# Credit disintermediation and monetary policy

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**Abstract**

Since the early 90s, the importance of banks in the intermediation of credit to firms has gradually declined. This papers studies the potential implications of this trend for the pass-through of monetary policy to corporate investment. Empirically, I show that this decline is driven by a change in the debt mix of the typical firm, as opposed to a reallocation of credit away from bank-dependent firms. Moreover, while monetary policy tightenings lead to a drop in investment at the typical firm, this drop is larger among more bank-dependent firms. Finally, since the early 1990's, both the response of the typical firm to a monetary policy shock, and the relative response of more bank-dependent firms, have declined by approximately half. Simple computations using a partial equilibrium model in which firms simultaneously choose investment and the debt mix suggest that, alone, disintermediation could account for two-thirds of this decline.

# I Introduction

Over the past three decades, the importance of banks in the provision of credit to corporations has gradually declined. The top left panel of Figure 1 reports the (log of) the stock of outstanding bank loans and mortgages, and the (log of) the stock of all other outstanding debt securities on the balance sheet of US non-financial corporations. From the 1960s to the early 1990s, these two quantities grew in tandem. Since the 1990s, a substantial gap has opened between the two, with each successive recession resulting in a permanently lower stock of outstanding bank loans on firms' balance sheets, relative to trend. In other words, since the early 1990s, corporate credit has become progressively "disintermediated," that is, less reliant on banks and bank loans.[1]

This paper studies what this trend might imply for the transmission of monetary policy shocks. This question speaks to the broader issue of the credit channel of monetary policy (Bernanke and Gertler, 1995), and how this channel has evolved over the past four decades.

There are a number of reasons to suspect that the structure of financial intermediation to corporations affects their sensitivity to monetary policy shocks. Some have to do with credit supply. An influential view of the monetary policy transmission mechanism is that it works through banks' balance sheets (Bernanke and Blinder, 1992), making bank-dependent firms potentially more exposed to monetary policy shocks. Other reasons have to do with credit demand. Loans and bonds differ in their maturity, interest rate exposure, and flexibility, among other things, and these characteristics may imply different interest rate elasticities of demand for each type of debt. The goal of this paper is to clarify some of these potential channels, and to provide supporting evidence of their importance for the monetary transmission mechanism.

I start by analyzing in more detail the changes in the composition of corporate debt highlighted in Figure 1. Specifically, in section II, I link the *aggregate* decline in the importance of loans, relative to other forms of credit, to *firm-level* trends. I show that the decline in the aggregate loan share does not seem to be driven by composition effects. Rather, it reflects a firm-level shift away from loans and toward market-based forms of financing. Specifically, I show, first, that the trend is

[1]The US is not an isolated example of this phenomenon, though it was a precursor among advanced economies. Though the overall bank share of total corporate credit is higher in Germany than in the US, the bank share in Germany is also on a downward trajectory, which has accelerated since the late 2000s and the onset of the Great Recession. The outlier, among advanced economies, is Japan, where Flow of Funds data indicate that the relative importance of bank loans has remained stable, and is substantially higher than in all other advanced economies.

present among publicly traded firms, so that it does not reflect a reallocation of credit away from (more bank-dependent) private firms. Second, I show that among publicly traded firms, the decline in the importance of loans is primarily a within-firm phenomenon, as opposed to being driven by a reallocation of credit toward the largest (mainly bond-financed) corporations.

Since disintermediation does not seem to simply be a reflection of broader forces affecting the distribution of credit across firms, one needs to appeal to theories of debt structure within firm in order to think through its potential implications for monetary policy transmission. In section III, I describe a simple, partial equilibrium model of debt financing and investment, which I use to draw some more precise cross-sectional predictions for the pass-through of monetary policy shocks to borrowing and, ultimately, investment.

This model has two key ingredients. First, it takes a particular stance on what makes loans different from bonds. Specifically, it assumes that banks charge higher intermediation spreads than bond markets, but also one that bank loans are easier to restructure in times of financial distress.[2] Second, it allows for banks and non-bank financial intermediaries to have differential exposures to monetary policy shocks, so that the supply (or the cost) of loans and bonds may respond differentially to monetary policy shocks. I start by analyzing a version of the model in which the intermediation spread between banks and bonds does not depend on the level of interest rates.

This version model has three key empirical predictions. First, keeping the debt composition of firms constant, total *borrowing* among predominantly loan-financed firms should be *less* sensitive to an increase in interest rates than among predominantly bond-financed firms. The intuition for this result is as follows. The increase in risk-free rates reduces firms' total demand for debt. It also steepens the credit supply curve, by making interest payments higher and thus (all other things equal) making liquidation more likely and deadweight losses higher. However, this effect is milder among predominantly bank-financed firms, for which liquidation is easier to avoid. As a result, the total decline in borrowing is smaller among bank-financed firms. Second, total *investment* among predominantly bank-financed firms should nevertheless be *more* sensitive to the increase in interest rates. This is because in the model, firms with a high loan share also tend to be more levered; this

[2] As mentioned above, there are other important differences between bonds and loans, which I discuss in section III, but which I choose to leave outside of the scope of the model, mostly because their relationship to monetary policy shocks has already been analyzed elsewhere.

translates into a higher sensitivity of total investment despite a lower sensitivity of total borrowing.[3] Third, allowing for the debt structure of firms to adjust in response to the increase in interest rates, the average loan share can either rise or decline in response to the shock, depending on how risky and leveraged a firm initially is. The riskiest and most leveraged firms, in the model, are almost entirely bank-financed; they issue as much loans as possible, and use bonds only as a residual source of debt. When interest rates increase, most of the deleveraging of these firms occurs through a reduction in bonds (the residual financing source), and their loan share increases. By contrast, firms with lower risk and lower leverage are at an interior solution, where they exactly trade off the higher intermediation spread of loans with the decline in liquidation losses induced by a higher loan share. In response to the shock, these firms deleverage; this induces a decline in their default risk, which in turn reduces the attractiveness of bank loans.

I then show that, when the intermediation spread responds to interest rates, these predictions are unchanged, except for the first one. Namely, if an interest rate increase also induces an increase in the intermediation spread of banks, and if that increase is sufficiently large, total borrowing among bank-financed firms can decline more than total borrowing among bond-financed firms. Movements in the bank intermediation spread indeed only affect the credit supply curve of bank-financed firms; if they are sufficiently large, they can offset the effects of loan flexibility described above.

Section IV then attempts to validate some of these predictions by constructing the pass-through of monetary policy shocks to borrowing, investment, and debt composition among publicly traded non-financial firms. I use intra-day innovations to Fed Funds futures contracts during days of monetary policy announcements (Bernanke and Kuttner, 2005) to identify monetary policy shocks for the 1990-2007 period. I construct firm-level responses using local projection methods analogous to Jordà (2005). Consistent with the model, investment falls significantly in response to a monetary policy contraction. Moreover, the effect is larger for initially more bank-dependent firms. Borrowing also declines in response to an increase in interest rates, but it does not respond significantly more among more bank-dependent firms (though the point estimate is positive.) Finally, I show that

[3]In the model, firms differ in their initial internal funds, which is a state variable. Because investment opportunities are the same across firms, those with lower internal funds have higher desired leverage. These firms select into loans because their high desired leverage makes them likely to experience financial distress, so that they highly value the flexibility of loans.

after a monetary policy contraction, the loan share tends to increase more for more risky firms. Overall, these results are consistent with a version of the model where bank credit supply are positive but mild, and in any case, too weak to offset the flexibility advantages of bank debt.

Finally, in section V, I discuss the implications of this model for how the pass-through of monetary policy shocks to investment and borrowing might have jointly evolved. Using the model, I show that a gradual increase in the relative intermediation spread of loans by about 2p.p. would have led to a decline in the loan share of a magnitude comparable with the data. Additionally, this increase would also have led to a decline in the pass-through of interest rate shocks to investment by about 40%. In the model, this occurs both because more firms become bond-financed as the intermediation spread rises, and because bank-financed firms become progressively less sensitive to interest rate shocks, relative to other firms. Consistent with these predictions, I show evidence suggesting that the pass-through of monetary policy shocks has declined since the 1990s. I use a potentially less accurate measure of monetary policy surprises, but one that is available for a longer period of time, the deviation from Greenbook forecasts proposed by Romer and Romer (2004). Firm-level results using this shock indicate that the pass-through of these shocks to investment declined substantially between the pre- and the post-1990s period, and moreover, that the differential effect of these shocks on bank-dependent firms has also declined.

The two key take-aways from this paper are the following. First, there has been a large a persistent shift, at the firm level, in the loan-bond mix. Though the 07-09 crisis accentuated it, the trend started long before that, and has accelerated since. Second, the loan-bond mix is significant a firm-level determinant of the sensitivity of investment to changes in policy rates, and so changes in the mix may have affected the transmission of policy rates. The paper provides both empirical and model-based arguments for this view. More research needs to be devoted to understanding the quantitative magnitude of the decline in the pass-through of policy rates to investment, and the underlying structural causes for the shift away from bank intermediation.

**Related literature** On the theory front, the paper relates to a large corporate finance literature which studies the determinants of the debt mix of firms, and which I discuss in section III. However, relatively few papers have focused on how the debt mix might affect monetary policy transmission. A notable exception is Bolton and Freixas (2006), which studies the general equilibrium effects of monetary policy shocks when the composition of intermediation between bonds and loans is endogenous. Their analysis emphasizes the importance of the endogenous response of bank equity capital to monetary policy shocks, but takes a relatively simple view of the bond/loan choice; in particular, credit markets in their model are perfectly segmented according to risk. By contrast, in this paper, I take a more reduced-form approach to model banks' cost of funds, but I allow for a richer equilibrium debt structure, in particular by having firms choose "interior" debt structures that combine bonds and loans, consistent with the data.[4]

On the empirical front, this paper relates to a more recent literature that explores the link between corporate debt choices, business cycles, and monetary policy. A closely related paper, though not primarily focused on monetary policy, is Becker and Ivashina (2014). These authors construct an indicator for the cyclicality of bank credit supply, by estimating how the propensity of a firm to issue loans conditional on issuing debt varies with a number of indicator of the state of the business cycle. One of their business cycle indicators are unexpected deviations of the fed funds rate relative to the target implied by a Taylor rule. They show that positive deviations (tightenings) lead to a lower propensity to issue loans, conditional on issuing debt. Their focus is therefore on new debt issuances. By contrast, most of my analysis focuses on the response of firms to a monetary policy contraction conditional on their (ex-ante, or pre-shock) debt mix. However, my results indicate that in response to an unanticipated tightening in monetary policy, the loan share increases, and particularly so among non-investment grade firms. One possible way to reconcile these results is that my debt composition measure captures the intensive margin of new debt issuances as well its the extensive margin; that is, it may be that the decline in the value of the typical issuance is larger for bonds than for loans, even if loans are less likely to be issued as monetary policy tightens. Another, broader difference is that in this paper, I study a model in which changes in debt composition in response to monetary policy shocks (and to shocks in general) can occur even if there are no fluctuations in bank credit supply. These effects occur because in my model, bank and loans are not perfect substitutes for the firm.

Two other recent papers studying the relationship between monetary policy and the structure of

[4] Interestingly, their framework predicts that an increase in risk-free rates leads to a shift from bonds to loans among safer firms, because equilibrium bank spreads can fall after monetary policy contractions. This is consistent with some of the empirical findings of section IV, but harder to rationalize in the model I develop in this paper, where equilibrium bank spreads are assumed to be weakly increasing in the level of risk-free rates.

financial intermediation Darmouni et al. (2019) and Ippolito et al. (2018). In a sample of European firms, Darmouni et al. (2019) show that stock prices and investment by firms that are more bond-dependent respond more to monetary policy shocks. They rationalize their findings using a model where bond financing is less flexible, and firms hoard cash after a monetary policy expansion in order to lower refinancing risk. These effects are absent in my model because I do not consider the possibility of liquidity hoarding. Additionally, the sample of European firms with access to bond markets is likely composed of larger firms relative to the Compustat sample I study in this paper. Ippolito et al. (2018) also study the response of firms to monetary policy shocks as a function of their debt composition. They focus on the mix of floating- and fixed-rate debt, but use the loan share as a proxy for this mix. They document a sharper high-frequency response of equity prices to monetary policy shocks when firms have a higher share of floating-rate debt. Instead, I treat the loan share as primarily reflecting the flexilibity of debt in times of distress, and I focus on lower-frequency responses of investment and borrowing, as well as long-run changes in the elasticities of these quantities to interest rates. Additionally, I show that the loan share tends to increase among non-investment grade firms after a monetary policy tightening. This result is more difficult to reconcile with the view that the loan share primarily proxies for the short-rate exposure of firms.[5]

Finally, the paper relates to a literature on time-variation in the effects of monetary policy shocks, and in particular the influential contribution of Boivin et al. (2010). These authors document a significantly smaller decline in real non-residential investment following a monetary policy contraction in the post-1984q1 sample than in the pre-1984q1 sample. Analogously, but in my sample of publicly traded firms, the estimated pass-through of monetary policy shocks to firm-level investment is significantly larger in the pre-1990q1 period than in the post-1990q1. The model I propose can generate this decline as a consequence of a secular increase in the relative cost of intermediation of banks, which also reduces the overall share of corporate credit intermediated by banks.

[5]Additionally, IMF (2016) provide broad evidence (in the US and elsewhere) of the effects of monetary policy shocks on the balance sheets of non-bank intermediaries, and discuss potential transmission mechanisms; but their focus is primarily on financial intermediaries, while this paper's focus is primarily on non-financial firms.

# II The disintermediation of corporate credit

This section studies trends in the composition of credit for the US non-financial corporate business sector. The primary distinction the section draws is between intermediated credit (loans, for short), and market-based credit (bonds, for short). I start with aggregate trends, and then connect these trends to firm-level changes in the composition of credit.

## II.A Trends in the aggregate loan share

Figure 1 reports data on the level of total outstanding loans and bonds in the non-financial corporate sector (NFCB, in what follows.) The data are obtained from table L.103 of the Flow of Funds. They run from 1960q1 to 2018q4, and encompass all domestic S- and C-corporations (both public and private.) I define loans as the sum of three items: mortgages; depository institution loans; and other loans and advances.[6] The latter two categories accounted respectively for 38.2% and 43.2% of total outstanding loans in 2015. I define bonds as the sum of three items: municipal securities; commercial paper; and corporate bonds.[7] Corporate bonds made up 87% of total outstanding bonds in 2015. Together, these "loan" and "bond" categories encompass all outstanding debt of the NFCB sector reported in the Flow of Funds.

Figure 1 reports the log of the dollar value of type of credit outstanding, substracting the value as of 1970q1. The striking feature of this graph is the break which occurs after the start of the 1990-1991 recession (1990q3.) Prior to that date, loans and bonds outstanding grow in tandem. After that date, each recession results in a successive decline of loans outstanding relative to their pre-1990q3 trend; moreover, this decline is permanent, leaving the stock of outstanding loans as of 2018q4 substantially below it pre-1990q3 trend. A brief exception is the 2005q1-2007q3 period, during which loans experienced a rapid growth period, which was undone by the 2007-2009 recession.

Figure 2 expands on this evidence. The solid black line reports the share of loans as a fraction of total debt (bonds plus loans). This share is stable, at around 50%, prior to 1990q3; it then

[6] This latter category primarily includes loans by non-bank or non-domestic financial intermediaries, the detail of which are provided in table L.216. In 2015, the breakdown by loan type is the following: syndicated loans (37.7%), finance company loans (33.4%), foreign institution loans (19.1%), US government loans (6.9%), holding company loans (2.1%), and GSE loans (0.9%).

