Corporate debt structure and heterogeneous monetary policy transmission

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Abstract

Using French firms' balance sheet data, we show that corporate debt structure plays a significant role in ECB monetary policy transmission. In addition to interest rate policy, we analyse the impact of a novel ECB-induced bond liquidity shock. While both types of policy tightening diminish French firms' investment, the transmission of conventional monetary policy shocks is stronger for firms with a higher share of bank debt. Conversely, contractionary bond liquidity shocks lower investment more for firms with higher bond shares of total debt. We further investigate the transmission channels and show that bond liquidity tightening reduces French sovereign bond market liquidity and leads to higher bond-bank loan interest rate spreads and lower bond issuance.

Keywords: Monetary policy transmission, Corporate debt structure, Investment.
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1. Introduction

Since the Global Financial Crisis, the share of debt securities in total non-financial corporation (NFC) debt has increased significantly.[1] This increase was particularly significant in the Euro area, traditionally dependent on bank-based finance, where the bond share of corporate debt almost doubled between 2007 and 2021 (from 9% to 16.6%). In France, the share of bond debt in total firm debt rose from 19% to 30% in the same period, but there were other countries where the increase was even more dramatic. In Spain, for example, market debt as a share of total firm debt went from 3% in 2007 to 14.7% in 2021.

Financial instruments that firms use to finance their activity have different characteristics, making them imperfect substitutes. Previous literature has shown that bank loans and bond securities respond differently to monetary policy shocks (Kashyap, Stein, and Wilcox, 1993, Becker and Ivashina, 2014, Lhuissier and Szczerbowicz, 2022). As such, corporate debt structure can matter for the monetary policy transmission.

In this paper, we show the importance of debt composition in the transmission of monetary policy to French firms' investment. Using a novel approach, we investigate the bond liquidity channel of unconventional monetary policy (UMP), and how the impact of monetary policy on a firm depends on its debt structure. We show that firms that are more dependent on bank finance react more to conventional monetary policy (CMP) shocks, while firms more reliant on market finance are more reactive to UMP.

The importance of debt structure of non-financial corporations (NFC) for monetary policy transmission was highlighted by Philip Lane and Isabel Schnabel, yet with apparently different conclusions. On one hand, Lane (2022) argued that a large bank share of NFC debt may dampen conventional monetary transmission due to slower speed of pass-through of policy rate changes into bank lending rates, when compared with corporate bond yields. On the other hand, Schnabel (2021), claimed that CMP shocks should have a stronger impact on the rates charged for bank loans than for corporate bonds, so the real effects of CMP strengthen with the share of bank finance in the economy. These contrasting views highlight that the importance of debt structure for the monetary transmission is not yet fully understood.

The canonical New Keynesian channel of monetary policy focuses on real rates and their impact on demand, via intertemporal consumption optimization. In such models, the financing structure of firms is irrelevant, as typically the Modigliani-Miller theorem holds. Recent literature has focused on financial frictions, where additional channels are present. For example, monetary policy has been shown to affect NFC investment through a "balance sheet channel" (Bernanke and Gertler, 1995). This channel implies

[1] Adrian, Colla, and Shin (2013), Darmouni and Papoutsi (2022).

that policy rate increases can make it more expensive for the firms to borrow externally and raise the firm-specific user cost of capital, decreasing their investment. Higher policy rates increase the "external finance premium" because they reduce asset values, and thus decrease the value of firms' balance sheets and their net worth.[2] Most of this literature has focused on loans or is silent about the distinction between market and bank debt.

But in the presence of financial frictions, the pass-through of monetary policy to bank and market debt could be quite different. In that case, central bank's rates would affect firms differently, depending on their access to different types of external financing. The firm-specific debt structure becomes an important factor of this heterogeneity, as long as monetary policy has an uneven impact on the costs of bank lending and debt securities (Holm-Hadulla and Thürwächter, 2021) and there is imperfect substitution between the two types of credit. Both bank loans and corporate bond markets can be subject to different frictions, independently reinforcing or attenuating the monetary transmission mechanism.[3]

According to the bank lending channel, CMP tightening leads to more restrictive bank credit conditions. In these circumstances, bond markets can provide an alternative to bank financing to NFC that have access to that "spare tyre" (Kashyap, Stein, and Wilcox, 1993, Adrian, Colla, and Shin, 2013).[4] If monetary tightening decreases bank loans but stimulates corporate bond issuance, then the effectiveness of monetary policy could be hampered. The investment will fall less after interest rates hike for the firms with better access to bond markets (Crouzet, 2021). Moreover, the burden of adjustment will fall disproportionately on firms that do not have access to the bond market "spare tyre", leading to possibly unwanted competitive effects of monetary policy. However, as argued by Darmouni, Giesecke, and Rodnyansky (2020), when frictions in bond financing are important, a bond lending channel can potentially dominate and firms with more bond financing would be *more* negatively affected by monetary tightening. In this paper, using a panel of micro data of French firms, we show that this is the case for unconventional monetary policy shocks, but not for conventional ones which have a stronger impact on firms that rely relatively more on bank financing.

The implementation of UMP has added an additional dimension to monetary policy and its transmission. In this paper, we acknowledge the development in central bank

[2]The external finance premium is the difference between the cost of capital raised by firms externally and the cost of capital raised using cash flows generated internally.

[3]Bank loans tend to be more costly and more exposed to cyclical shifts in credit supply (Becker and Ivashina, 2014). Bonds on the other hand are held by a dispersed number of investors, which makes them difficult to renegotiate existing credit contracts in times of financial distress, impeding efficient restructuring (Bolton and Scharfstein, 1996, Crouzet, 2017).

[4]The term "spare tyre" was used by Greenspan (1999) in his speech "Do efficient financial markets mitigate financial crises?", where he referred to capital markets as substitutes for the loss of bank financial intermediation.

toolkits and investigate whether there are differences in the transmission of CMP and UMP with respect to corporate debt structure. UMP have already been shown to have heterogeneous effects on issuance and cost of each debt instrument compared to CMP.[5] Quantitative easing in particular, reduced risk premia on debt securities, which stimulated corporate bond issuance rather than bank lending to NFC.[6] Therefore, conventional and unconventional monetary policies have potentially different effects on NFC investment.[7] In this paper, we focus on the bond credit channel of unconventional monetary policies and show that firms which rely relatively more on market finance are more sensitive than those that rely more on bank finance, while the converse holds true for conventional monetary policy.

We use firm-level panel data for France (FIBEN) to investigate the relevance of corporate debt structure for the the ECB monetary policy transmission. Our dataset consists of more than 11,000 distinct firms and around 80,000 observations, over the period 1999-2019. We rely on high frequency surprises around ECB announcements to identify monetary policy shocks. For CMP, we use the updated surprises from Jarociński and Karadi (2020), who separate conventional monetary policy shocks from central bank informational shocks. These surprises are based on risk-free yield changes of maturity up to one year around ECB announcements, which allows them to capture both interest rate decisions and (Odyssean) forward guidance. For UMP, we use the high frequency changes of 10-year sovereign spread between French and German bonds around ECB announcements, in order to study the effect of monetary policy shocks linked to French bond market liquidity.[8]

Since conventional monetary policy could also have an impact on bond liquidity, we orthogonalize the 10-year French-German spread surprises[9] with respect to CMP surprises. We find that the bond liquidity (BL) shock is relevant for French NFC investment, but also that transmission is heterogeneous and dependent on their firm-specific mix of bank and market debt. It also impacts French firms debt securities

[5]Lhuissier and Szczerbowicz (2022) show that an expansionary CMP in the United States leads to a rise in loans and a decline in debt securities issuance, while an expansionary UMP to a decline in loans and a rise in debt issuance.

[6]There is evidence that CB asset purchases lowered the NFC debt securities cost relative to the cost of bank funding, thus encouraging companies to switch from bank to bond financing (see for instance Arce, Mayordomo, and Gimeno, 2020, De Santis and Zaghini, 2021, Grosse-Rueschkamp, Steffen, and Streitz, 2019.

[7]Holm-Hadulla and Thürwächter (2021) study the effects of the ECB shocks to short-term and long-term rate on euro area countries' GDP. They show that a higher bond share goes along with a weaker transmission of short-term policy rate shocks to GDP, but the transmission of longer-term yields policy shocks is stronger.

[8]The French sovereign bond market is comparable to the German market in terms of credit rating, currency and amounts outstanding in the individual bonds (Ejsing and Sihvonen, 2009). Moreover, Schwarz (2018) finds that liquidity is an important drive of Euro area sovereign spreads.

[9]Using data from Altavilla et al. (2019).

issuance and cost.[10] Finally, consistent with our interpretation, we also find that it indeed affects sovereign bond market liquidity across a wide range of maturities.

