information comes from Datastream.