[7] Municipal securities are industrial revenue bonds issued and guaranteed by state and local governments, but the payments to which are made by the corporate entities recipient of the funds.

steadily declines to 30% by 2018q4, and the decline accelerates during each of the three recessions of the 1990s, 2000s and 2010s. The graph also reports the share of non-mortgage loans to total debt (grey circled line) and mortgage loans to total debt (crossed black line), which add up to the total loan share. This decomposition suggests that the bulk of the 1990-2018 decline in the loan share is driven by non-mortgage loans, while the brief increase in the loan share in 2005-2007 is driven by mortgage loans.

Overall, these data suggest that the NFCB sector has become progressively less reliant on loans over the last three decade. Moreover, this trend is driven by non-mortgage loans, with non-residential mortgages playing a relatively more muted role.

## II.B From aggregate to firm-level loan shares

From a purely statistical standpoint, the decline in the aggregate loan share could be driven either by a decline in firm-level loan shares, or by a reallocation of total debt toward less loan-dependent firms. These two stories would have different implications for how to think about changes in the pass-through of monetary policy to firm borrowing. Next, I attempt to disentangle these two stories by using firm-level data. I start by discussing the data sources used to measure the firm-level loan share.

### II.B.i Measurement

The main source for this analysis is US non-financial segment of Compustat. There are two key challenges in using this data as a source for decomposing changes in the aggregate loan share.

First, Compustat only includes publicly traded firms.[8] This is an important limitation, particularly because private firms seldom issue publicly traded debt securities, so that their debt composition is likely to differ substantially from public firms', and especially large public firms. However, to my knowledge, there is no alternative publicly available data source with a sufficiently

[8] An additional challenge, in comparing Flow of Funds and Compustat data is that even for domestically incorporated firms, Compustat balance sheet data are international consolidations, so that some of the debt reported on balance sheet might correspond to consolidated foreign entities. By contrast, the Flow of Funds only consolidates domestic subsidiaries' balance sheets. This would affect trends in debt composition if foreign subsidiaries' debt structure differed substantially from their domestic parents. It is unclear whether the Compustat data can be corrected to address this issue, but the similarity of aggregate trends for different debt categories between Compustat and Flow of Funds data suggest that it may not be substantial.

long panel dimension and good private sector coverage.[9]

Second, Compustat balance sheets do not report loans separately from the rest of debt outstanding.[10] In what follows, I will approximate the firm-level loan share using the sum of two variables: a short-term debt variable, notes payable (`np`) and long-term debt variables, other long-term debt (`dlto`). The advantage of this definition is that it provides a comprehensive long-run measure of the loan share at the firm level, since data on both items is available after 1970q1 for most firms. The choice of the two Compustat items used to define loans is based on the definitions of debt components in the Compustat manuals.[11] In section IV, I use securities-level data on new issuance of bonds and syndicated loans by firms in order to validate this measure. In particular, I show that it is positively associated with past syndications and negatively associated with past bond issuances, and that the association is significant, large, and holds after controlling for a number of other observables.

With these issues in mind, Figure A4a compares Flow of Funds and Compustat data on the stock of outstanding debt in the NFCB sector. This Figure suggests that public firms account for approximately half of all debt outstanding in the NFCB sector, a share that has been stable over time. The stability of the share is fairly important: it implies that changes in the aggregate loan share cannot have been driven purely by a reallocation of debt toward publicly traded (and presumably less loan-dependent) firms. Moreover, the medium-run fluctuations in debt outstanding in the two datasets are similar (with the notable exception of the 2005-2009 period, where debt growth in the Flow of Funds far outpaced debt growth in Compsutat.) Figure A4b compares total loans outstanding in Compustat and in the Flow of Funds. By this measure, publicly traded firms account for about 40% of total loans outstanding. Again, medium-run fluctuations in aggregates are similar except in the 2005-2009 period.

Figure 3 then constructs the aggregate loan share in the non-financial segment of Compustat,

[9] For the US, the two main publicly available data sources with some coverage of private sector firms are Orbis (Kalemli-Ozcan et al., 2015) and Sageworks (Farre-Mensa and Ljungqvist, 2016), but neither have sufficiently long time dimensions to document trends. The Quarterly Financial Report micro data files (Crouzet and Mehrotra, 2018) have coverage of private firms going back to the late 1970s, but they are limited to the manufacturing and retail sectors, and their access is restricted.

[10] To my knowledge, the only publicly available dataset providing information on debt structure for a sufficiently large sample of firms is Capital IQ, but the data are only available after 2001, and at the annual frequency.

[11] In particular, for short-term debt, `np` includes bank acceptances, bank overdrafts, and loans payable. For long-term debt, `dlto` includes all revolving credit agreements, as well as all construction and equipment loans. It excludes senior nonconvertible bonds (which are included in debentures, `dd`), convertible or subordinate bonds (included in `dcvt` and `ds`, respectively). The main drawback is that both `np` and `dlto` include commercial paper outstanding.

and compares it with the aggregate loan share in the Flow of Funds (the solid black line in Figure 2.) The aggregate loan share is lower among publicly traded firms than in the NFCB overall, as should be expected. However, the post-1990 decline in the loan share is similar. The Compustat aggregate loan share falls from 42% in 2001q4, to 25% in 2017q4; the fall accelerates during each of the three recessions that took place during this period, similar to the Flow of Funds measure. The main divergence between the two measures occurs again during the 2005-2009 period, when Compustat data seems to miss the surge in mortgage loans present in the Flow of Funds data.

Overall, the comparison of the two data sources suggests that the post-1990 decline in the aggregate loan share also occurs, though with a somewhat smaller magnitude, among publicly traded firms.

### II.B.ii Is the decline in the loan share a within-firm phenomenon?

In order to disentangle whether the decline in the aggregate loan share among publicly traded firms is primarily a within-firm phenomenon, or the result of reallocation, we decompose the aggregate loan share as follows:

$$\Delta S_t = \Delta S_t^{\text{within}} + \Delta S_t^{\text{between}} + cov_t, \tag{1}$$

where $\Delta S_t$ is the change in the aggregate loan share from 1990 to year $t$, $s_{i,t}$ is the firm-level loan share (the ratio of loans to total debt for firm $i$ in year $t$), $w_{i,t}$ is the ratio of firm's $i$ debt in year $t$ to total (aggregate) debt in year $t$, $\Delta S_t^{\text{within}} = \sum_i w_{i,0}\Delta s_{i,t}$, and $\Delta S_t^{\text{between}} = \sum_i s_{i,0}\Delta w_{i,t}$, $cov_t = \sum_i \Delta s_{i,t}\Delta w_{i,t}$. The term $\Delta S_t^{\text{within}}$ gives the change of the aggregate loan share if the distribution of total debt across firms were kept constant. The term $\Delta S_t^{\text{between}}$ gives the change in the aggregate loan share if firm-level loan shares were kept constant. The residual term is, up to a constant, the cross-sectional covariance between changes in firm's share of total debt and changes in its loan share.

This decomposition is exact only in the panel of firms which are present and have debt outstanding in every year after 1990. It is in principle possible that the trends in the aggregate loan share differ substantially in this group of firms, relative to the overall Compustat non-financial sample.[12] Figure 4 however shows that the decline in the loan share among the balanced-panel

[12]Indeed, selection bias implies that the balanced panel of non-financial Compustat firms is much narrower. However, balanced panel firms are also much larger than average, implying that their borrowing behavior is likely to

firms was similar in magniutde (in fact, somewhat larger) than in the overall Compustat sample.

Figure 5 then reports the components of the decomposition (1) constructed using only the balanced-panel firms. This decomposition shows, strikingly, that the change in the loan share is a within-firm phenomenon. Debt reallocation among balanced-panel firms somewhat contributed to the decline in the loan share, but its impact is fairly limited — it only accounts for approximately 5% of the total 25% decline in the aggregate loan share. By contrast, the within-firm component declined by 15% through 2017, and by as much as 25% (relative to 1990) in certain years, particularly at the height of the crisis.

### II.B.iii Which firms experienced the largest decline in their loan share?

The upshot of the previous analysis is that the decline in the aggregate loan share seems, by and large, to have been driven by a change in the within-firm loan share, as opposed to a reallocation of total debt, either between private and public firms, or among public firms, toward low-loan share firms. This leads to a natural question — did all firms experience similar declines in their loan share, or were certain subgroups of firms particularly exposed?

Figure 6 reports the average within-firm loan share, by year and by either industry group (top panel) or credit rating group (bottom panel). For consistency with the decomposition of Figure 5, the sample considered here is the balanced sample. The top panel indicates that industry composition does not explain the trend in the loan share; the loan share decline is common to all industries in the sample. On the other hand, the bottom panel shows that unrated firms did not experience a large decline in their loan share, while rated firms did, regardless of their rating category, though investment-grade firms seem to have experienced a slightly larger decline in their loan share. This suggests that the evolution of the aggregate loan share is largely driven by intensive margin changes in debt composition, by firms with access to alternatives to bank credit.

This section has established that, starting in 1990, the composition of corporate debt progressively shifted away from loans and toward bonds. Disintermediation occured both for the NFCB sector as a whole, and among public firms. Moreover, it is driven by a within-firm change in the loan share, which seems to be primarily concentrated among firms with access to public debt markets.

be a key driver of the aggregate loan share in Compustat.

# III Monetary policy and debt composition: theory

The previous section has established that the mix of loans and bonds that firms use has evolved over time. This section explores why the effects of monetary policy on firms might, in theory, depend on that mix.

I first discuss, qualitatively, four potential mechanisms. Two are related to firms' demand for credit (the flexibility of loans, and their interest rate exposure), and two are related to the supply of loans and bonds to firms (the bank lending channel, and the higher collateral intensity of loans.) Unsuprisingly, all four mechanisms predict a negative pass-through of interest rate increases to borrowing and investment. However, without a model, it is more difficult to provide predictions for (a) whether this pass-through depends on firms' initial loan mix; and (b) how the debt mix adjusts in reponse to interest rate hikes.

I then choose to focus on two of the four mechanisms (loan flexibility, and the bank lending channel). I embed them in a simple formal model.[13] The model predicts that investment among initially more loan-dependent firms is always more responsive to interest rate hikes, but that borrowing can be less responsive if the bank lending channel is sufficiently weak. Additionally, the loan share can increase in response to the interest rate shock, particularly when the bank lending channel is weak.

## III.A Potential transmission mechanisms

### III.A.i Credit demand mechanisms

**Monitoring and flexibility** A number of key theories on the choice between loans and bonds emphasize the role of credit quality (Diamond, 1991; Chemmanur and Fulghieri, 1994; Park, 2000; Bolton and Freixas, 2000). In these models, costly monitoring by banks serves to overcome asymmetric information and/or agency problems. As credit quality improves, firms move from debt structures dominated by monitored debt (loans), to debt structures dominated by by arm's-length

[13]It should be noted that the mechanisms I discuss implicitly assume that equity issuance is constrained for firms, so that debt is the primary source of external finance. This assumption is consistent with the fact that equity financing accounts for a small fraction of net financial flows to the NFCB sector. For instance, Flow of Funds data indicates that in all years from 2015 to 2018, net equity financing flows to the NFCB sector are negative.

debt (bonds).[14]

A related set of theories (Bolton and Scharfstein, 1996; Hackbarth et al., 2007; Crouzet, 2018) arrives at similar predictions for the relationship between debt structure and credit quality, though through a slighly different mechanism. In these models, the primary advantage of loans is not that they provide a solution to an incentive or an asymmetric information problem, but that they help firms avoid inefficient liquidation.[15] Low credit quality issuers, which are typically more leveraged and more likely to default (and hence more likely incur liquidation costs), then select into more loan-dominated debt structures.

The predictions of this set of theories for the effects of an interest rate hike are not straightforward.[16] The increase in interest rates leads to a decline in the present value of future cash flows of firms, which will presumably force them to deleverage and cut back on investment. How this achieved, though, depend on firm characteristics. For instance, firms with poor credit quality, which strongly value the flexibility offered by loans, may keep them roughly unchanged, and cut back on any residual arm's-length financing instead, leading to an increase in the loan share. Firms with higher credit quality, on the other hand, may substitute loans for bonds as leverage and default risk decline. It is also unclear whether total borrowing and total investment will respond more strongly for firms with poor credit quality. The model in subsection III.B attempts to sort out these possibilities more formally.

**Floating vs. fixed interest rates** A second important difference between loans and bonds is that while the vast majority of loans are floating-rate debt instruments, most bonds are fixed-rate instruments.[17] Ippolito et al. (2018) argue that not all firms hedge the interest rate risk implied by

[14] It should be noted that this class of models tends to predict debt specialization. High credit quality firms use arm's length debt only, while medium-quality firms use monitored debt, and low-quality firms are either rationed (Diamond, 1991) or use costly equity markets (Bolton and Freixas, 2000). The exception is Park (2000): in his model, as credit quality deteriorates, firms move from a specialized debt structure with only arm's-length debt, to a credit structure in which monitored debt is senior or secured, but arm's-length (which is junior or unsecured) remains an important funding source.

[15] This is because banks are assumed to be more willing, or able, to restructure debt when the firm violates covenants or misses a payment. A microfoundation for this assumption is that bondholders are more dispersed creditors, and thus less individually incentivized to accept a debt restructuring; evidence in favor of this view is provied by Asquith et al. (1994), in their analysis of a sample of junk bond issuers.

[16] The discussion here implicitly assumes that investment is a continuous choice variable. It should be noted that in many papers in this strand of the literature, investment is modelled as the choice between a finite number of growth opportunities, making it more difficult to derive implications for investment elasticities in response to shocks. In the model proposed later in the section, investment is a continuous choice variable.

[17] In a sample of loan syndications in the chemicals industry, Faulkender (2005) shows that more than 90% of syndications are floating rate. Vickery (2008) uses the survey of Small Business Finance to show that 54% of bank

the use of loans. Interest rate payments could then be more responsive to hikes in the short rate among firms with high loan shares, leading to a stronger decline in internal funds and (if the firm is financially constrained) in investment.[18]

This channel predicts a higher sensitivity of borrowing and investment for firms that have an ex-ante higher loan share so long as their marginal source of funds is debt. Its predictions for the response of debt composition are ambiguous, though. In particular, if the monetary contraction is transitory, the firm might prefer not to hedge new issuances (thus leading to an increase in the loan share), while if is persistent, it might choose to hedge them (thus leading to a decline in the loan share.)

#### III.A.ii Credit supply mechanisms

**Bank lending channel** The bank lending channel (Bernanke and Blinder, 1992; Bernanke and Gertler, 1995) states that a tightening in monetary policy reduces *bank* credit supply because it tightens banks' financial constraints. Stein et al. (1998) describes a model of bank financing under assymmetric information in which a reduction in non-borrowed reserves (or equivalently, an increase in the Fed Funds rate) leads to a reduction in the supply of loans by banks.

This view of the transmission of monetary policy shocks predicts that the loan share should *decline* in response to a monetary policy contraction. This prediction holds to the extent that the supply of bonds is less responsive to the tightening. On this latter point, Kashyap et al. (1993) show that a proxy for the relative cost of loans over bonds (commercial paper, in their case) indeed responds positively to monetary policy contractions.

The bank lending channel in general predicts that loan-financed firms will be more responsive to monetary policy shocks, though the strength of the effect depends on the elasticity of substitution between loans and bonds. This elasticity of substitution is fundamentally driven by the credit demand considerations described above. If bonds and loans are perfect substitutes, and bond

loans (among which 72% of lines of credit) are floating rate, while 80% of non-bank debt is fixed-rate. Ippolito et al. (2018) document a strong cross-sectional correlation between measures of the floating rate debt share and the loan share in the Capital IQ database. By contrast, SIFMA data on corporate bond issuance for 1996-2018 indicates that on average over that period, only 21% of (the dollar value of) new corporate bond issuances for the NFCB sector were floating-rate instruments. This share peaked at 47% in 2005-2006, though this primarily reflected issuance of floating rate instruments by financial firms.