We use local projections proposed by Jordà (2005) to first evaluate the aggregate effects of the ECB conventional and unconventional monetary policy on French firms' investment. Then we proceed to estimate the heterogeneous effect of both types of monetary policy depending on firms' debt structure. We control for firm fixed effects to capture permanent differences across firms and, when exploring cross-sectional differences, also for sector-time fixed effects in order to capture differences in how sectors respond to aggregate shocks. We find that both CMP and BL shocks have an economically and statistically significant negative effect on French firms' investment. We also provide evidence that monetary policy transmission to firm investment is a function of each firm's share of market debt and the specific type of monetary policy being used. Conventional monetary policy has a stronger impact on firm investment when the firm is more reliant on bank loans, while unconventional policies that increase liquidity in bond markets (such as quantitative easing) have a stronger effect when firm financing is more market-based.

Consistent with our interpretation of the shock, we show that ECB-induced BL shocks indeed reduce French sovereign bond market liquidity, measured by bid-ask spreads across a range of maturities. To shed light on the mechanism of transmission, we also show that BL shocks transmit to higher corporate bond prices and lower bond issuance, with negative effects on NFC investment. Moreover, we also show that after a contractionary BL shock the relative cost of bonds compared to bank loans increases, indicating that the transmission of BL to funding costs is stronger for market debt.

The contribution of this paper is twofold. First, we identify a bond-liquidity channel of MP and provide evidence on its impact on French firm investment. In particular, we provide evidence on the impact of the ECB policies on the liquidity of the French bond market and its effect on corporate bond prices. Second, we study the role of corporate debt structure in the transmission of both types of monetary policy to investment. By uncovering the relative importance of bond and bank credit supply shocks induced by these two types of monetary policy, we provide novel empirical evidence on the credit and liquidity channels of different forms of monetary policy.

The paper is organised as follows. Section 2 provides an overview of the literature. Section 3 describes the data used, while Section 4 compares the aggregate effects of both types of monetary policy. Section 4 also explores the heterogeneous responses of firms in response to the two monetary policy shocks. Section 5 uses complementary data sources to shed light on the transmissions channels and Section 6 concludes.

[10] ECB asset purchases were shown to spill over from sovereign to corporate bonds (Altavilla, Carboni, and Motto, 2021). Secondly, sovereign bond yields are an important benchmark for corporate bond pricing. Finally, the liquidity of French sovereign and corporate bonds is highly correlated (AMF, 2015).

2. Literature

Our paper relates to the literature on the credit channel of monetary policy, both from the firm balance sheet and the bank lending channel perspectives.[11] This literature links the heterogeneous response of firms to monetary policy shocks in the presence of financial frictions, related both to banks and NFC balance sheets. Ottonello and Winberry (2020) find that firms with low default risk are the most responsive to monetary shocks. Other studies argue that the firm-level response also depends on size (Gertler and Gilchrist, 1994) and their holdings of liquid assets (Jeenas, 2019). Cloyne et al. (2023) use the firm's age and dividend payouts to proxy for financial constraints, finding that financial frictions account for about one third of the aggregate investment response to conventional monetary policy.

The imperfect substitutability of different instruments of corporate debt generates additional frictions that affect monetary policy transmission. In particular, the share of floating-rate debt and the debt maturity were shown to affect the transmission of monetary policy to firms' investment and stock prices (Ippolito, Ozdagli, and Perez-Orive, 2017, Gürkaynak, Karasoy-Can, and Lee, 2022, Jungherr et al., 2022).[12]

Another important aspect of debt heterogeneity is related to the loan-bond composition of corporate debt.[13] The firm-level evidence from the United States shows that a higher share of bonds in corporate financing attenuates the impact of conventional monetary policy on firms' stock prices and investment, in line with bank lending channel (Crouzet, 2021, Ippolito, Ozdagli, and Perez-Orive, 2017). In this context, the possibility of issuing corporate bonds can hamper the effectiveness of interest rate increases, as the NFC can substitute bank loans with bond financing, even if only partially so. On the other hand, Darmouni, Giesecke, and Rodnyansky (2020), using firm-level data, highlight that stock prices and investment of listed euro area firms with higher bond to asset ratios are more affected by conventional monetary policy shocks than their counterparts, pointing to the importance of bond market frictions in the euro area.

We contribute to this literature by investigating the reaction of French firms investment to conventional monetary policy shocks. French firms have the highest share of bond financing in the EA, and as such we provide evidence that is more in line with the US evidence. This reinforces the idea that bond market depth is important to explain differences between US and EA-wide results. More importantly, we study here not only the role of bond-loan debt structure for CMP transmission but also for UMP trans-

[11]For the firm balance sheet channel, see Ashcraft and Campello (2007), Bernanke and Gertler (1995), and Gertler and Gilchrist (1994). For the bank lending channel, see Bernanke and Blinder (1988), Bernanke and Gertler (1995), Jiménez et al. (2012), Stein and Kashyap (2000), Kishan and Opiela (2000).

[12]See also Bräuning, Fillat, and Wang (2020), Barclay and Smith, 1995, Diamond and He (2014).

[13]The composition of debt instruments and related financing costs play an important role in firms' investment dynamics. See Dees et al. (2022), De Fiore and Uhlig (2015), Adrian, Colla, and Shin (2013).

mission, with a focus on the bond liquidity channel.[14] To do this, we use high-quality microeconomic data on French firms. Earlier literature found that unconventional monetary policy reduces corporate bond yields and risk premia, stimulating corporate bond issuance (Wright, 2012, Altavilla and Giannone, 2017, Lo Duca, Nicoletti, and Vidal Martínez, 2016, Lhuissier and Szczerbowicz, 2022). Giambona et al. (2020) used microeconomic data to study the effect of QE on investment. They find that investment by firms with access to the bond market increases. Using aggregate data in a panel of EA countries, Holm-Hadulla and Thürwächter (2021) show that the share of aggregate bond financing plays an opposite role in conventional and unconventional monetary policy transmission. It weakens the transmission of short-term policy rate shocks to GDP but strengthens the effects of monetary policy shocks to longer-term yields, which tend to be more responsive to UMP measures. This suggests that bank lending channel is not the main transmission channel for UMP. In this paper, we explore a separate channel of UMP related to bond liquidity, exploiting firm-level data. We provide a novel way to identify bond liquidity shocks and show that firms which are more reliant on corporate bonds markets for their external finance are more impacted by it than firms that are more reliant on bank lending.

Finally, our paper is related to the literature studying the impact of monetary policy shocks using high-frequency identification (Kuttner, 2001, Gürkaynak, Sack, and Swanson, 2005, Gertler and Karadi (2015), Gerko and Rey, 2017, Jarociński and Karadi, 2020, Nakamura and Steinsson, 2018, Altavilla et al. (2019) among others). We add to this literature by constructing high frequency surprises for the bond liquidity channel of monetary policy, which was particularly important during ECB asset purchase programs. We identify French bond liquidity shocks as movements in ten-year French sovereign spread around ECB policy announcements that are orthogonal to CMP shocks.

3. Data and summary statistics

3.1. Monetary policy shocks

We rely on high frequency surprises to identify monetary policy shocks. For CMP, we use the updated surprises from Jarociński and Karadi (2020) who separate conventional monetary policy shocks from central bank informational shocks. These (updated) surprises are based on risk-free asset changes around the ECB announcement of maturity up to one year, which allows them to capture both interest decisions and forward guidance.[15]

[14]Our sample also includes firms that aren't publicly listed.

[15]The updated MP shocks are available on Marek Jarocinski's webpage. The updated series are based on the 1st principal component of the Monetary Event-window changes in OIS with maturities 1, 3, 6

Unconventional monetary policy is a large set of tools that encompasses anything that goes beyond the use of policy rates. This can include very diverse instruments such as forward-guidance, asset purchases or lending operations. Since we want to examine the role of credit channels in bank and bond financing of French firms, we want to capture unconventional monetary policy shocks that are most directly connected to French bond markets. In order to do so, we use the high frequency movements in the 10y French-German sovereign spread to capture the effect of the unconventional monetary policy channel. To remove any possible systematic effect of CMP on these spreads, we also orthogonalize these surprises with respect to the CMP shock. The Figure 1 displays the yearly series of the two types of shocks. As expected, CMP shocks are of greater magnitude until 2008, while BL shocks are more important during the ZLB period.