[18] Using the loan share as a proxy for the share of floating-rate debt, Ippolito et al. (2018) provide evidence that stock prices of high floating-rate debt firms is indeed more responsive to monetary policy innovations.

supply is unresponsive to changes in short-term rates, then the bank lending channel is completely neutralized for firms with access to bond markets. Interest rate hikes reduce investment and borrowing purely for credit demand reasons (if any); moreover, the loan share declines, as any new borrowing will occur via bond issuance. At the other extreme, if loans and bonds are perfect complements, then interest rate increases will also reduce borrowing and investment, but for credit supply reasons; and the loan share will remain fixed.

**Collateral channel** A related but distinct shift in the relative supply of loans in response to monetary policy shocks could be due to collateral. While loans — either credit lines or term loans — tend to be either fully secured, or senior to all other credit obligations, bonds tend to be unsecured and/or subordinated. For instance, Rauh and Sufi (2010) document that, in a sample of rated firms, 53.9% of all secured debt consists of credit lines or terms loans, and a further 31.8% consists of mortgage and equipment debt. Subordinated debt, on the other hand, is entirely comprised of (either convertible or non-convertible) debt.

To the extent that monetary policy affects asset values (Kiyotaki and Moore, 1997), it also affects the value of collateral. If loans are more likely to be backed by collateral than bonds, this could lead to a higher sensitivity of loan supply to monetary policy shocks. While, to my knowledge, there is no fully fleshed out model of this collateral channel in a context where firms can choose among secured and unsecured debt, it is reasonnable to expect that the model would predict a stronger decline in borrowing and investment through this channel for firms that are ex-ante more reliant on loans, as well as a decline in the average loan share in response to the monetary policy shock.

## III.B A simple formal model

In what follows, I describe a model that incorporates one credit demand and one credit supply mechanism, either of which could, in principle, make the corporate debt mix matter for monetary policy transmission. On the credit demand side, the model focuses on the flexibility of bank loans.[19] On the credit supply side, the model introduces a reduced-form bank lending channel, by assuming

[19] Previous work has focused on how other differences between loans and bonds on the credit demand side relate to monetary policy. In particular, Ippolito et al. (2018) study how the dichotomy between fixed and floating rates interacts with monetary policy shocks.

that the cost of funds of banks is more exposed to interest rate fluctuations than the cost of funds of bondholders. Finally, in the model, monetary policy shocks are intepreted as changes in the risk-free real interest rate with which both firms and creditors discount future cash flows. Accordingly, I use the words interest rate shocks and monetary policy shocks interchangeably in what follows.

### III.B.i Model description

A detailed exposition of the model is given in Appendix A. Here, I focus on describing its key elements.

The model is static, and describes an industry, composed of a continuum of measure 1 of firms. Each firm has internal funds $e$, which exogenously given and fixed. In combination with external finance, internal funds are used to purchase capital, which is the only input into a decreasing returns to scale production function. Firm-level productivities are all drawn from the same distribution. The manager/owners of each firm (i.e., the equityholders) choose production and financing plans to maximize expected (end-of-period) dividend distributions.

Equityholders in this model would like to raise external finance because their internal funds in general fall short of the optimal, unconstrained investment level. This level depends only on productivity, the degree of returns to scale, and the risk-free rate; it is given by:

$$k^* = \left( \frac{\zeta \mathbb{E}(\phi)}{1+r} \right)^{\frac{1}{1-\zeta}}, \tag{2}$$

where $r$ is the risk-free rate, $\mathbb{E}(\phi)$ is expected productivity, and $\zeta < 1$ is the degree of returns to scale.

Equityholders borrow prior to the realization of their productivity, and so borrowing potentially exposes them to default. Equityholders have access to two sources of external finance: loans and bonds.[20] Loans differ from bonds in that they are more flexible in times of financial distress: specifically, they can be renegotiated, while bonds cannot. The renegotiation process is described in detail in Appendix A; it involves a reduction of principal and interest payments to the bank. The bank is willing to accept this because liquidation (or changes in control rights) involve deadweight losses: a fraction $1-\chi$, with $\chi \in ]0,1]$, of output and existing capital is destroyed upon liquidation.

[20] Seasoned equity issuances are ruled out, though results don't change qualitatively if they are allowed but made sufficiently costly.

As a result, in some states of the world, it is preferable, from the standpoint of the bank, to accept a reduction in repayment rather than to liquidate or assume control. Bondholders are assumed to be unable to engage in this sort of restructuring; they can only force liquidation.[21]

Loans and bonds issued by the firms are bought by lenders (banks and bondholders) who are assumed to be perfectly competitive, risk-neutral, and who discount end-of-period profits at the risk-free interest rate $r$. Additionally, banks incur a cost per unit of funds intermediated that is given by $\gamma_b(r) > 0$, whereas bondholders do not. I allow this intermediation cost to vary with the level of interest rates, as a reduced-form way of introducing a bank-lending channel. This intermediation cost can be thought of in two ways. First, it could capture differences in funding costs across intermediaries (which could be driven, for instance, by adverse selection, as in Stein et al. (1998), or alternatively by differences in regulatory treatment.) Second, from a credit supply perspective, it could capture monitoring costs which loan providers have to incur in order to prepare for the eventuality of renegotation, should default occur. Given the perfect competition assumption, the higher intermediation costs are passed through to firms in the form of higher interest payments in non-default states, so that loans are (all other things equal) more costly to firms than bonds. In choosing how much to borrow from each funding source, the firm faces a trade-off: on the one hand, loans offer more flexibility, should financial distress arise, thereby reducing potential liquidation losses; on the other, outside of financial distress, bonds are a cheaper source of funding.

For a given level of interest rates, an equilibrium of the model is described by a set of policy functions, which characterize the choices of a firm with internal funds $e$: $d(e)$, for total borrowing; and $s(e)$, for the share of total borrowing that is funded through loans. Additionally, since the model is static, total investment is given by $k(e) = d(e) + e$. Finally, we assume that firms' distribution across levels of internal funds is given by the density $\mu(e)$; in numerical examples, we assume that $\mu(e)$ is a Beta distribution supported on $[0, k^*]$.

### III.B.ii Equilibrium debt structure

A useful starting point in order to understand the equilibrium borrowing and investment choices of firms in this model is the frictionless (debt) case: $\chi = 1$, or no liquidation losses in default.

[21] Additionally, loans are assumed to be senior to bonds, as they tend to be empirically; this is not crucial for the equilibrium segmentation of firms across debt structure types, though it matters for the overall level of the loan share.

In this case, banks have no incentive to restructure debt when the firm is in financial distress; they always liquidate, just as nonbank financial intermediaries would. From the standpoint of the equityholders, the two forms of debt financing are therefore perfect substitutes. As a result, equityholders only care about their relative price. If there is no loan intermediation premium ($\gamma_b(r) = 0$), they are indifferent across all debt structures. If there is a loan intermediation premium ($\gamma_b(r) > 0$), equityholders strictly prefer bonds, and never use loans.

When $\chi < 1$, loans present an advantage for firms whose leverage is sufficiently large that they might face some ex-post risk of financial distress, which is more likely to happen for firms with lower internal funds $e$. The optimal policies then involve three separate regions, depending on the initial level of internal funds of the firm.[22] The top left panel of Figure 7 describes these three regions.

In the first two regions, firms with low or intermediate levels of internal funds optimally choose to use a combination of loans and bonds, so that the loan share is strictly positive. For firms with low levels of internal funds, the loan share *increases* with internal funds. These firms have a very high need for external funds, and therefore high leverage and ex-ante probability of financial distress. This makes using loans most attractive for them; in fact, these firms exhaust their loan capacity (i.e., they borrow as much as banks are willing to lend, conditional on breaking even), and use bonds as a residual funding source.

Firms with intermediate levels of internal funds also use a combination of loans and bonds, but in their case, the loan share *declines* with internal funds. These firms have lower leverage and choose an interior debt structure (that is, they exhaust neither their loan nor their bond issuance limits.) This debt structure is such that the marginal decrease in expected liquidation losses associated with a marginal increase in the share of loans (keeping total borrowing fixed) is exactly equal to $\gamma_b(r)$, the gap between loan and bond intermediation costs. As a firm's internal funds grow, leverage falls, marginal liquidation losses decline, and the firm chooses a lower loan share. In fact, in this region firms retire a dollar of loan for every incremental dollar of internal funds.

Finally, firms with a sufficiently high internal funds choose to bypass loans altogether. These firms require relatively little leverage, and so their default risk ex-ante is not sufficient to justify

[22]In this model, leverage and ex-ante default risk are decreasing in the level of internal funds, so that the three regions can also be described as high, medium or low-leverage firms, or high, medium and low credit quality firms.

paying the extra intermediation cost $\gamma_b(r)$ associated with loans. They have a simple debt structure, with only senior bond debt, on which they default very infrequently.

### III.B.iii Predictions for the transmission of interest rate shocks

**No bank lending channel** ($\gamma_b'(r) = 0$) I start with a special case of the model, in which there is no bank lending channel; that is, the relative intermediation cost of banks, $\gamma_b(r)$, is independent of $r$: $\gamma_b(r) = \gamma_b^0$.[23]

In order to discuss the model's predictions, it is useful to write the first-order condition that pins down borrowing, for a firm with internal funds $e$. Regardless of whether the firm is loan-dependent or not, this first-order condition will take the following form:

$$\zeta \mathbb{E}(\phi)(d+e)^{\zeta-1} - (1+r) = \gamma_b^0 s + \frac{\partial L}{\partial d}(d,s,e), \tag{3}$$

where $\tilde{r}(s) = r + \gamma_b^0 s$ is a weighted average cost of debt. The left-hand side, which captures the marginal product of capital net of the risk-free rate, captures credit demand. The right-hand side captures credit supply effects. $L(d,s,e)$ denotes total expected liquidation losses for a firm with internal funds $e$ that chooses the debt structure $(d,s)$. $\partial L/\partial d$ represents the marginal increase in those losses associated with an extra dollar of borrowing, which is increasing in $d$. Note that this marginal loss function depends on the debt structure, characterized by $s$.

The first-order effect of an increase in the risk-free rate is to shift firms' credit demand, that is, the left-hand side of equation (3). Alternatively, one can think of this effect as a reduction in firms' optimal size, as given by equation (2). Note that the downward shift in credit demand is vertical, and identical for all firms. As a result of that downward shift in credit demand, borrowing and investment decline for all firms.[24]

However, the response of borrowing and investment is not the same across firms with different levels of internal funds, $e$. More specifically, borrowing among bond-financed tends to be *more* responsive to changes in interest rates than among firms that are predominantly loan-financed, but that investment tends to be *less* responsive.[25]

[23]Figure A5 reports the interest rate elasticity of three variables of interest: the loan share $s(e)$, total borrowing $d(e)$, and total investment, $k(e) = d(e) + e$.

[24]This is visible in the top right and bottom left panels of Figure A5.

[25]See also figure 11.

The reason why borrowing among predominantly loan-financed firms is less responsive has to do with the flexibility of loans in default. In response to the shock, the credit supply curve (the right-hand side of equation 3) steepens, because higher risk-free rates imply (all other things equal) higher interest payments, and therefore a higher likelihood of default and liquidation. But it steepens less sharply for firms using more loans (i.e. with a higher $s$), since these firms can use renegotiation to avoid liquidation in some of those new default states. As a result, the total response of borrowing is smaller.

The lower interest rate elasticity of borrowing among loan-dependent firms does not translate into a lower interest rate elasticity of investment simply because these firms initially have higher leverage, as indicated by the top right panel of Figure 7. This itself comes from the fact that high-leverage firms are ex-ante more likely to face financial distress. They therefore value more the flexibility offered by bank loans, and choose to issue relatively more loans.

The model has more subtle predictions, having to do with the difference in interest rate elasticities between firms with *low* and *intermediate* levels of internal funds (both of which still use loans as a source of funds.) In particular, firms with higher internal funds — those that are the most highly leveraged, the most prone to default, and the closest to exhausting their overall borrowing capacity — *reduce* their loan share in response to the hike in interest rates, while firms with *lower* internal funds *increase* their loan share.

Recall that loan-dependent firms with higher internal funds are at an interior solution. Specifically, their choice of debt structure is governed by the following first-order condition:

$$\gamma_b^0 = -\frac{\partial L}{\partial s}(d, s, e), \tag{4}$$

where $L$, as before represent total expected liquidation losses. The function $\partial L/\partial s$ is the marginal decrease in liquidation losses that occurs from keeping total leverage constant but replacing a dollar of bonds with a dollar of loans. As interest rates increase, this schedule shifts down. This shift causes a decline in the loan share.

By contrast, firms that have lower levels of internal funds exhaust their bank borrowing capacity, and use bonds as a residual source of funds. The fact that they exhaust their bank borrowing capacity means that they are in the steepest part of their loan supply curve; as a result, the shift in credit demand has a low overall effect on the amount of loans they issue (while it does have a large effect on their price.) As a result, even though these firms reduce borrowing overall, they do so less via reducing loans than via reducing bond issuance, and so their loan share rises.

Finally, there are also some important extensive margin effects induced by the shock. Given the non-linearity of the model, these effects depend on how large the shock itself is. Figure A5 reports that, for a 1% decline in the risk-free rate, a portion of firms (highlighted by the grey shaded area) respond by changing completely their debt structure, and, essentially, paying down their loans. They replace these loans by issuing bonds, and they are the only firms to do so.

Summarizing, the model without a bank lending channel has three key cross-sectional predictions regarding the effects of an increase in the level of the risk-free interest rate:

P1. investment is *more* responsive among loan-dependent firms.

P2. borrowing is *less* responsive among loan-dependent firms.

P3. among loan-dependent firms, the sign of the response of the loan share is ambiguous: it is positive for riskier firms (or alternatively, firms with higher leverage or lower net worth), and negative otherwise.

**The role of the bank lending channel** I next turn to discussing model with a bank lending channel, that is, the case in $\gamma_b'(r) > 0$. In the numerical examples that follow, I use:

$$\gamma_b(r) = \gamma_b^0 + \nu_b \left(r - r_0\right),$$

where $\nu_b > 0$, and $r_0$ is the baseline value around which the interest rate is perturbed in order to compute elasticities.[26]

The first notable difference with the case of no bank lending channel is that the responses of borrowing and investment among loan-dependent firms can now be larger than those of bond-financed firms. This can be understood by re-writing the first-order condition for borrowing with the bank lending channel:

$$\zeta \mathbb{E}(\phi)(d+e)^{\zeta-1} - (1+r) = (\gamma_b^0 + \nu_b \left(r - r_0\right))s + \frac{\partial L}{\partial d}(d, s, e), \tag{5}$$

[26] Figure A6 reports the same interest rate elasticities as before in this more general model.

The left-hand side is unchanged relative to the baseline case, but the credit supply curve now also depends on the risk-free rate. In addition to a downward shift in the credit demand curve, there is now also an upward shift in the credit supply curve, and therefore a larger decline in borrowing and investment. By contrast, the borrowing and investment responses for firms that do not rely on loans ($s = 0$) are, unsurprisingly, unchanged, relative to the case of no bank lending channel.

The second difference is in the response of the loan share, among firms that are loan-dependent. In particular, firms with intermediate levels of internal funds experience a much larger decline in their loan share.[27] The first-order condition for the loan share, with an active bank lending channel, becomes:

$$\gamma_b^0 + \nu_b(r - r_0) = -\frac{\partial L}{\partial s}(d, s, e), \tag{6}$$

The left-hand side of this expression increases with the level of interest rates. Given that the liquidation loss function $L$ is concave in $s$, this force contributes toward lowering the loan share. Thus, a stronger bank lending channel can lead to stronger substitution effects.

However, than among firms with the lowest level of internal firms, the loan share still increases in response to the interest rate shock, even when there is a strong bank lending channel. The intuition for this increase is the same as before; these firms exhaust their loan issuance capacity, and their deleveraging consists primarily of reducing bond issuance.[28]

With a bank lending channel, the model's key cross-sectional predictions regarding the effects of an increase in the level of the risk-free interest rate remain similar, with the exception of the predictions regarding borrowing:

P2.' borrowing is *more* responsive among loan-dependent firms *if the bank lending is sufficiently strong,* that is, if $\gamma_b'(r)$ is sufficiently large.

**The relative effects of the bank lending channel** The strength of the bank lending channel depends on how large the slope parameter $\nu_b$, with a higher slope leading to stronger loan supply effects. As a result, when the bank lending channel is sufficiently strong, the model can imply a

[27] In fact, as indicated by the bottom left panel of figure A6, some of them choose to issue bonds in replacement of bank loans.

[28] The top left panel of figure A6 shows that these firms' loan share still rises in response to the interest rate shock.

higher reponsiveness of borrowing among loan-dependent firms. This is by contrast with the model where there are no bank lending channel effects, in which borrowing among more loan-dependent firms in general responds less.

Figure 11 reports the (cross-sectional) average elasticity of the borrowing, investment, and the loan share to interest rate shocks. These averages are computed separately for ex-ante loan-dependent and bond-dependent firms.[29] This graph shows that, for a sufficiently strong bank lending channel, the interest rate elasticity of borrowing among loan-dependent firms can fall below that of firms which only rely on bond financing. Additionally, when the bank lending channel is sufficiently strong, the average elasticity of the loan share can turn from positive to negative. This reflects a rising substitution from loans to bonds, among firms with an intermediate level of internal funds, as discussed above.

### III.B.iv Summary

The model described in this section emphasizes a simple trade-off in the determination of debt structure. While loans offer firms more flexibility in times of financial distress, banks also pass on their higher funding costs to borrowers. This makes bond financing more attractive for firms that are less risky, less leveraged, or have more internal ressources. Firms that are riskier or have fewer internal ressources will instead chose a debt structure in which they will issue both loans and bonds.

This model has a few simple, testable cross-sectional predictions for the effect of interest rate increases on borrowing, investment and the composition of debt. In particular, investment among predominantly loan-financed firms should be more responsive. Moreover, absent a bank lending channel, borrowing should be *less* responsive among bank-financed firms, while if the bank lending channel is sufficiently strong, it should be *more* reponsive. Finally, the sign of the response of debt composition varies in the cross-section: riskier firms (or alternatively, firms with higher leverage or lower net worth) tend to increase their dependence on loans in response to the shock, while other firms reduce it. The next section proposes to test both of these predictions using data on publicly traded non-financial firms.

[29] For instance, let $\epsilon_d(e) \equiv \frac{\Delta \log(d)}{\Delta r}(e)$. Then the red line in the top right panel of Figure 11 is $(1/M_{LB}) \int_{e \leq e^*} \epsilon_d(e) d\mu(e)$, where $M_{LB} = \int_{e \leq e^*} d\mu(e)$ and $\mu(.)$ is the ex-ante distribution of firms across levels of internal funds.

# IV Monetary policy and debt composition: evidence

This section tests some of the key predictions of the simple model described in section III for the transmission of monetary policy shocks.

## IV.A Data

**Monetary policy shocks** The main measure of monetary policy shocks is derived from high-frequency movements in Federal Funds futures contracts, building on the work of Gürkaynak et al. (2005) and Gorodnichenko and Weber (2016). A monetary policy shock is defined as $\tilde{\eta}^{HF}_{t_a} = w(t_a) \times (ffr_{t_a+\Delta^+} - ffr_{t_a-\Delta^-})$. Here, $ffr_{t_d}$ is the Federal funds rate implied, at time $t_d$, by the Federal Funds futures contract for the current month, $t_a$ is a policy announcement date, $\Delta^+$ and $\Delta^-$ are strictly positive numbers, and $w(t_d)$ is an adjustment weight, which takes into account the fact that Fed Funds futures contracts pay out based on the average effective rate over the month. I focus on a window of one hour around each announcement ($\Delta^- = 15$ minutes before and $\Delta^+ = 45$ minutes after). I follow the procedure of Ottonello and Winberry (2017) to aggregate the daily shocks to a quarterly frequency, weighting them by the number of days remaining in the quarter after they occur.[30]

The quarterly shock series $\eta^{HF}_t$ can only be constructed after 1990q1 (when the Fed Funds futures market started operating). This means that these shocks cannot be used to compute the pass-through of monetary policy shocks before 1990q1. In order to analyze monetary pass-through over a longer sample period, toward the end of this section I will use an alternative measure, proposed by Romer and Romer (2004) and extended by Wieland and Yang (2016). This measure defines monetary policy shocks as the deviation of the implemented Fed Funds rate from internal forecasts prior to the meeting date. This series, which I denote $\eta^{RR}_t$, is available monthly starting in 1969q4. I aggregate it to a quarterly frequency by summing the shocks over the quarter. Relative to the high-frequency identified shock, the main drawback of this time series is that revisions relative to internal forecasts may be correlated with market expectations about changes in the Federal Funds rate over the prior quarter, making it a potentially less accurate measure of *unexpected* changes in the stance of monetary policy.

[30] I thank the authors for making their shock series available to me.

I only use the two time series of shock $\eta_t^{HF}$ and $\eta_t^{RR}$ up to and including 2007q4. This is primarily in order to focus the analysis on the transmission of conventional monetary policy shocks. Additionally, after 2007q4, innovations to Fed Funds futures are very small because of the zero lower bound.

Table A1, in Appendix, reports summary statistics for the two time series. The most striking fact is that the standard deviation of $\eta_t^{HF}$, the high-frequency identified monetary policy shocks, is substantially smaller than that of $\eta_t^{RR}$. In part, this is due to the fact that $\eta_t^{RR}$ covers the Volcker recessions, during which measured innovations were particularly large. However, even in the overlapping sample (1990q1-2007q4), measured innovations using $\eta_t^{RR}$ are more volatile. This is consistent with the possibility, mentioned above, that deviations from internal forecasts may be overstating the unexpected component of monetary policy announcements. In the overlapping sample, however, the correlation between the two monetary policy shock measures is positive and statistically significant.

**Firm-level data** The main source for firm-level balance sheet data is Compustat. These are the same data as in section II, except that I use the quarterly instead of the annual version. I focus on non-financial firms incorporated in the US. Consistent with the analysis of the model of section III, I focus on four main variables from this data: total debt $d_{j,t}$, leverage $l_{j,t}$, fixed assets $k_{j,t+1}$, the loan share $s_{j,t}$.

Total debt is defined as as the sum of long- and short-term debt outstanding ($\texttt{dlcq}_{j,t}+\texttt{dlttq}_{j,t}$). Additionally, leverage is measured as the ratio of total debt to total book assets (`atq`). I construct a measure of fixed assets $k_{j,t+1}$ for each firm adding the cumulative sum of quarterly net investment, computed as the change in net property, plant and equipment (`ppentq`), to the first observation of gross property, plant and equipment, `ppegtq`. This helps address the fact that observations of `ppegtq` are often missing in the quarterly data.

The loan share is measured using the Compustat variables described in section II, with one exception. Since other long-term debt (`dlto`) is not available at the quarterly frequency, I construct it as: $\texttt{dltoq}_{j,t} = \frac{\texttt{dlto}_{j,\tau(t)}}{\texttt{dltt}_{j,\tau(t)}}\texttt{dlttq}_{j,t}$ (or zero if $\texttt{dltt}_{j,\tau(t)} = 0$), where $\texttt{dlto}_{j,\tau(t)}$ and $\texttt{dltt}_{j,\tau(t)}$ are the balance sheet values from the firm's annual report at the annual reporting date $\tau(t)$ that immediately precedes quarter $t$.

Aside from this data, I construct an indicator, $\mathbf{1}(\Delta m_{i,t} > 0)$ for whether a firm has issued a bond over the past quarter, by merging the quarterly Compustat sample with securities-level bond issuance data from the Mergent Fixed Income Securities Database (FISD.) After consolidating the data at the parent level, I merge it to Compustat using CUSIPs and, for unmatched firms, tickers. Figure A7 in Appendix shows that between 80 and 90% of all issuance by domestic non-financial firms in FISD is matched to the Compustat sample.

Table A1 reports summary statistics for the sample used in the analysis. The sample is restricted to firms with spells of at least 40 quarters of consecutive data, in order to be able to precisely estimate firm-level averages of control variables, as described below.

**Validation of the loan share measure** As discussed in section II, the loan share measure used in this analysis, $s_{j,t}$, is based on two Compustat items (notes payable, `np`, and other long-term debt, `dlto`) which do not explicitly identify loans. Table A2, in Appendix, provides supportive evidence for the fact that this measure of the loan share indeed captures the ratio of total loans to total debt outstanding. The table documents the correlation between $s_{j,t}$ and measures of the ratio of new syndicated loans to the sum of new syndicated loans plus new bonds issued. New bonds are obtained from FISD, while new loans are obtained by merging the Compustat data with Dealscan.[31] Note that the conceptual difference is that the Dealscan and FISD loan share captures gross issuances, while the Compustat loan share captures net stocks outstanding. Nevertheless, the correlation between the Compustat loan share, and the Dealscan-FISD measure of the composition of new issuances is positive and significant. Moreover, it remains significant even after controlling for firm and sector-time effects and for a number of firm-level observables (size, growth, liquidity, and leverage.) The estimates suggest that a 1% increase in the loan share of new issuances translates into an approximately 0.15% increase in the loan share of outstanding debt. Finally, the Compustat loan share is also robustly negatively associated with the indicators for past bond issuance. Overall, these results are consistent with the view that the Compustat loan share $s_{j,t}$ is indeed informative about the composition of debt between loans and bonds.

[31] I use the latest version of the Dealscan-Compustat bridge of Chava and Roberts (2008).

### IV.B Results

Next, I study the pass-through of high-frequency identified monetary policy shocks, $\eta_t^{HF}$, to firm decisions. Following the discussion of the previous section, I first study the response of investment and borrowing, contrasting firms that are initially more or less bank-dependent. I then look at how firms dynamically adjust their debt composition — as measured by the loan share — in response to the shock.

#### IV.B.i The response of investment and borrowing conditional on initial debt composition

I first focus on investment. I start by estimating the following model:

$$\Delta \log(k_{j,t+1}) = \alpha_j + \beta\eta_t^{HF} + \delta\left(\eta_t^{HF} \times s_{j,t-1}\right) + \Gamma_Z Z_{t-1} + \Gamma_X X_{j,t-1} + \varepsilon_{j,t}, \tag{7}$$

where $\Delta \log(k_{j,t+1})$ is the change in fixed capital following the shock; $\alpha_j$ is a firm fixed effect; $\eta_t$ is the quarterly shock to the Federal unds rate; $s_{j,t-1}$ is the lagged loan share; $Z_{t-1}$ is a set of macroeconomic controls; and $X_{j,t-1}$ is a vector of firm-level controls.

Macroeconomic controls include the first lag of the change in the log of industrial production and of the change in the log of the CPI. Firm controls consist of the log change in real sales (deflated using the CPI), as a proxy for investment opportunities, the log of total book assets, as a proxy for size, the ratio of net current assets to total assets, as a proxy for liquidity, and a set of dummies for fiscal quarters, all evaluated at the end of period $t-1$. With the exception of the lagged loan share, the firm-level proxies are all potential determinants of the response of the loan share, but they are outside of the scope of the model of section III.

Columns (1) and (2) from Table 1 report estimates of the average response of investment (the coefficient $\beta$ in the specification above), without controlling for the loan share. The top panel focuses on the impact response, while the bottom panel focuses on the one-year cumulative response. At both horizons, the average response to the shock is negative and significant. The point estimate suggests that following a 100bps surprise hike in the Fed Funds rate, net capital falls by approximately 4 percentage points by the end of the year. The magnitudes of the point estimates are consistent whether one controls for firm-level observables or not, so that the shock to the Fed Funds rate is relatively uncorrelated with time-series variation in these observables.

Column (3) introduces the loan share and its interaction with the shock as controls. I standardize the loan share, so that $\delta$ should be interpreted as the incremental response of a firm whose loan share is one standard deviation higher than average (i.e. 64.6% instead of 30.1% in the regression sample). The point estimate for the average effect of the shock is unchanged. Moreover, on impact, firms with a higher loan share are not differentially affected. However, over the following year, these firms experience a substantially larger contraction in investment. The point estimate indicates that the cumulative change in capital for these firms is approximately 1 percentage point (or 25%) larger than average.

Column (4) uses a more flexible specification in order to estimate this differential effect more precisely:

$$\Delta \log(k_{j,t+1}) = \alpha_j + \gamma_{k,t} + \delta \left(\eta_t^{HF} \times s_{j,t-1}\right) + \Gamma_X X_{j,t-1} + \varepsilon_{j,t}. \tag{8}$$

In this specification, $k$ is the firm's sector, and $\gamma_{k,t}$ is a sector-by-quarter fixed effect, where sectors are defined using the Fama-French 10 sectors. This specification estimates the incremental pass-through of more loan-dependent firms relative to other firms in the same industry and quarter. In the short-run, firms with a higher loan share respond similarly to their industry peers; but by the end of the year, they have cut back net investment by approximately 1.3 percentage point more than average, a magnitude consistent with the differential effect obtained without industry-by-time fixed effects.

Figure 9 reports complete dynamic estimates of these average and relative effects over a two-year window following the monetary policy contraction. Average effects are obtained from specification (7), while relative effects are obtained from the specification (8) with sector-by-quarter fixed effects. The average investment trough occurs after 3 quarters. After the third quarter, however, the investment recovery is slower for firms with initially higher loan shares. Two years after the shock, the average firm's cumulative decline in capital is on average zero; by contrast, a firm with a one standard deviation higher initial loan share experiences a cumulative decline in capital of approximately 3 percentage points.

Next, I look at the response of borrowing. Table 2, and the bottom panels of Figure 9, contain estimates of specifications identical to specifications (7) and (8), but using the cumulative growth rate of debt (that is, the change in $\log(1 + d_{j,t})$) over different horizons as outcome variables.

The results indicate a negative and persistent average effect of the increase in interest rates on borrowing. In response to a surprise 100bps tightening in monetary policy, borrowing declines by approximately 2% in the short-run, and 4.5% one year out. As for the case of capital, these average effects have the same magnitude whether or not one controls for firm-level observables. The dynamic response (the bottom left panel of Figure 9) indicates that the trough in the average response occurs three quarters after the shock, and that borrowing is still 2 percentage points below its initial level two years after the shock.

By contrast with investment, the differential response of initially more loan-dependent firms is positive. However, it is not statistically significant either on impact or one year-out, as indicated by table 2. The dynamic differential response reported on the bottom right panel of Figure 9 indicates that the differential effect peaks 1 to 2 quarters out (it is significant at the 10% level one quarter out.) The magnitude of the point estimate indicates that a one standard deviation higher initial loan share mitigates the contraction in borrowing by about 1.0 percentage points (or about 25%) relative to average. This positive average effect disappears after 4 to 5 quarters; two years out, point estimates are negative but insignificant.

Overall, the data indicate that initially more bank-dependent firms experience a larger decline in fixed investment following a monetary policy contraction, though the response is protracted. The differences are more muted for borrowing; if anything, more bank-dependent firms experience a smaller decline in borrowing, especially in the short-run.