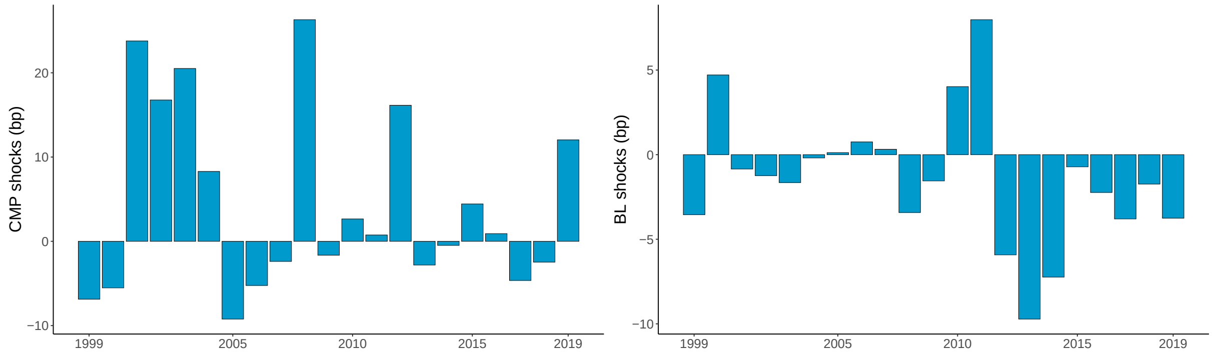
Both French and German sovereign bond markets are comparable in terms of credit rating, currency and amounts outstanding in the individual bonds (Ejsing and Sihvonen, 2009), but most importantly there is also evidence that movements in French-German sovereign spreads reflect mostly changes in liquidity premia.[16] We will show in Section 5 that the bond spreads surprises have a strong and consistent impact on French sovereign bond liquidity across all maturities and their first principal component. Although we cannot claim that all high-frequency surprises in the spread are due to liquidity, we label it as a Bond Liquidity (BL) shock given how strongly connected they are to sovereign bond bid-ask spreads across all maturities.

There are also important reasons to believe movements in the spread shocks can be important to firms, and in particular to corporate bond markets. First, ECB asset purchases were shown to spill over to corporate bonds (Altavilla, Carboni, and Motto, 2021). Second, sovereign bond yields are an important benchmark for corporate bond pricing. Literature showed that during periods of sovereign distress, governments might divert resources from the private sector to cover their fiscal needs, for example, by raising taxes (Corsetti et al., 2014), which implies that corporate borrowers can only be as safe as their sovereign. In line with this argument, Eichengreen and Mody (2000) and Bedendo and Colla (2015) find that sovereign risk ratings or other measures of sovereign risk affect corporate spreads and the likelihood of bond issuance. Finally, sovereign bond yields usually represent a floor for corporate bond yields or, in terms of bond prices or credit ratings, a ceiling, known as the "sovereign-ceiling hypothesis" (Borensztein, Cowan, and Valenzuela, 2013, Adelino and Ferreira, 2016, Almeida et al., 2017).

months and 1 year. Monetary Event-window as in Altavilla et al. (2019).

[16] ECB (2009), box 4: "New evidence on credit and liquidity premia in selected euro area sovereign yields".

Figure 1: Monetary policy shocks



3.2. Firm-level data

We measure the impact of the ECB monetary policy on French firms' investment using firm-level data on French companies from the Banque de France's FIBEN (*Fichier Bancaire des Entreprises*) database. This database contains balance sheets and income statements, covering all companies whose annual turnover exceeds 0.75m EUR or have debt above 0.38m EUR. We combine two consolidated databases for each of the accounting standards under which French companies can publish their results (French standards and International Financial Reporting Standards).

Companies are identified by their SIREN number, which is an Insee[17] code identifying uniquely each company, organization or association operating in France. Results are typically reported once a year, so data is annual, but the reporting date and the length of the fiscal year can vary. To avoid double-counting we exclude observations whenever there are multiple entries with the same SIREN-date pair, and for consistency we exclude those for which the duration of the fiscal year is different from 12 months. This ensures that any observation is for a complete year of business. For the remaining observations, if the date is between January and June, the observation year is considered as occurring preceding year. Otherwise, it is considered as occurring in the year of reporting. This allows us to consider the year in which most of the activities described in the observation take place. We also exclude firm observations with negative equity or negative assets.

3.3. Descriptive statistics

The final database contains 81 358 observations for 11 478 distinct firms. Our sample covers the years from the introduction of the Euro in 1999 to 2019.[18] All firm-level

[17]French National Institute of Statistics and Economic Studies

[18]We remove the observations from 2020, so as not to incorporate the Covid-19 pandemic period.

variables are winsorized or trimmed.[19] There is substantial heterogeneity among the firms of our sample. We report summary statistics in Table 1 and in Figure 2. The ratio of bonds to debt is on average 0.05, but it is mainly driven by a high number of firms that do not finance themselves through bonds. This is about half of the ratio found by Darmouni, Giesecke, and Rodnyansky (2020) in their dataset on firms entering the EURO STOXX 50. Around 80% of the observations in the sample are from firms with no bond debt during that reporting year.

Table 1: Summary statistics

	Mean	Std.dev.	Min	Max
Monetary policy shocks (pp)				
CMP	0.04	0.10	-0.09	0.26
French bond liquidity	-0.02	0.04	-0.10	0.08
Dependent variable				
Investment rate* (%)	1.57	5.87	-19.58	43.25
Aggregate control variables				
French output gap	-0.006	1.60	-2.6	2.79
French inflation	1.38	0.77	0.07	2.81
VIX	19.9	7.06	11.04	40
10y French sovereign rate	3.01	1.65	0.13	5.39
3m interbank rate	1.75	1.76	-0.36	4.63
Firm-specific control variables				
Leverage	0.25	0.17	0	0.79
Total assets (in bn)	0.39	1.72	0	25.72
Cash flows to total assets	0.10	0.07	-0.19	0.75
Bond share ratio	0.05	0.16	0	1

** Investment rate is defined as the difference in net tangible assets with respect to lagged total assets.*

Figure 2 displays histograms from the subsample of firms that finance themselves at least partly through bonds.[20] Within the group that has access to the bond market, there are more firms with low bond ratios than there are with large ones. Despite this pattern, the distribution is more even for bond ratios than it is for bond debt over assets. There are a non-negligible number of observations across all possible values of bond ratios, allowing us to explore this dimension of the panel data. For bond debt over assets, we observe a more concentrated distribution. This is expected, since firms at the higher end of the distribution need to combine high leverage ratios with high bond ratios. In Figure 12 of the Appendix, we also provide histograms for log assets and leverage for the full sample of firms.

[19] Net investment rate, total assets and cash flow over total assets are winsorized at the 1st and 99th percentiles, while leverage is trimmed at the 99th percentile.

[20] As mentioned before, there is a large mass point at 0, just that including it masks the heterogeneity within the remaining firms.

Figure 2: Histograms

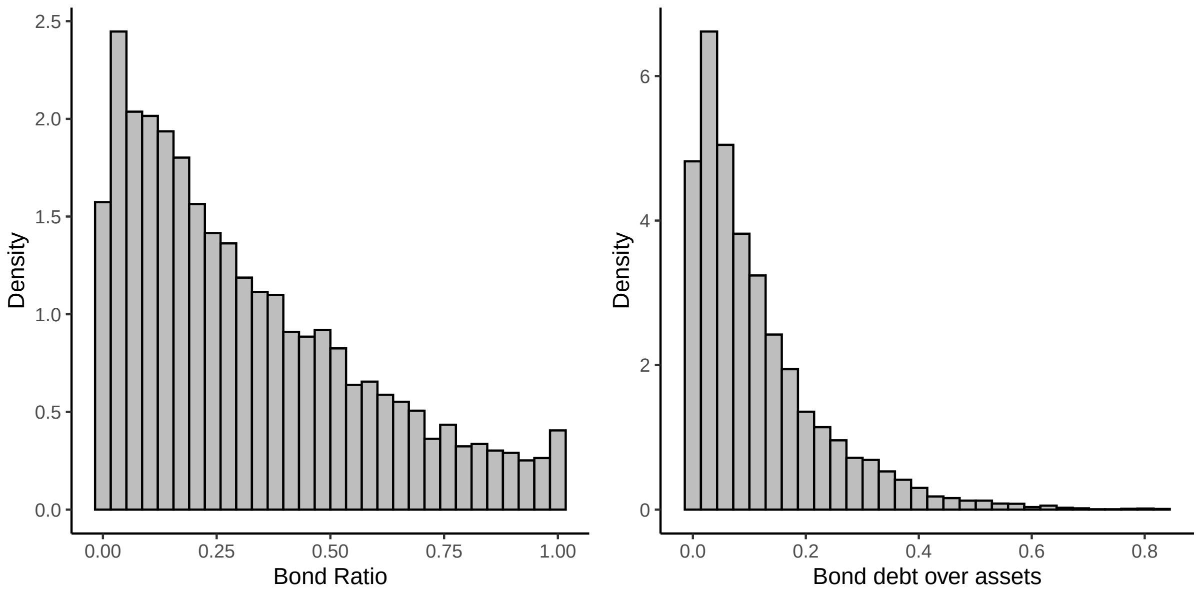
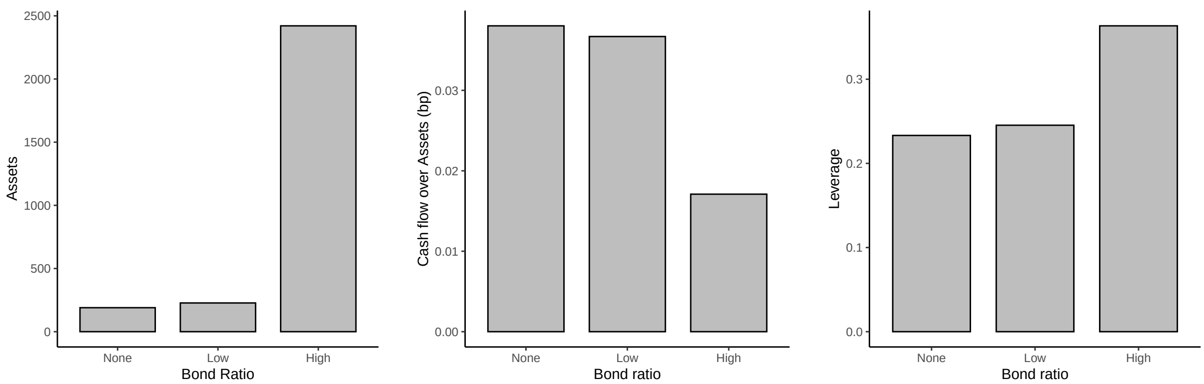