### IV.B.ii The response of debt composition

I next document how debt composition responds to a monetary policy contraction. I start by estimating regressions of the form:

$$\Delta s_{j,t} = \alpha_j + \beta \eta_t^{HF} + \delta \left( \eta_t^{HF} \times r_{j,t-1} \right) + \Gamma_Z Z_{t-1} + \Gamma_X X_{j,t-1} + \varepsilon_{j,t}. \tag{9}$$

Here, $\Delta s_{j,t}$ is the change in the loan share of firm $j$. The rest of the controls are the same as in specification (7), except for $r_{j,t-1}$. Following the predictions of the model, I focus on differences in the response of the loan share for bank-dependent firms with low vs. high net worth. Net worth has no simple empirical counterpart. However, because it is monotonically increasing in default risk in the model, I use a firm's credit rating as a proxy for net worth. $r_{j,t-1}$ is a dummy variable taking the value of 1 if a firm has a either no long-term credit rating, or a rating below $A-$, and 0 otherwise. Additionally, consistent with the model, I focus the analysis on firms with strictly positive loan shares at the time of the shock.

The results of Table 3 indicate that among high-rated firms ($r_{j,t-1} = 0$) the loan share increases in response to a tightening in monetary policy, though the response is sluggish: the loan share does not respond immediately, but, within a year, it increases significantly. The point estimate suggests that a 100bps increase in Fed Funds rate raises the loan share among high-rated firms by approximately 2 percentage points (again, relative to a sample mean of 30%.) Figure 10 shows that this increase continues in the second year after the shock; the point estimate for the cumulative change in the loan share after two years is 4 percentage points, and it is statistically significant.

Additionally, Table 3 and Figure 10 show that the change in the loan share is larger among lower-rated firms. In the last columns of the top and bottom panel of Table 3, as well as in the right panel of Figure 10, I report estimates of the differential effect of $r_{j,t-1}$, using a specification analogous to (8). Compared to a firm with a high credit rating, the adjustment toward bank debt for firms with a low credit rating ($r_{j,t-1} = 1$) is economically large: four quarters out, these firms experience a four percentage points larger increase in their loan share. The differential effect becomes insignificant after five quarters.

The data thus indicate that among bank-dependent firms, the loan share increases after a monetary policy tightening. Moreover, the adjustment is stronger and more rapid for firms with lower credit ratings.

### IV.C Discussion

From the standpoint of the predictions derived from the model of III, the evidence presented in this section can be summarized as follows.

First, consistent with the first prediction of the model, the evidence indicates that investment declines in response to an exogenous increase in the risk-free rate, and more so among loan-dependent firms. This prediction of the model is independent of the strength of the bank lending channel.

Second, the evidence indicates that borrowing also declines in response to an increase in the risk-free rate. However, there is no clear evidence on the sign of the relative response of loan-dependent firms, though point estimates are positive. Relative to the second prediction of the model, this indicates that the bank lending channel is nonzero (for otherwise, borrowing would be less responsive among loan-dependent firms); but it does not rule out a weak borrowing channel.

Third, the evidence indicates that, among firms with a positive loan share, the loan share increases more for firms with lower credit ratings. This is qualitatively consistent with the third prediction of the model (that among loan-dependent firms, those with the lowest levels of internal funds will tend to increase their loan share in response to the shock), but only qualitatively. However, the point estimate of the response for firms that are loan-dependent but have higher credit ratings is still positive; by contrast, in the model, firms in the middle of the net worth distribution substitute bonds for loans in response to the shock, and their loan share declines. The limited evidence of this sort of substitution for lower-risk firms is more difficult to reconcile with the model. It may be that credit ratings are a poor proxy for the underlying unobservable firm characteristic upon which the sign of the response depends; in the model, this is whether or not a firm is exhausting its loan issuance capacity. Alternative proxies for this may include, for instance, the frequency with which firms renegotiate their debt contracts.

This section has provided partial supporting evidence in favor of the model of section III. Next, I turn to the model's implications for changes in the pass-through of monetary policy shocks as the degree of bank intermediation declines.

# V Disintermediation and the pass-through of monetary policy shocks

This section uses the model of section III to study the implications of disintermediation for the pass-through of monetary policy shocks to firms. It then provides supporting evidence for these predictions.

## V.A Model predictions

The model of section III can be used to think about the evolution of the pass-through of interest rate shocks to firms as the degree of intermediation declines. Consistent with the initial data analysis, I use the aggregate loan share as a proxy for the degree of intermediation. The aggregate loan share, in the model, is defined as $S = \int_e s(e)d(e)d\mu(e)/\int_e d(e)d\mu(e)$, where $s(e)$ is the firm-level loan share, and $d(e)$ is firm-level borrowing. Figure 11 reports results from different calibrations of the model, corresponidng to different (and declining) aggregate loan shares.

In order to produce these comparative statics, one must take a stance on the structural parameter that is driving the change in the aggregate loan share. I choose to let the intermediation cost function, $\gamma_b(r) = \gamma_b^0 + \nu_b(r - r_0)$, vary across model calibrations, while keeping all other parameters constant.[32] More specifically, across these calibrations, I vary the intercept of this intermediation cost function, $\gamma_b^0$, while keeping the parameter controlling the strength of the bank lending channel, $\gamma_b'(r) = \nu_b$, constant and equal to 1. That is to say, I study the change in the pass-through of monetary policy as bank intermediation becomes progressively more costly, but the "bank lending channel" (i.e. the elasticity $\nu_b$) stays constant. A higher intermediation cost $\gamma_b^0$ leads, unsurprisingly, to equilibria with fewer loan-dependent firms and a lower aggregate loan share.

In each panel of Figure 11, the horizontal axes report the aggregate loan share corresponding to a particular calibration. The vertical axes report the cross-sectional average elasticities in response to a 1% increase in the risk-free rate. For each outcome variable, three elasticities are reported: the unconditional average elasticity; the elasticity among loan-dependent firms, that is, firms that issue both loans and bonds in the model; and the elasticity among firms that only issue bonds.

The top left panel of Figure 11 reports the relationship between the aggregate loan share, and these difference investment elasticities. Three things are worth noting. First, the average pass-through of monetary policy shocks to investment weakens as the aggregate loan share rises. The pass through falls by about 40%, from a 1% decline in investment for every percentage point increase in the risk-free rate when the aggregate loan share is approximately 50%, to a 0.6% decline in investment for every percentage point increase in the risk-free rate when the aggregate loan

[32] In particular, for the results reported in Figure 11, the distribution $\mu(.)$ is the same Beta distribution with support on $[0, k^*]$ across all calibrations.

share is 25%. Second, the pass-through changes very little for firms that are purely bond-financed. Third, *even* conditional on being loan-dependent, the pass-through declines, though it declines less than the average pass-through. Thus, the relative pass-through between loan-dependent and bond-financed firms (the gap between the red and the blue lines) also declines with the aggregate loan share.

The decline in the average pass-through thus has two origins. First, as bank intermediation costs rise, for a given level of internal funds, firms in the model are more likely to choose to be bond-dependent. In other words, within firm, debt composition will shift toward bond financing. Because the pass-through to investment is in general weaker for bond-financed firms (as discussed in section III), this contributes to lowering the pass-through overall. Second, the average pass-through declines because even loan-dependent firms become less sensitive to shocks. The reason for this is less straightforward. Recall that there are two types of loan-dependent firms in the model: those with low internal funds, for which the bank borrowing constraint binds, and which are relatively insensitive to monetary policy shocks; and those with a higher level of internal funds, which are at an interior solution and whose investment is comparatively more sensitive to interest rate shocks. As intermediation costs rise, it is the latter type of firms that primarily switch to bond financing, leaving only the former, less sensitive ones among the group of loan-dependent firms.

Figure 11 also reports comparative statics for the pass-through of interest rate shocks to borrowing. Both the average pass-through, and the relative pass-through between loan-dependent and bond-financed firms, increase as intermediation costs $\gamma_b^0$ increases and the aggregate loan share declines. There are two notable differences with investment, though. First, the pass-through for bond-financed firms *declines* as $\gamma_b$ increases. This result is driven by composition. As intermediation costs rise, certain firms switch to a debt structure with only bonds. Compared to firms that already used only bonds, these firms have lower levels of internal financing, and thus are more constrained. Because they are more constrained, their borrowing response is weaker than other bond-financed firms.[33] Second, the pass-through for loan-dependent firms is smaller than for bond-financed firms. This result depends on the strength of the bank lending channel, as discussed in section III; the value of $\nu_b$ (the bank lending channel parameter) used in these calibrations is low

[33] In other words, conditional on being bond-financed, the interest rate elasticity of borrowing is increasing (in absolute value) with internal funds, as indicated in Figures A5 and A6.

enough to imply a lower pass-through for loan-dependent firms. This implies that, under alternative calibrations with a stronger bank lending channel, the relative pass-through (the gap between the red and the blue lines) might increase as intermediation costs rise.

Thus, when bank intermediation costs $\gamma_b$ change, the model has robust predictions regarding investment: the average pass-through should decline as the loan share rises, and the relative pass-through to loan versus bond-dependent firms should also decline.[34] Additionally, the average pass-through to borrowing should decline, though the relative pass-through might increase or decline, depending on the overall strength of the bank lending channel.

### V.B Evidence

I conclude this section by documenting whether the pass-through of monetary policy shocks to firms changed since 1990 in ways that are consistent with the model's predictions.

In order to do this, I replicate the analysis of the pass-through of monetary policy shocks to borrowing and investment described in section IV, using a longer-run (but potentially less accurate) measure of monetary policy. Specifically, as described in section IV, I use deviations of changes in the fed funds rate relative to internal forecasts, which I denote by $\eta_t^{RR}$.

I use an identical approach to section IV in order to construct the average effect of the shock on investment and borrowing, and its relative effect on more bank-dependent firms, either using specifications that control for sector effects and macroeconomic variables (i.e., specification 7); or specifications controlling for sector-by-time effect (i.e., specification 8). Moreover, I focus on cumulative net investment or borrowing over a one-year window after the shock. The results are reported in Tables 4 and 5.

First, the results in the 1990q1-2007q4 sample, reported in the top panels of Tables 4 and 5, are broadly in line with those obtained using $\eta_t^{FF}$, the measure of monetary policy shocks constructed using short-run changes in fed funds futures. Namely, investment and borrowing decline on average; moreover, investment declines more among initially loan-dependent firms, while borrowing declines

[34] The predictions hold regardless of whether or not one incorporates a bank lending channel into the model, that is, regardless of whether $\nu_b$ is zero or positive. They do, however, depend on the nature of the underlying structural change. For instance, a reduction in the volatility of idiosyncratic productivity shocks would also produce a reduction in the aggregate loan share; but its effects on the pass-through would it general have the opposite sign, as a lower volatility of idiosyncratic shocks tends to relax borrowing constraints (and thus make investment more interest-sensitive) in the model.

less, though the statistically significance is only marginal. However, consistent with the view that the shock $\eta_t^{RR}$ is more likely to be more correlated with expected changes in interest rates, the documented effects are generally weaker than those obtained in the analysis of section IV.

The bottom panel of Tables 4 and 5 report results obtained in the pre-1990q1 sample. For comparison with the post-1990q1 sample, I use 72 quarters of data, going back to 1971q1. Average effects of interest rate shocks on borrowing and investment are substantially larger over this sample, with point estimates more than doubling for both investment and borrowing. As predicted by the model, the relative pass-through to investment is also larger, though economic magnitude in the difference is relatively small (approximately 0.5% more decline in investment over the first year after the shock.) Finally, the relative pass-through to borrowing is approximately unchanged (the point estimate declines slightly), though, as highlighted above, it is unclear whether the model has robust predictions for how this pass-through should change.

Thus, overall, the data indicate that the pass-through of monetary policy shocks to firms fell from the pre- to the post-1990 period, and moreover, that the differential effect of the initial loan mix also declined. Both are consistent with the predictions of the model, suggesting that disintermediation could have played a role in the decline of the pass-through.

# VI Conclusion

The results of this paper can be summarized as follows. First, I have documented a decline in the loan share of total corporate debt. This decline does not seem to be driven by composition effects; rather, it reflects a within-firm change in debt structure. Second, I have proposed a simple model of the equilibrium determination of debt structure within firm. This model has a number of empirical predictions, among which a higher pass-through of monetary policy shocks to investment for initially loan-dependent firms. Third, using data on publicly traded firms, I have shown that the data partially support the model's predictions, though they seem to indicate less substitution toward bonds after monetary policy shocks than the model would predict. Finally, I've argued that from the standpoint of the model, disintermediation should lead to a lower pass-through of monetary policy shocks to investment, something that the data seem to support.

It is important to highlight that one cannot infer from these results that the declining pass-through of monetary policy shocks documented in the sample of firms studied in this paper is attributable to disintermediation. Rather, the evidence is consistent with disintermediation being a contributor to this phenomenon. Figuring out how big of a contributor would require a calibration of the model the elasticities estimated here in the pre- and post-1990 samples.

These results leave a number of open questions. First, I assumed that banks' relative intermediation costs increased since the early 1990s, as this change can correctly and transparently account for the patterns observed in the data since. What this reduced-form assumption captures is less clear, but surely relevant for understanding the policy implications of disintermediation. Second, I focused on publicly traded firms; since disintermediation was presumably less important among private firms, it is less clear how monetary pass-through might have evolved among them. Finally, I chose to take a particular stance on what makes loans different from bonds — their flexilibity; but as highlighted in the paper, loans and bonds differ in other important ways that might also be relevant to the transmission of monetary policy. All these shortcomings of the paper offer opportunities for future research.

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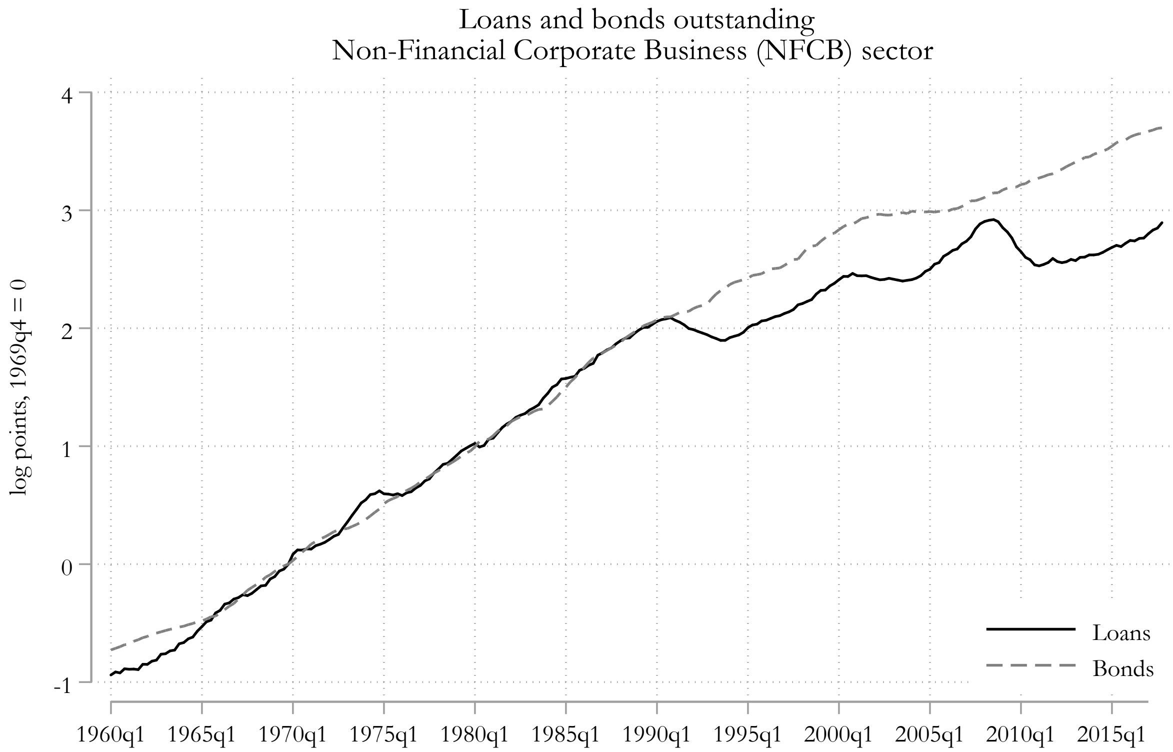



**Figure 1:** The stock of outstanding bonds and loans in the NFCB sector. Data are from Flow of Funds table L.103. Bonds are defined as data item FL104122005, "Debt Securities", which is the sum of corporate bonds, municipal securities, and commercial paper. Loans are defined as data item FL104123005, "Loans", which is the sum of depository institution loans, other loans and advances, and mortgages. The series are logged but not deflated, and the value of each series in 1970q1 is subtracted.