Figure 3 provides information on firms' assets, cash flow over assets and leverage, according to their corporate debt structure. For each variable, we indicate the average across 3 categories of firms: those with a bond ratio equal to zero, those with a bond ratio below a cut-off value and those with a bond ratio above it. The cut-off value is the median bond ratio of firms with non-zero bonds. Firms with a bond share ratio higher than the (conditional) median are on average significantly larger than those within the other two categories. They are also more highly levered and have lower cash flows relative to the other two groups. Given the heterogeneity in terms of size, we follow the standard approach and look at variables scaled by firm size while at the same time controlling for firm size.

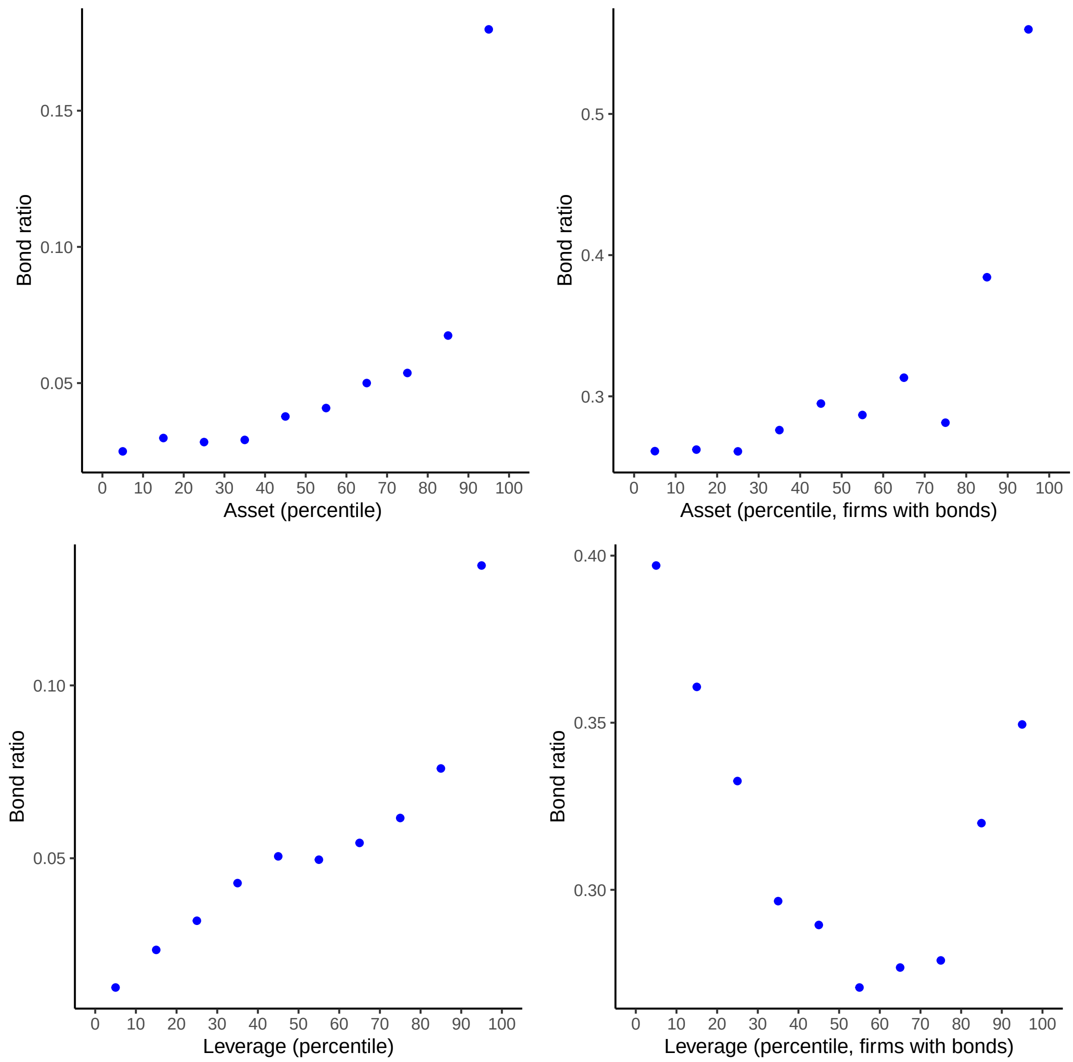
Figure 3: Corporate debt structure and firm characteristics



Each panel represents the average of the corresponding variable for three groups of firms: those with no bonds, those with bond ratios below the median (conditional on having bonds), and firms with bond ratios above the median.

Figure 4 shows binned scatter plots of the average bond ratio for different bins of, respectively, assets and leverage.[21] Panels on the left are constructed using the full sample, while the ones on the right restrict the analysis to only firms with bonds. As can be seen in the top row, we retrieve the positive relationship between bond ratio and asset size. The distribution has significant skewness, as large firms have significantly larger bond ratios. In the top right panel, we see a similarly shaped distribution when we limit the sample to firms with non-zero bond debt, but with much higher values of bond ratios (and a bit more noise).

Figure 4: Binned scatterplots of bond ratios by asset size and leverage



In the bottom row, we see that doing a similar analysis by leverage reveals very different patterns in the full sample and the bond firms subsample. While we have a stable and monotonic positive relationship in the full sample, the subsample is U-shaped. The combination of the two panels shows that the low average bond ratios for firms in the lower leverage percentiles of the full sample are driven by firms with no

[21] Figure 13 in the Appendix also shows the equivalent for cash flow over assets.

bonds, but conditional on having bonds, low leverage firms actually have the highest share of bonds across the bins represented.

4. Investment response to monetary policy

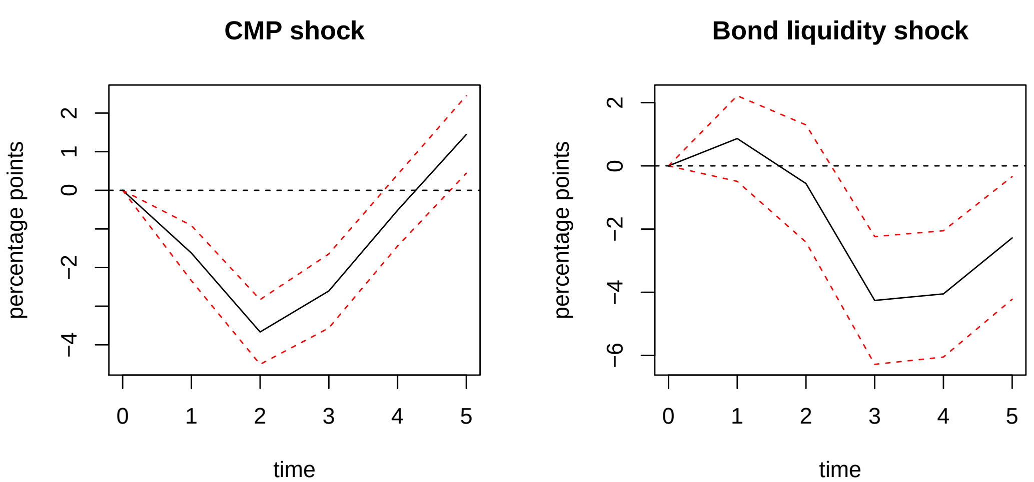
We examine first the aggregate effect of monetary policy shocks on French firms' investment rates. To capture the time profile of the response, we use a panel local projection approach proposed by Jordà (2005). We define net investment rate $I_{i,t}$ of firm i as the first difference of net tangible assets in year t, scaled by total assets in year *t-1*.[22]

To measure the effect of a conventional and unconventional monetary policy shocks at time t on investment at horizons $h \in (0, 1, ..., 5)$, we estimate the following set of equations:

$$\Delta I_{i,t+h} = \alpha^h S_t + \sum_{l=1}^{3} \Psi_l^h Z_{t-l} + \sum_{l=1}^{3} \Gamma_l^h X_{i,t-l} + \mu_i^h + \epsilon_{i,t+h} \tag{1}$$

where $\Delta I_{i,t+h}$ is the h-year forward difference in the net investment rate: $\Delta I_{i,t+h} = I_{i,t+h} - I_{i,t-1}$. S_t is a CMP shock or a French bond liquidity shock. Z_{t-1} is the control vector of lagged aggregate controls: French output gap, French inflation, VIX, 10-year French sovereign rate, 3-month interbank rate. $X_{i,t-1}$ is the vector of lagged firm-specific controls: leverage, total assets, cash flows to total assets and bond dummy that is equal to 1 for firms that have non-zero share of bond financing. μ_i are firm fixed effects.

Figure 5: Average response of investment to CMP (left panel) and BL (right panel) shocks



[22]We focus on tangible investment as the literature showed that the debt financing shocks are relatively more important for explaining physical investment dynamics, while equity financing shocks are relatively more important for explaining R&D investment dynamics (Bianchi, Kung, and Morales, 2019).

Figure 5 shows the average impulse response function of investment rate to a 100 basis point upward surprise for CMP (left panel) and BL shock (right panel) at each horizon h (from 1 to 5 years). A CMP tightening of 100bp leads to a 3.5pp decline of investment with respect to firm's total assets, while a contractionary BL shock of 100bp reduces it by 4.2pp. The CMP shock has an economically and statistically significant negative effect in the first three years after the shock. The BL shock decreases French firms' investment with a lag, starting only from the third year after the shock.

Our estimates for CMP shocks is consistent with the ones found in the literature.[23] The identified BL shock has then an impact at its peak of similar magnitude per unit of the shock. However, it's important to note that the standard deviation of CMP is 2.5 times larger than BL shocks across the full sample. Restricting the sample to the post-2008 period, this ratio is almost halved, with the standard deviation of CMP shocks being only 30% larger than BL shocks. As expected, BL shocks had a much more active role post-2008.

In order to investigate possible heterogeneity in the transmission of the two types of monetary policy shocks, we then explore the role of corporate debt structure. To do this, we again estimate LP, but we interact the shock with the (lagged) firm-specific *bond ratio* (defined as the share of bond liabilities in total firm debt). A value of 0 indicates that the firm has only bank loans, while a value of 1 implies the firm has no bank loans but only bond debt.

$$\Delta I_{i,t+h} = \alpha_i^h B_{i,t-1} S_t + \sum_{l=1}^{3} \Gamma_l^h X_{i,t-l} + \mu_i^h + \theta_{s,t}^h + \epsilon_{i,t+h} \tag{2}$$

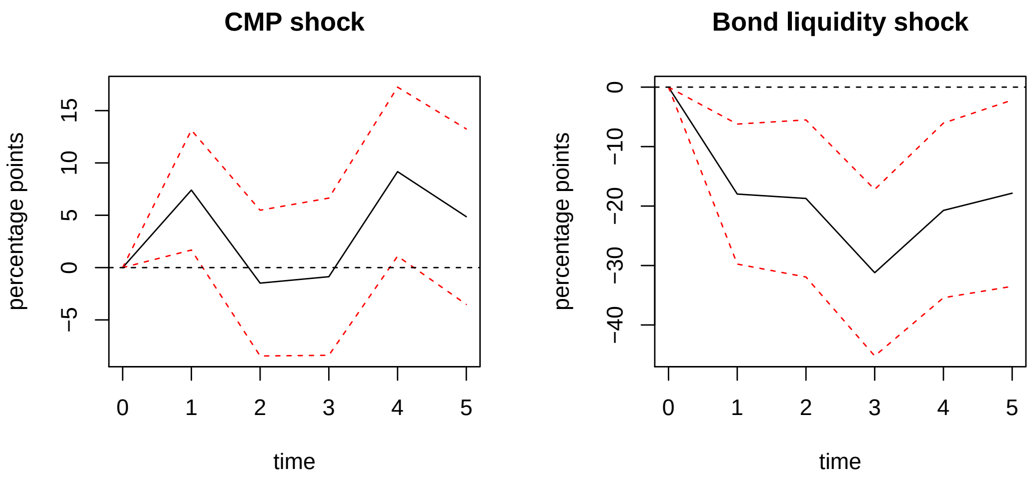
where $B_{i,t-1}$ is the lagged bond ratio. Since we are now interested only in the heterogeneity of responses, we can include sector-time fixed effects $\theta_{s,t}$ which will (among other things) absorb all sector-specific responses to the shocks. All other variables, such as firm-specific controls and firm fixed effects, are as in Equation 1.

Figure 6 shows the estimated coefficients for the interaction variable between monetary policy shocks and the lagged bond share in NFC debt. As the left panel of the graph indicates, after a contractionary 100bp CMP shock, firm investment falls less, the higher its share of market financing is. In particular, the contemporaneous decline in investment with respect to total assets of bank reliant firms is 7pp bigger compared to bond reliant ones [24]. On the other hand, after a contractionary 100bp BL shock, firm investment falls more, the higher is its market financing share. After one year, the decline in investment of more bond reliant firms is 18pp bigger compared to more bank reliant ones, and this effect increases to 30pp at its peak.

[23] Using US firm-level data, Cloyne et al. (2023) show that a 25bp rise in the interest rate leads to a fall in business investment of around 0.6-0.8% after two years.

[24] i.e. comparing a firm with a bond ratio of 0 to one with a bond ratio equal to 1.

Figure 6: Heterogeneous response of investment to CMP (left panel) and BL (right panel) shock depending on firms' bond share



Monetary policy transmission to firm investment is then a function of each firm's share of market debt and the specific type of monetary policy being used. Conventional monetary policy has a stronger impact on firm investment when the firm is more reliant on bank loans, while unconventional policies that increase liquidity in bond markets (such as QE) have a stronger effect when firm financing is more market-based. To shed light on why this is the case, we explore in the next section the links between each type of credit supply and the two types of monetary policy shocks.

5. Inspecting the transmission channel

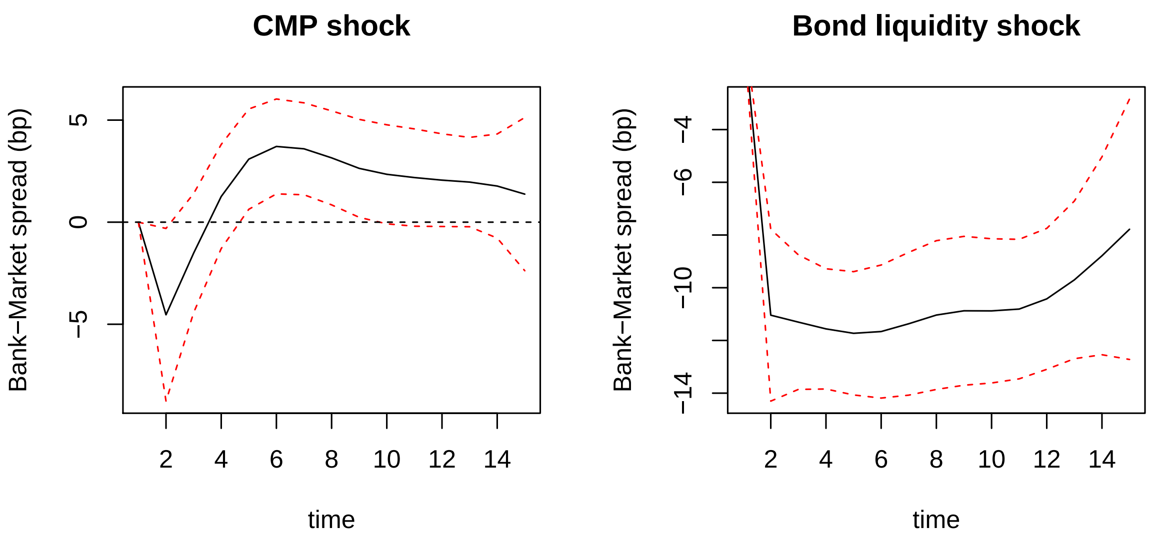
5.1. Impact on aggregate debt flows and prices

In Section 4, we established that the different types of monetary policy affect firms differently depending on their financing structure. In this section, we investigate the channels by looking at funding cost data. Unfortunately, we do not have data on firm-specific funding costs so we need to look at aggregate variables. On the other hand, this allows us to use monthly frequency which might be important when looking at financial variables.