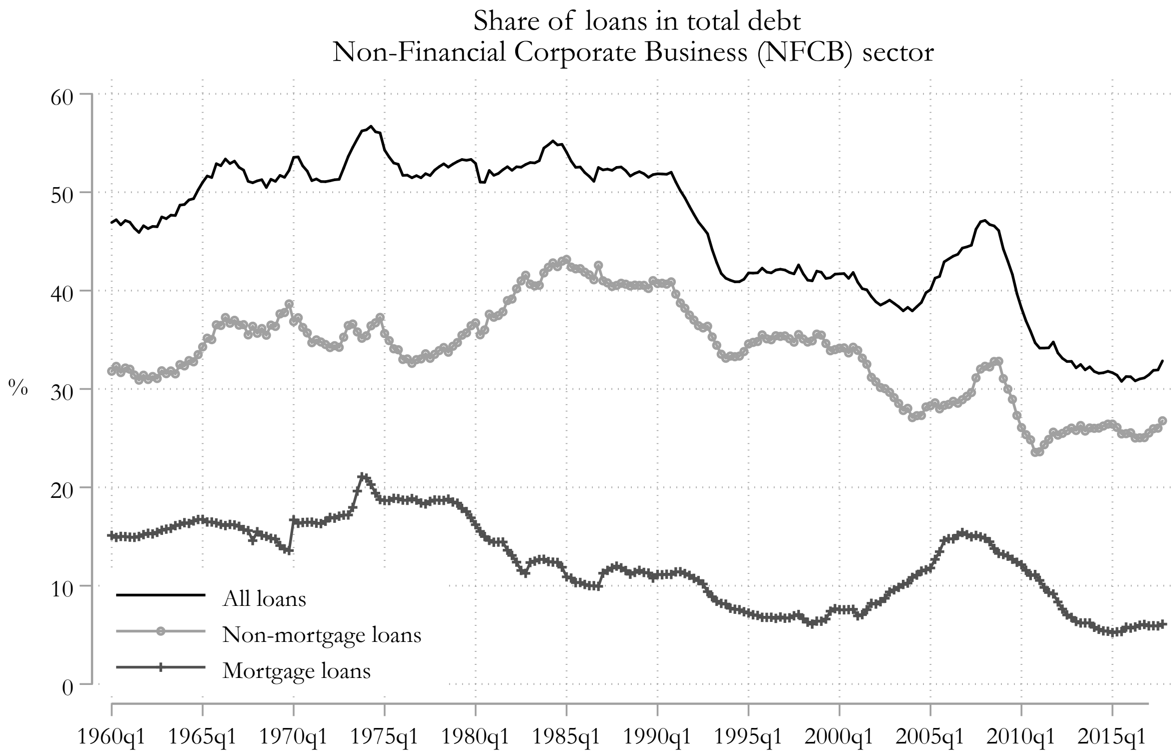



**Figure 2:** Loans as a share of total debt in the NFCB sector. Data are from Flow of Funds table L.103. Bonds are defined as data item FL104122005, "Debt Securities", which is the sum of corporate bonds, municipal securities, and commercial paper. Loans are defined as data item FL104123005, "Loans", which is the sum of depository institution loans, other loans and advances, and mortgages. The share plotted is the ratio of loans to the sum of bonds plus loans.

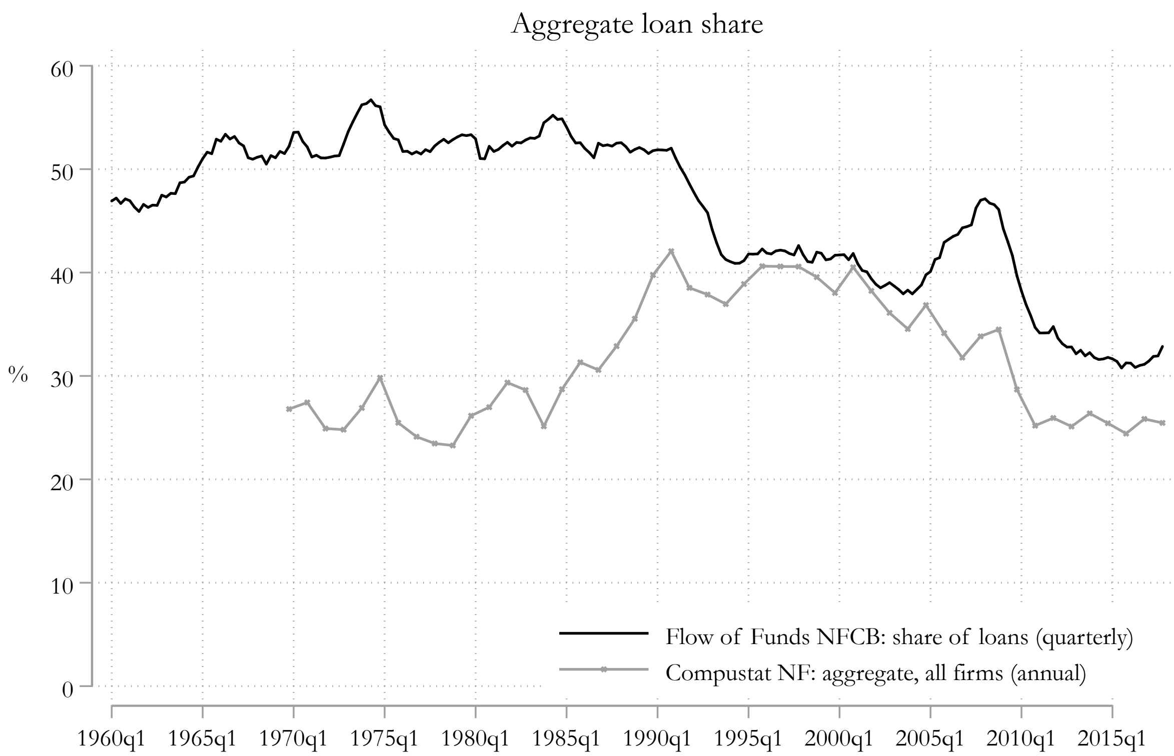



**Figure 3:** A comparison of the aggregate loan share in the NFCB, between Flow of Funds (public plus private) and Compustat (public) firms. Data are from Flow of Funds table L.103 and from the Compustat Fundamentals Annual files. For Flow of Funds, loans are defined as item FL104122005. For Compustat Annual, loans are defined as the sum of notes payable (`np`) and other long-term debt (`dlto`). The Compustat sample is restricted to the nonfinancial (NF) sector. In both the Flow of Funds and the Compustat data, the denominator of the share is the book value of total debt (the sum of `dlc` and `dltt` in Compustat.)

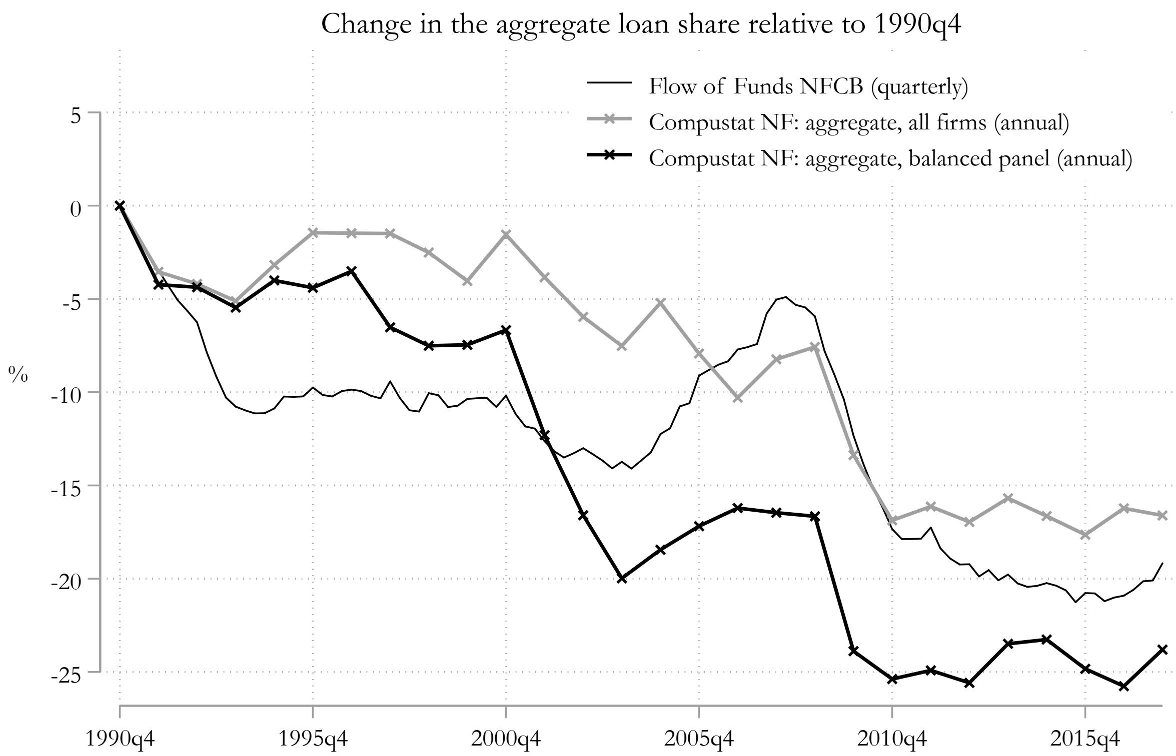



**Figure 4:** Change in aggregate loan shares since 1990q4. Data are from Flow of Funds table L.103 and from the Compustat Fundamentals Annual files. Variables are defined as in Figure 3, and the Compustat sample is restricted to non-financials. All the loan shares are aggregate and expressed relative to their level in 1990q4. The two lines drawn for the Compustat sample are the aggregate loan share in the overall sample, and in the balanced sample.

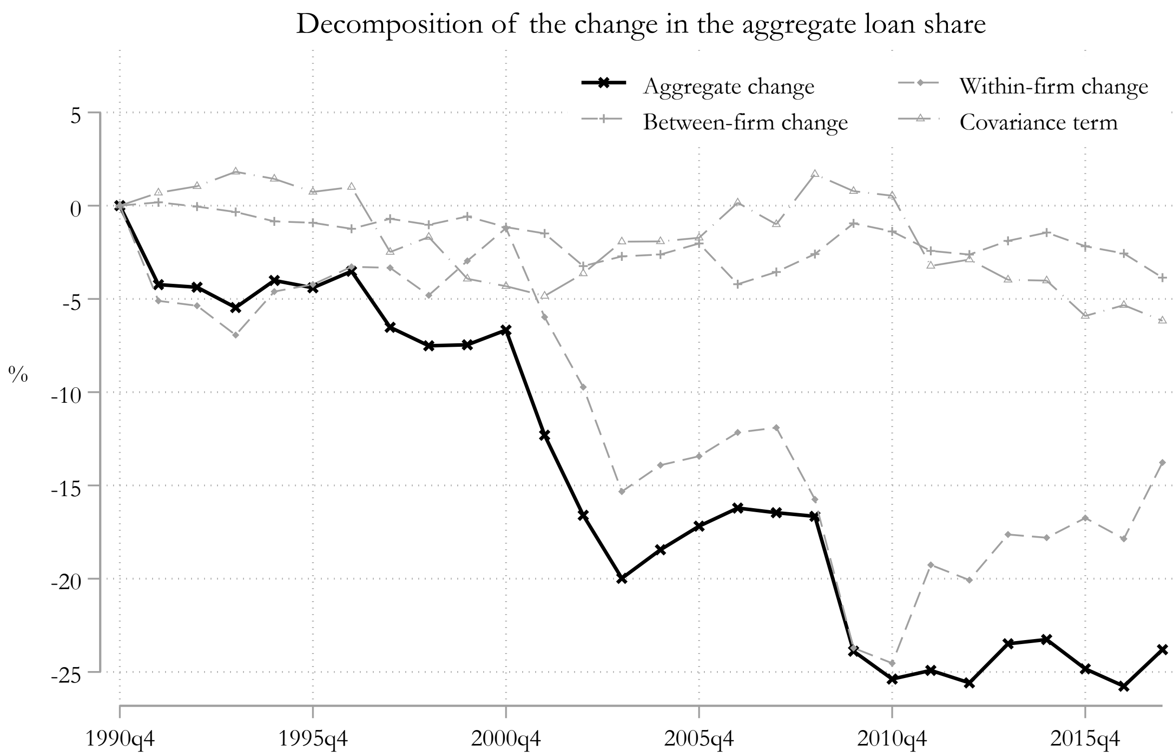
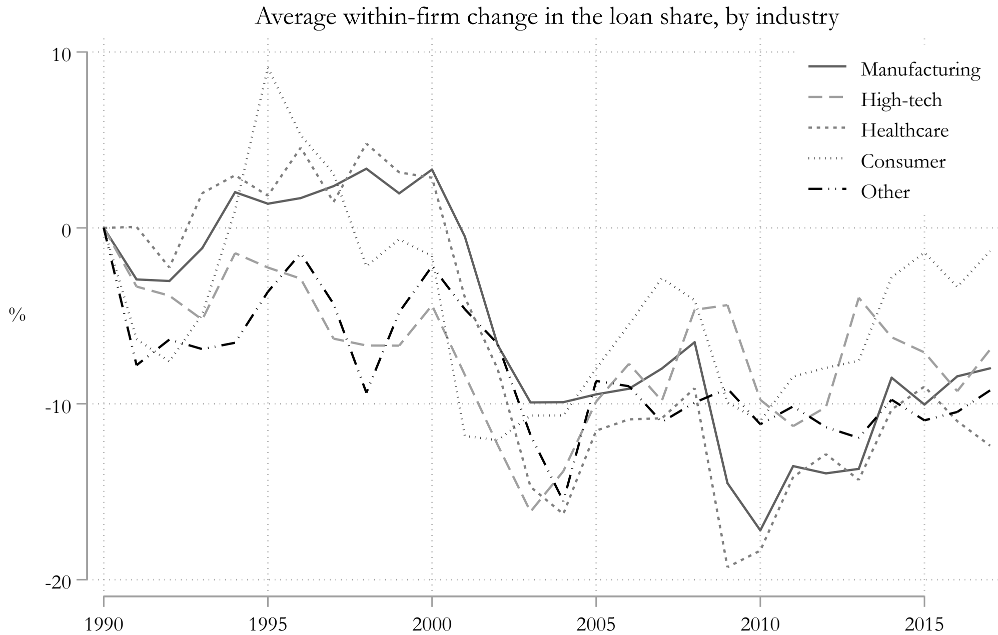
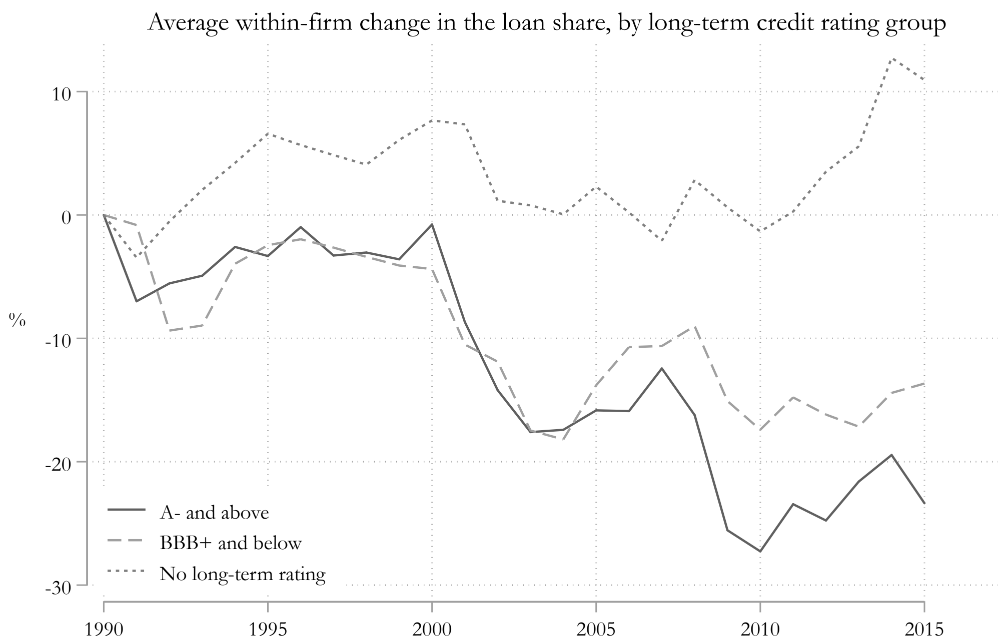



**Figure 5:** Decomposition of the aggregate loan share in the balanced panel of Compustat non-financial firms. Data is from the Compustat Fundamentals Annual file. The Compustat sample is restricted to the Non-Financial (NF) sector and to firms that are present in sample for each year from 1990 to 2017, and with stricly positive total debt at all dates. The crossed black line represents the decline in the ratio of total loans to total debt for this group of firms since 1990q4. The first term (the within-term) shows the evolution of the aggregate loan share if the distribution of total debt across firms were kept constant. The second term (the between-term) shows the aggregate loan share if the share of loans were kept constant. The residual term, up to a constant, is the cross-sectional covariance between changes in firm's share of total debt and changes in its loan share.