Without the cross-sectional dimension of the panel, the sample size is reduced considerably. However, the impulse responses in LP are heavily parametrized and they can have high variability (Ramey, 2016). On the other hand, more efficient VAR approaches might be too restrictive and lead to bias. We then use smooth local projections (S-LP) as in Barnichon and Brownlees (2019). This penalization method can help deal with excess variability, without restricting ex-ante the shape of the impulse response function.[25] To achieve that, S-LP make use of a shrinkage parameter that pins down the bias/variance trade-off of the estimator. When this parameter is set to 0, the method coincides with standard local projections estimated by least squares, whereas when it is large the impulse response converges to a polynomial distributed lag model (Almon, 1965). We follow Barnichon and Brownlees (2019), and let the data choose the shrinkage parameter using 5-fold cross-validation, picking the value that provides the best pseudo-out-of-sample fit.[26]

Using S-LP, we explore the transmission channel in more detail by looking at the impact of monetary policy shocks on the cost of each type of debt, as well as on the quantity dimension (flows and stocks).[27] In Figure 7, we show the response of the bank-market spread, defined as the rate bank loans compared with the average yield of corporate bonds. In the left panel, we see the response of the aggregate bank-market

Figure 7: Response of bank-market spreads to CMP (left panel) and BL (right panel) shocks



spread to a CMP shock. As monetary policy contracts, the spread seems to fall in the short run but quickly becomes persistently positive. As highlighted by Schnabel (2021), conventional shocks have indeed a *stronger* pass-through to bank loan rates relative to bond ones. However, the short-lived drop during the first period after the shock is also consistent with Lane (2022) who argues that the pass-through is *faster* to bond market prices than to bank rates. The impulse response can then shed light on how the two statements are not necessarily contradictory.

[25]See Li, Plagborg-Møller, and Wolf (2022)

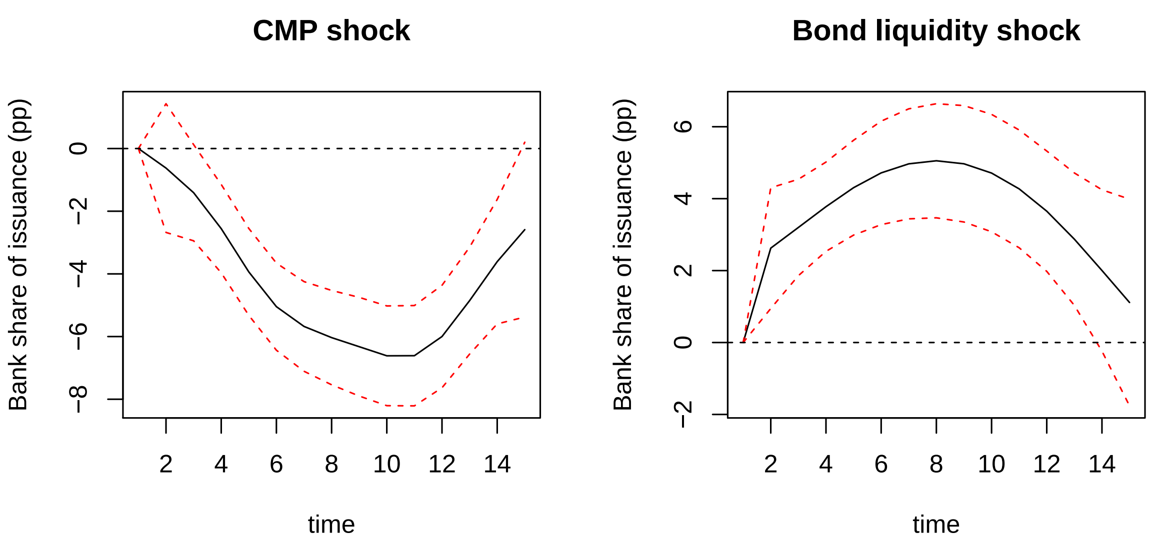
[26]For additional details on the method and its properties, see Barnichon and Brownlees (2019).

[27]Monthly data on French NFC financing is published on Banque de France website: https://www.banque-france.fr/en/statistics/loans/loans/financing-entreprises.

In the right panel, we see a more standard dynamic. After a BL shock, market rates rise more than bank rates and therefore the spreads are reduced. The impact of such unconventional shocks is then also *stronger* for bond markets. Firms facing these dynamics could then try to substitute bank debt with market debt after a CMP shock and conversely, they could substitute market debt with bank debt after a BL shock.

In Figure 8 we can see the impact on debt flows in response to the two shocks. In the left panel, we observe that the share of bank debt in new issuance falls after a CMP shock and in the right panel we see that it rises after a BL shock. This is again consistent with the interpretation that there is segmented transmission and different pass-through of different shocks to different debt markets. The banking sector is more sensitive to CMP shocks and so interest rates hikes have higher pass-through to bank loans. On the contrary, bond markets are more sensitive to BL shocks, which have therefore a stronger pass-through to bond debt volumes than to bank loans. In the Appendix, we also show that the same effects can be observed in the relative stocks of debt (Figure 14) but also the absolute flows and not just the relative ones (Figures 16 and 15).

Figure 8: Response of bank share of issuance to CMP (left panel) and BL (right panel) shocks

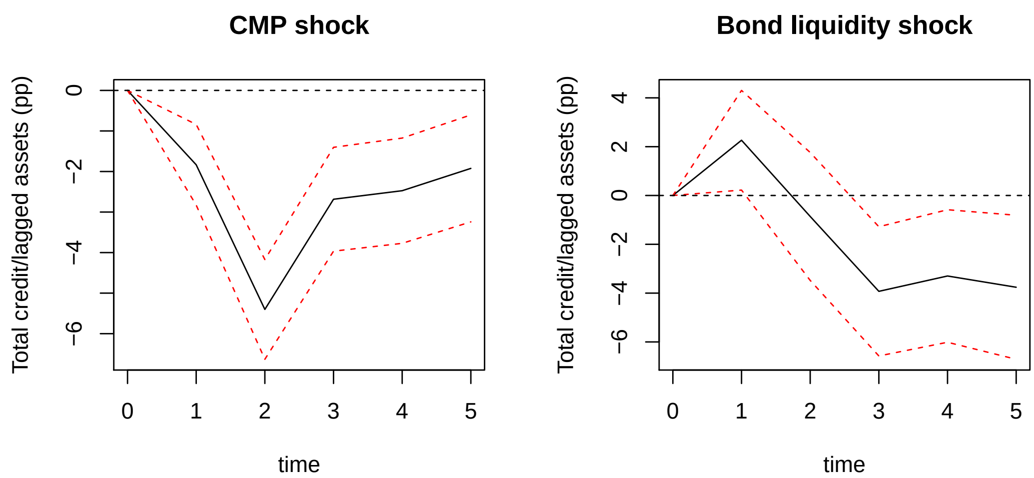


These results shed light on the channels explaining the results of our baseline regressions. After a CMP tightening, firms that are more dependent on bank lending tend to contract investment significantly more than firms that have more access to bond markets, while BL tightening affects bond-dependent firms relatively more. Given the reaction of quantities and prices, the two shocks act as relative supply shocks on each of the two markets: CMP for bank debt and BL for bond debt. We also show that firms with high reliance on bond financing can use it as a "spare tyre" when faced with CMP shock. Yet, bond financing makes them more exposed to unconventional monetary policy tightening, in particular to shocks that impact bond markets like our BL shock. The two markets are not perfectly integrated and firms have difficulty substituting one for the other, irrespective of the direction required. As the right panel of Figure 16 and the left panel of Figure 15 in the Appendix show, there is some degree of substitutability since bond flows rise after a contractionary CMP shock and bank loans grow after a contractionary BL shock. However, this is not sufficient to stop the contractionary effects on aggregate investment, as highlighted in our baseline panel results.

5.2. Firm-level data: Total Credit

Although we do not have data on firm-level funding costs for each debt instrument, in this section we explore the panel data to shed additional light on the credit channel of monetary policy transmission. Consistent with our interpretation of this channel, along with imperfect substitution across credit instruments, we expect total credit to fall across firms for all shocks, but CMP to have a stronger impact on firms that are more bank-based, while BL to have a stronger impact on more market-based firms.

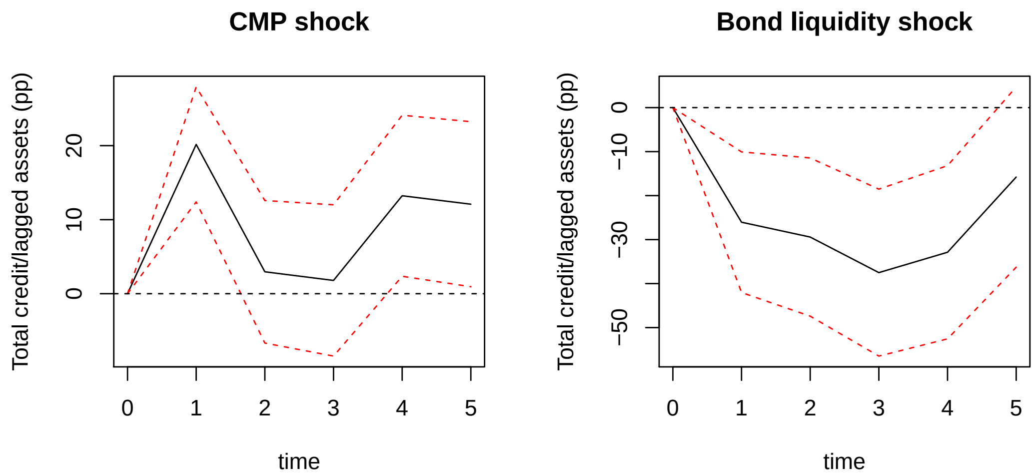
Figure 9: Average response of leverage to CMP (left panel) and BL (right panel) shocks



We then first look at total firm credit, scaled by lagged assets, using the same controls and fixed effects as in Equation (1). Using LP to compute the impulse responses, we show in Figure 9 the estimated effect in percentage points of a 100 basis point upward surprise for CMP (left panel) and BL (right panel) shocks. The left panel highlights that CMP shocks have an economically and statistically significant negative effect, with the total credit falling up to 5pp of lagged total assets 2 years after the shock. The BL on the other hand leads to a fall in credit that reaches around 4pp of lagged assets 3 years after the shock. Unsurprisingly, both shocks are contractionary and lead to reductions in firm credit.

We then explore the cross-sectional heterogeneity, and let the panel results reveal the role of debt structure in the monetary policy transmission. To do so, we interact monetary policy shocks with the lagged bond share in NFC debt, including the same controls and fixed effects as in Equation (2). Figure 10 shows the estimated coefficients for the interaction variable between monetary policy shocks and the lagged bond share in NFC debt. After a contractionary CMP shock (left panel), firms' total credit falls less, the higher the bond share is. On the other hand, after a contractionary BL shock, firms' total credit falls more, the higher the bond share is. The transmission of conventional monetary policy to total credit is stronger to firms that are more dependent on bank financing, while it is weaker for those who have more market financing. On the other hand, those that are more market-based are more exposed to unconventional monetary policy shocks that impact bond markets.

Figure 10: Heterogeneous response of total credit to CMP (left panel) and BL (right panel) shock depending on firms' bond share



5.3. Liquidity shocks and bid-ask spreads

Finally, we show that BL shocks indeed have a strong link with bond market liquidity. We also show that the impact is felt at all levels of maturity, despite the BL shock being identified using only 10y French and German bonds. To do so, we run smooth local projections on daily bid-ask spread data for French sovereign bonds with maturities running from 1m to 50y.[28] In Figure 11, we show the impact of each shock on the first principal component of bid-ask spreads across all maturities. In Figure 17 of the Appendix we also show the results for each individual maturity.

[28]The following maturities were considered: 1m, 3m, 6m, 1y, 2y, 3y, 5y, 10y, 15y, 20y, 30y and 50y.

Figure 11: Response of the first principal component of bid-ask spreads across all maturities to CMP (left panel) and BL (right panel) shocks

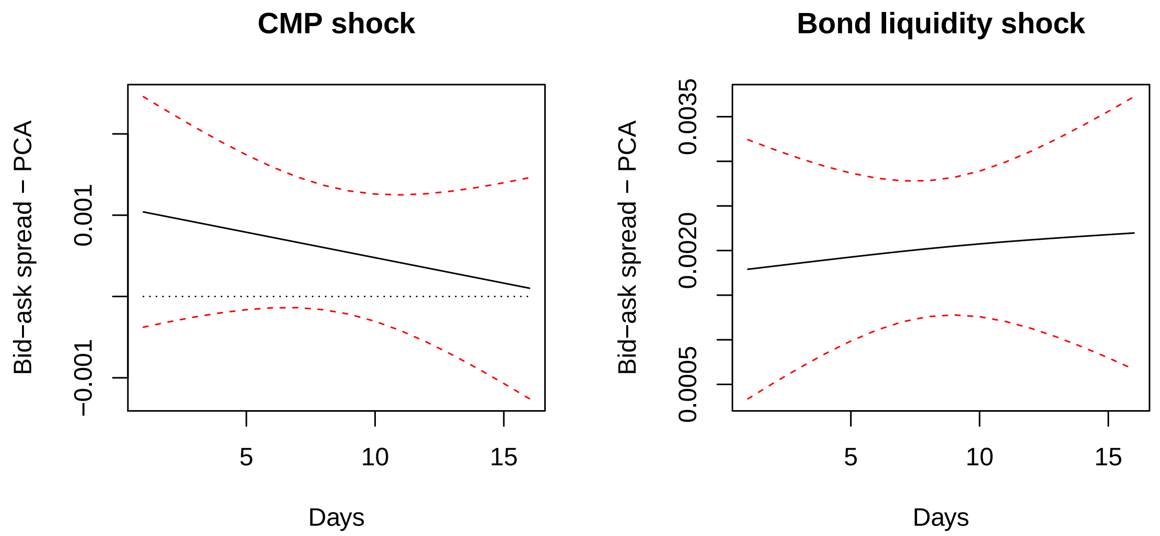


Figure 11 shows that the BL shocks have a consistent positive impact on the first principal component of bid-ask spreads, pointing to the worsening of market liquidty of French sovereign bonds. After a contractionary BL shock, the common component of bid-ask spreads across all maturities rises by about 0.2bp. The average bid-ask spread of 10y bonds is about 0.4bp, so it is not a trivial value.

The same is not true for CMP shocks, where there is no consistent liquidity impact of CMP shocks as can be seen on the left panel of Figure 11. Looking at specific maturities, there is some limited impact on intermediate maturities but overall the effect is much less clear. In particular, there is no positive impact of CMP on any of the bid-ask spreads in the set of maturities used to identify CMP shocks (1m, 3m, 9m and 1y). However, there is some impact on spreads at 10y maturity, highlighting the importance orthogonalizing movements in the spread from CMP shocks when identifying BL shocks.

Although it's true that it's hard to claim *all* high frequency movements in the French-German spread are due to relative liquidity across these markets, the evidence provided in this section clearly indicates that there is a stronger and more consistent link between BL shocks and liquidity in bond markets, than there is between CMP shocks and liquidity. This is not claiming that CMP has no impact on liquidity, rather simply that BL shocks are a useful proxy for bond market liquidity shocks driven by monetary policy.

6. Conclusion

In this paper, we identify significant heterogeneity in the transmission of monetary policy across firms. Using a novel approach to identify unconventional monetary policy shocks that are tightly linked to liquidity and a large panel of French firms, we show that while both conventional monetary policy and bond liquidity shocks reduce average firm investment, the strength of this effect depends on their debt structure.

Firms which are more reliant on bank credit contract investment relatively more after contractionary CMP shocks, but are affected less by contractionary bond liquidity shocks. This points to imperfect integration across the two debt markets. Using aggregate data, we show that there is substantial substitution between types of debt after each type of monetary policy shock. While there is some degree of substitutability, it is insufficient to stop contractionary effect of monetary policy on NFC investment.

Heterogeneous monetary policy impact on firms' investment has important policy implications. Investment of large NFC with better access to capital markets could be more affected by quantitative tightening, while investment of smaller firms would decrease more by conventional tightening. In the absence of a coordinated approach, monetary policy can generate winners/losers depending on the tool used. On the other hand, policy can be more targeted when there are specific issues with one type of funding.