**(a)**




**(b)**

**Figure 6:** Change in within-firm loan share, by firm group. The data are from the Compustat annual files. The sample is restricted to non-financial firms that present in every year of the panel from 1990 to 2017. The top panel reports the average within-firm loan share by broad industry category; the industry categories are based on Fama-French industry classifications, and are constant within firm. The bottom panel reports the loan share by groups of long-term credit rating.

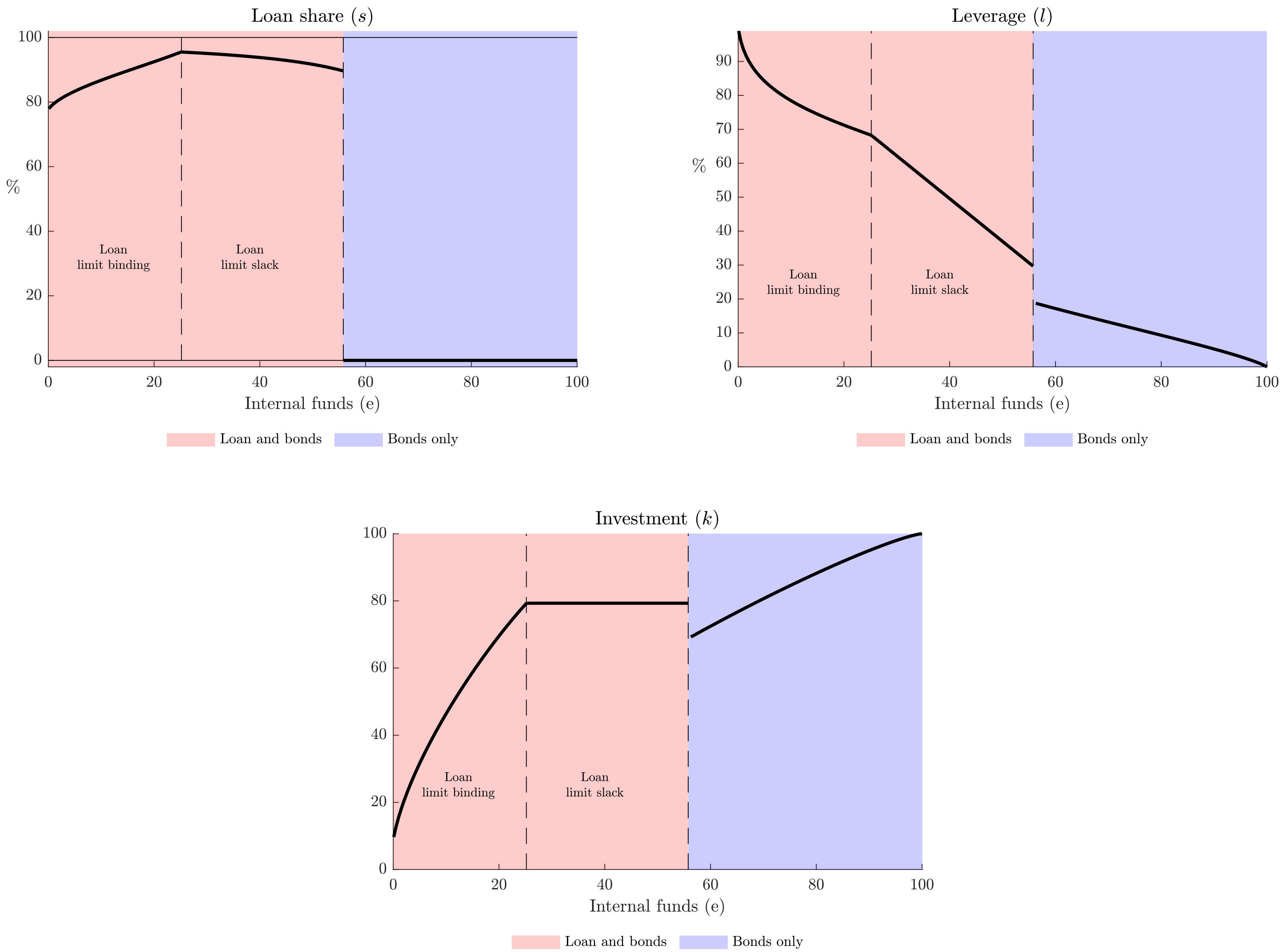



**Figure 7:** Policy functions in the model of section III.B. The state variable is internal funds. Idiosyncratic productivity shocks follow a Weibull distribution with location parameter $\lambda$ and shape parameter $\xi$, i.e. $F(\phi) = 1 - e^{-(\phi/\lambda)^{\xi}}$. The model's structural parameters are given by $r = r_0 = 0.05$, $\zeta = 0.92$, $\gamma_b^0 = 0.02$, and $\xi = 1.6$, and the location parameter of the Weibull distribution is normalized so that $k^* = (\zeta \mathbb{E}(\phi)/(1+r))^{1/(1-\zeta)} = 100$. The red shaded region corresponds to firms that choose to issue both loans and bonds, while the blue shaded region corresponds to firms that choose to issue only bonds. Among firms that issue both loans and bonds (the red region), the dashed black line separates those whose bank borrowing constraint is binding, from those who choose an interior solution for debt composition.

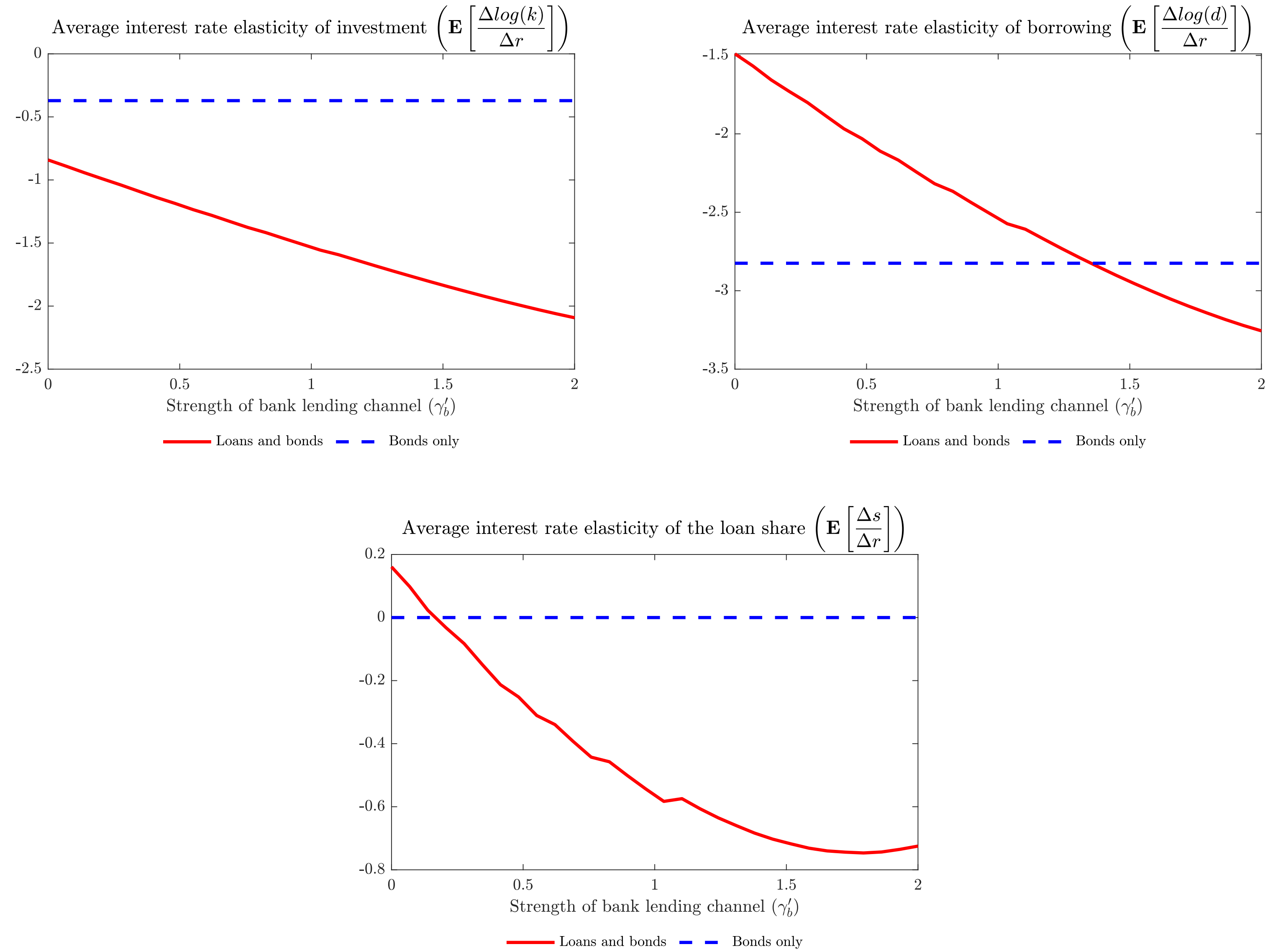



**Figure 8:** Average interest rate elasticities as a function of the strength of the bank lending channel. In order to construct these graphs, we assume that $\gamma_b(r) = \gamma_b^0 + \nu_b(r - r_0)$, where $\nu_b$ is a constant, and $r_0 = 0.05$ is the level of risk-free rates used in the baseline calibration of the model. On the horizontal axis, the interest rate elasticity $\gamma_b' = \nu_b$ is reported. For each value of $\gamma_b'$, the elasticities reported are the cross-sectional average percent change in a variable of interest (or the percentage point change, for the loan share) for a $100bps$ increase in the risk-free rate, $r$. The cross-sectional averages are computed using, for $\mu(e)$, a Beta distribution with parameters $(2, 6)$, supported on $[0, k^*]$. The red solid line reports the conditional average elasticity among firms which continue issuing both loans and bonds in response to the interest rate hike, while the dashed blue line reports the conditional average elasticity among firms which issue only bonds both before and after the interest rate hike. Other than the strength of the bank lending channel, the calibration of the model is the same as in Figure 7.

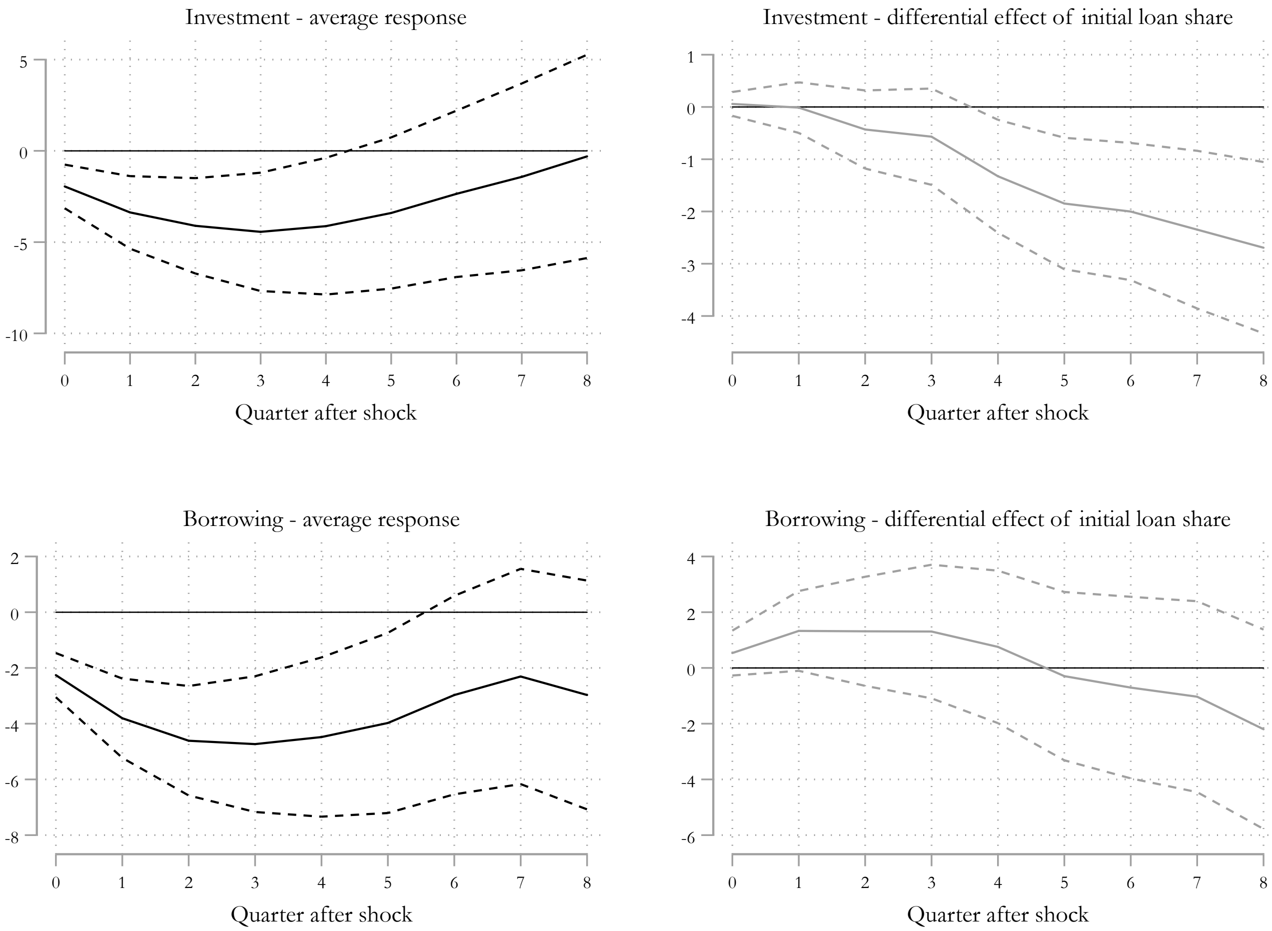



**Figure 9:** Dynamic response of investment and borrowing to a monetary policy tightening: average effects and differential effect of the loan share. The top graphs report results for the cumulative change in net property, plant and equipment, while the bottom graphs report results for the cumulative change in debt. The left column reports average effects. They are the coefficients $\beta_h$ regressions of the form $\Delta_h y_{j,t} = \alpha_{j,h} + \beta_h \eta_t^{HF} + \delta_h(\eta_t^{HF} \times s_{j,t-1}) + \Gamma_{Z,h} Z_{t-1} + \Gamma_{X,h} X_{j,t-1} + \varepsilon_{j,h,t}$. $\Delta_h y_{j,t}$ is the cumulative change in variable $y_{j,t}$ between the end of quarter $t-1$ and the end of quarter $t+h$; $Z_{t-1}$ are macro controls (the log change in the industrial production index and the log change in the CPI, both lagged one period), and $X_{j,t-1}$ are firm-level controls (aside from the loan share $s_{j,t-1}$, these include the log change in real sales, the log of total book assets, the ratio of net current assets to total assets, all lagged one period, and a set of dummies for fiscal quarters.) The right column reports the differential effect of the shock based on the lagged loan share. This differential effect is the coefficient $\delta_h$ in regressions with sector-time fixed effects: $\Delta_h y_{j,k,t} = \alpha_{j,h} + \beta_{h,k,t} + \delta_h(\eta_t^{HF} \times s_{j,t-1}) + \Gamma_{X,h} X_{j,t-1} + \varepsilon_{j,h,t}$, where $k$ is the firm's sector. The loan share is standardized in the regression sample. The dashed lines are 90% confidence bands; standard errors are clustered by firm and quarter.