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Appendix

Figure 12: Additional histograms

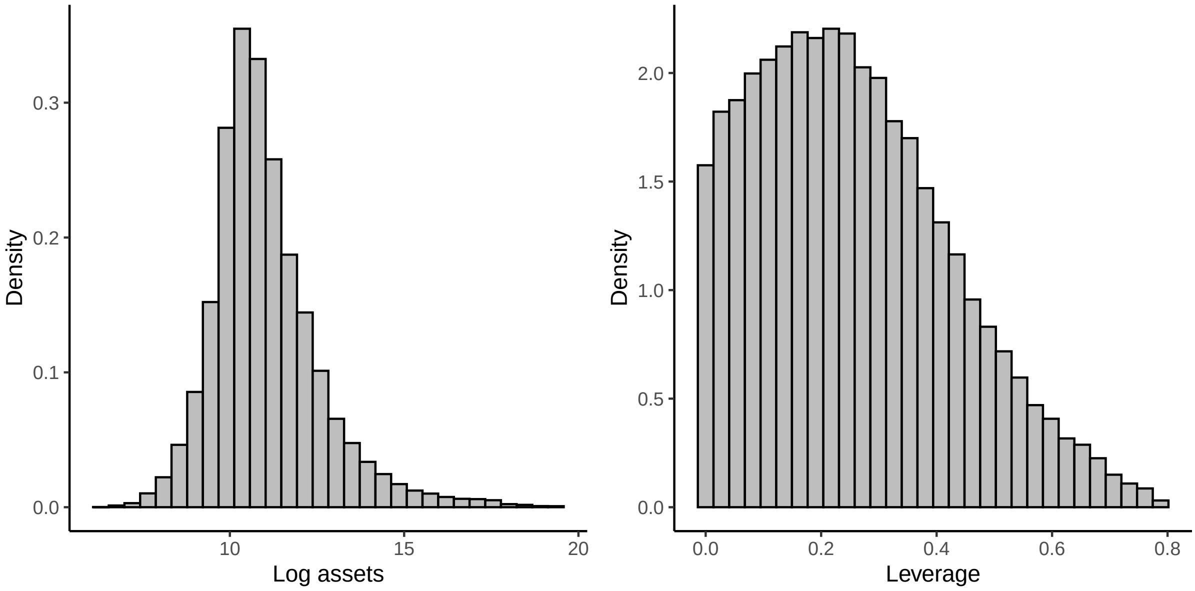

Figure 13: Binned scatterplots of bond ratios by cash flow over assets

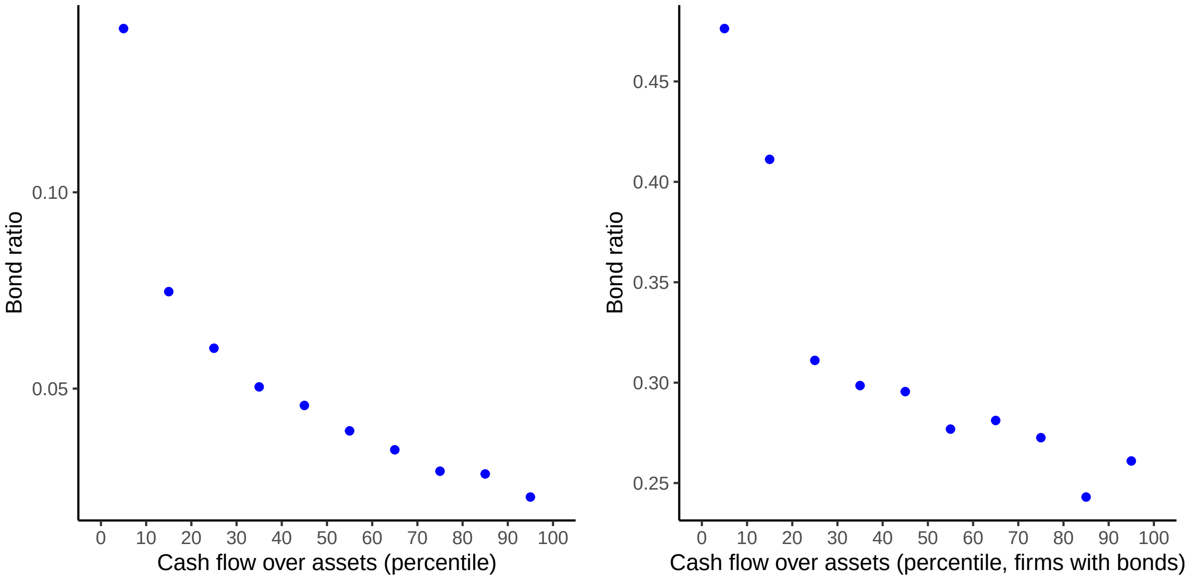

Figure 14: Response of bond share of debt to CMP (left panel) and BL (right panel) shocks

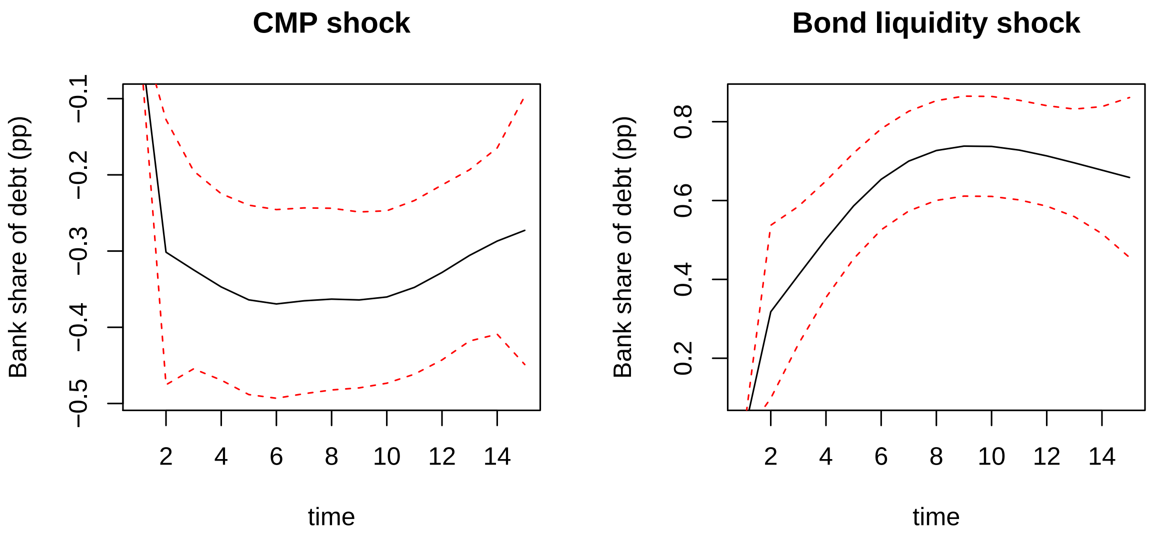

Figure 15: Response of bond issuance CMP (left panel) and BL (right panel) shocks

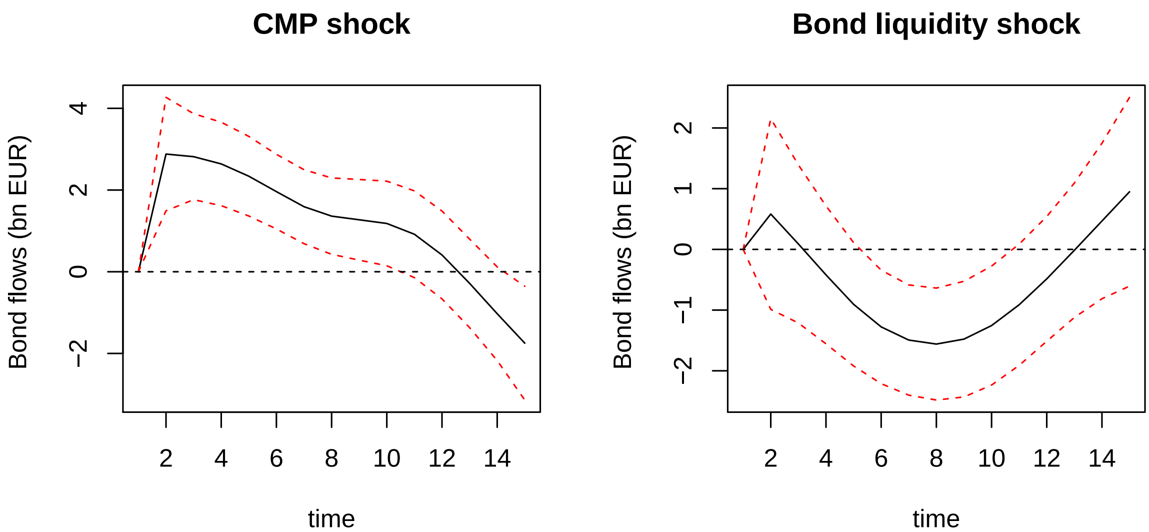

Figure 16: Response of bank loan flows to CMP (left panel) and BL (right panel) shocks

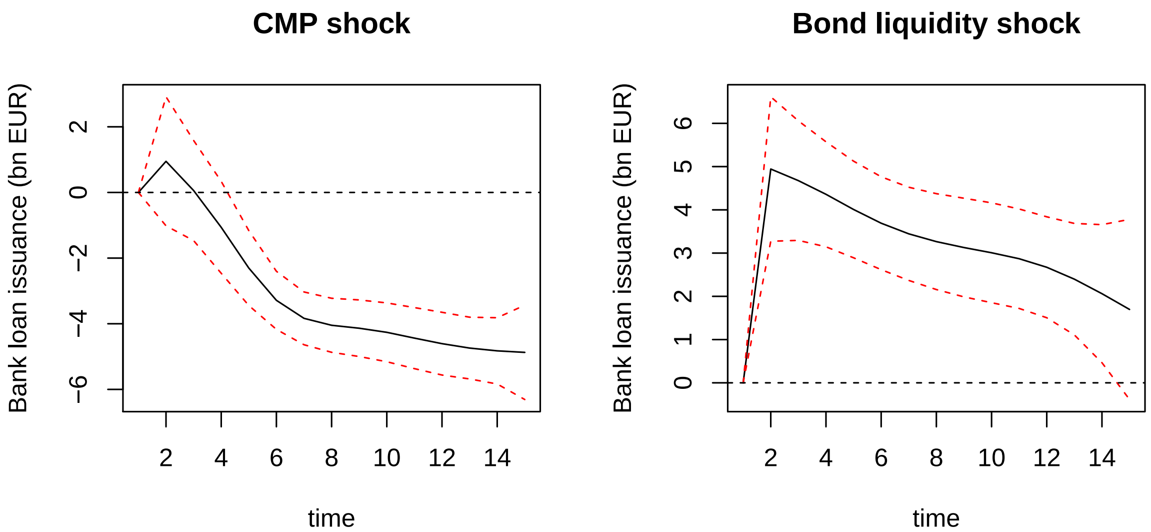

Figure 17: Response of bid-ask spreads at different maturities to to CMP and BL shocks