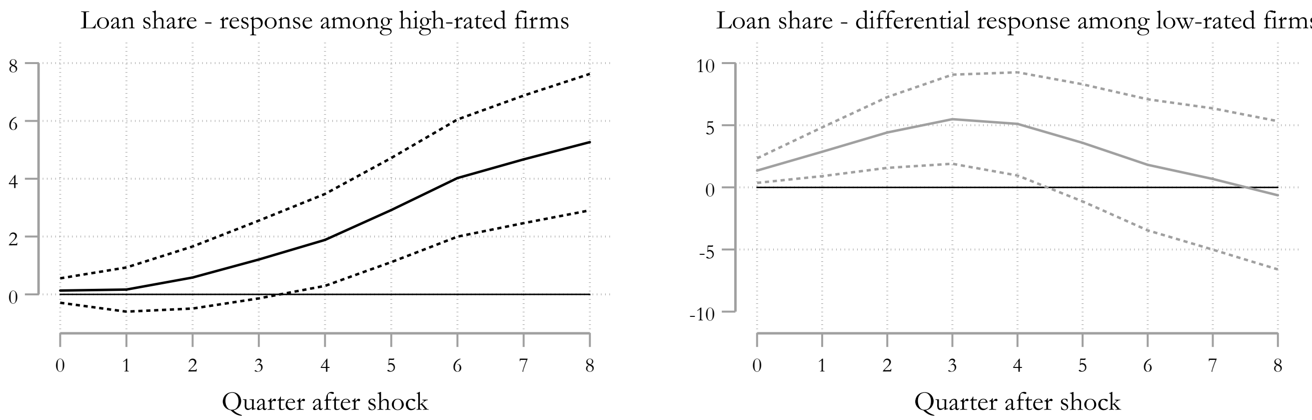



**Figure 10:** Dynamic response of the loan share to a monetary policy tightening: average effects and differential effect of credit ratings. The results reported are for the 1990q1-2007q4 sample. The top graphs report results for the cumulative change in net property, plant and equipment, while the bottom graphs report results for the cumulative change in debt. The left column reports average effects. They are the coefficients $\beta_h$ regressions of the form $\Delta_h s_{j,t} = \alpha_{j,h} + \beta_h \eta_t^{HF} + \delta_h(\eta_t^{HF} \times r_{j,t-1}) + \Gamma_{Z,h} Z_{t-1} + \Gamma_{X,h} X_{j,t-1} + \varepsilon_{j,h,t}$. $\Delta_h s_{j,t}$ is the cumulative change in the loan share between the end of quarter $t-1$ and the end of quarter $t+h$; $Z_{t-1}$ are macro controls (the log change in the industrial production index and the log change in the CPI, both lagged one period), and $X_{j,t-1}$ are firm-level controls (these include the log change in real sales, the log of total book assets, the ratio of net current assets to total assets, all lagged one period, the credit rating group $r_{j,t-1}$, and a set of dummies for fiscal quarters.) The right column reports the differential effect of the shock based on the credit rating group $r_{j,t-1}$. This differential effect is the coefficient $\delta_h$ in regressions with sector-time fixed effects: $\Delta_h s_{j,k,t} = \alpha_{j,h} + \beta_{h,k,t} + \delta_h(\eta_t^{HF} \times r_{j,t-1}) + \Gamma_{X,h} X_{j,t-1} + \varepsilon_{j,h,t}$, where $k$ is the firm's sector. The credit rating group is coded so that $r_{j,t-1}$ corresponds to a rating of $A-$ or less. The dashed lines are 90% confidence bands; standard errors are clustered by firm and quarter.

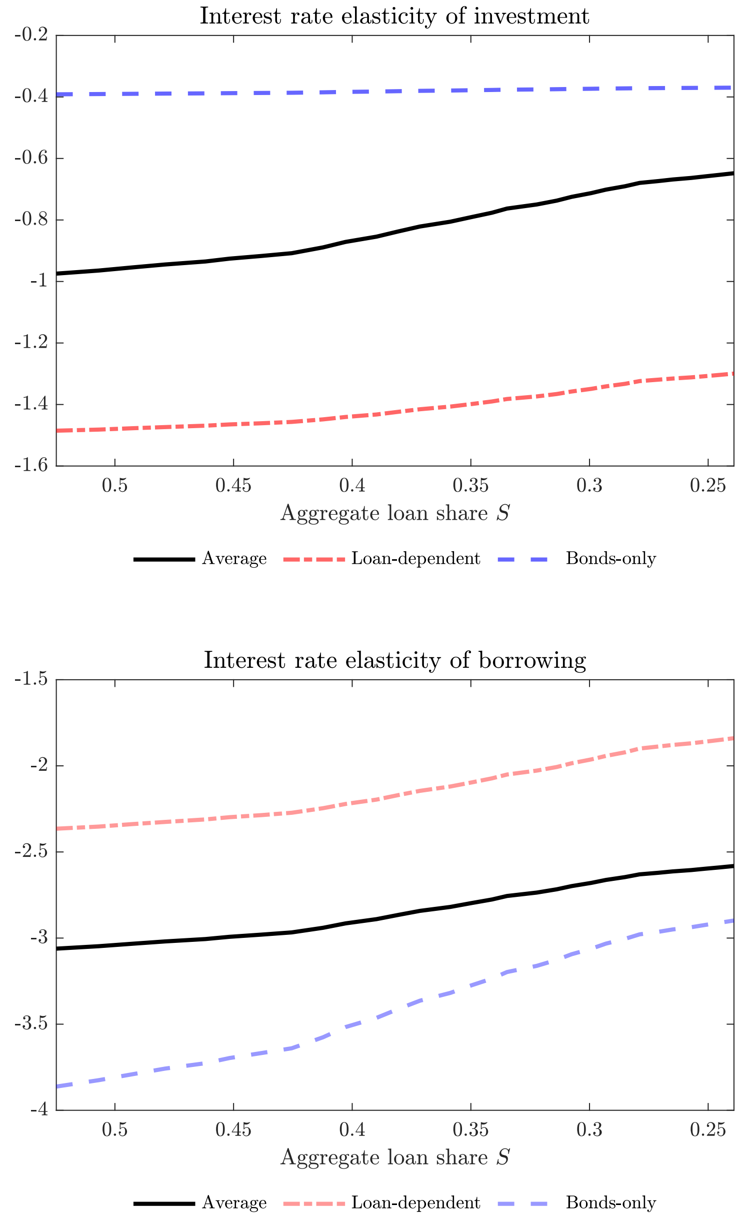



**Figure 11:** Disintermediation and the pass-through of interest rate shocks. The horizontal axis reports the aggregate loan share, while the vertical axes report the cross-sectional average elasticity of various quantities to interest rates. In each of the four panels, a point corresponds to a different calibration of the model. Across calibrations, only the intermediation spread $\gamma_b$ changes: it varies between 0.02 (for the point with highest aggregate loan share) and 0.04 (for the point with the loan aggregate loan share.) In all calibrations, the bank lending channel is active ($\nu_b > 0$ in the model of section III). The elasticities reported are the cross-sectional average percent change in a variable of interest (or the percentage point change, for the loan share) for a $100bps$ increase in the risk-free rate, $r$; for instance, for investment, they are the cross-sectional average of $\Delta log(k)/\Delta r$, with $\Delta r = 100bps$. The black line reports the unconditional average elasticity; the blue, short-dashed lined reports the elasticity among bond-financed firms; and the red, long-dashed line reports the elasticity among loan-dependent firms.

**(a)** Investment: impact response

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{HF}$ | -2.35*** | -1.95*** | -1.95*** | |
| | (0.77) | (0.73) | (0.73) | |
| $\eta_t^{HF} \times s_{j,t-1}$ | | | 0.13 | 0.06 |
| | | | (0.15) | (0.14) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.107 | 0.122 | 0.122 | 0.140 |
| $N$ | 200358 | 200358 | 200358 | 200358 |

**(b)** Investment: cumulative 4-quarter response

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{HF}$ | -5.24** | -4.15* | -4.12* | |
| | (2.40) | (2.28) | (2.28) | |
| $\eta_t^{HF} \times s_{j,t-1}$ | | | -1.07 | -1.33** |
| | | | (0.67) | (0.66) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.226 | 0.259 | 0.259 | 0.274 |
| $N$ | 189794 | 189794 | 189794 | 189794 |

**Table 1:** Response of investment to a monetary policy tightening. The top panel reports estimates for the impact response, while the bottom panel reports estimates for one-year ahead cumulative response. Columns (1) to (3) report estimates from: $\Delta y_{j,t} = \alpha_j + \beta\eta_t^{HF} + \delta(\eta_t^{HF} \times s_{j,t-1}) + \Gamma_z Z_{t-1} + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$. $\Delta y_{j,t}$ is the change in $log(k_{j,t})$, either from the end of quarter $t-1$ to the end of quarter $t$ (top panel) or to the end of quarter $t+4$ (bottom panel). Additionally, $\eta_t^{HF}$ is the shock to the Federal Funds rate; $s_{j,t-1}$ is the share of bank loans in total debt at the end of quarter $t-1$; $Z_{t-1}$ are macro controls (the log change in the industrial production index and the log change in the CPI, both lagged one period); and $X_{j,t-1}$ is a vector containing the log change in real sales, the log of total book assets, the ratio of net current assets to total assets, the loan share, all lagged one period, and a set of dummies for fiscal quarters. Column (4) reports estimates from a model with sector-time fixed effects: $\Delta y_{j,k,t} = \alpha_j + \gamma_{k,t} + \delta(\eta_t^{HF} \times s_{j,t-1}) + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$, where $k$ is the firm's sector. In all specifications, the loan share is expressed in terms of its deviation from the within-firm average, and standardized in the regression sample. Standard errors are clustered by firm and quarter.

**(a)** Borrowing: impact response

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{HF}$ | -0.96*** | -1.13*** | -1.13*** | |
| | (0.24) | (0.24) | (0.24) | |
| $\eta_t^{HF} \times s_{j,t-1}$ | | | 0.25 | 0.27 |
| | | | (0.24) | (0.24) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.056 | 0.071 | 0.071 | 0.080 |
| $N$ | 200358 | 200358 | 200358 | 200358 |

**(b)** Borrowing: cumulative 4-quarter response

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{HF}$ | -2.54*** | -2.23** | -2.24*** | |
| | (0.87) | (0.87) | (0.87) | |
| $\eta_t^{HF} \times s_{j,t-1}$ | | | 0.22 | 0.38 |
| | | | (0.83) | (0.83) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.109 | 0.111 | 0.111 | 0.122 |
| $N$ | 189794 | 189794 | 189794 | 189794 |

**Table 2:** Response of borrowing to a monetary policy tightening. The top panel reports estimates for the impact response, while the bottom panel reports estimates for one-year ahead cumulative response. Columns (1) to (3) report estimates from: $\Delta y_{j,t} = \alpha_j + \beta\eta_t^{HF} + \delta(\eta_t^{HF} \times s_{j,t-1}) + \Gamma_z Z_{t-1} + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$. $\Delta y_{j,t}$ is the change in $log(1 + d_{j,t})$, either from the end of quarter $t-1$ to the end of quarter $t$ (top panel) or to the end of quarter $t+4$ (bottom panel). Additionally, $\eta_t^{HF}$ is the shock to the Federal Funds rate; $s_{j,t-1}$ is the share of bank loans in total debt at the end of quarter $t-1$; $Z_{t-1}$ are macro controls (the log change in the industrial production index and the log change in the CPI, both lagged one period); and $X_{j,t-1}$ is a vector containing the log change in real sales, the log of total book assets, the ratio of net current assets to total assets, the loan share, all lagged one period, and a set of dummies for fiscal quarters. Column (4) reports estimates from a model with sector-time fixed effects: $\Delta y_{j,k,t} = \alpha_j + \gamma_{k,t} + \delta(\eta_t^{HF} \times s_{j,t-1}) + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$, where $k$ is the firm's sector. In all specifications, the loan share is expressed in terms of its deviation from the within-firm average, and standardized in the regression sample. Standard errors are clustered by firm and quarter.

**(a)** Loan share: impact response

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{HF}$ | 0.14 | 0.21 | 0.13 | |
| | (0.25) | (0.25) | (0.26) | |
| $\eta_t^{HF} \times r_{j,t-1}$ | | | 1.10* | 1.35** |
| | | | (0.58) | (0.60) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.059 | 0.059 | 0.059 | 0.064 |
| $N$ | 140783 | 140783 | 140783 | 140783 |

**(b)** Loan share: cumulative 4-quarter response

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{HF}$ | 1.81* | 2.21** | 2.21** | |
| | (0.93) | (0.93) | (0.93) | |
| $\eta_t^{HF} \times r_{j,t-1}$ | | | 0.05 | 0.13 |
| | | | (0.69) | (0.69) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.114 | 0.116 | 0.116 | 0.124 |
| $N$ | 120900 | 120900 | 120900 | 120900 |

**Table 3:** Response of the loan share to a monetary policy tightening. The results reported are for the 1990q1-2007q4 sample. The top panel reports estimates for the impact response, while the bottom panel reports estimates for one-year ahead cumulative response. Columns (1) to (3) report estimates from: $\Delta s_{j,t} = \alpha_j + \beta\eta_t^{HF} + \delta(\eta_t^{HF} \times r_{j,t-1}) + \Gamma_z Z_{t-1} + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$. $\Delta s_{j,t}$ is the change in the loan share $s_{j,t}$, either from the end of quarter $t-1$ to the end of quarter $t$ (top panel) or to the end of quarter $t+4$ (bottom panel). Additionally, $\eta_t^{HF}$ is the shock to the Federal Funds rate; $r_{j,t-1}$ is the credit rating group; $Z_{t-1}$ are macro controls (the log change in the industrial production index and the log change in the CPI, both lagged one period); and $X_{j,t-1}$ is a vector containing the log change in real sales, the log of total book assets, the ratio of net current assets to total assets, the credit rating group, all lagged one period, and a set of dummies for fiscal quarters. Column (4) reports estimates from a model with sector-time fixed effects: $\Delta s_{j,k,t} = \alpha_j + \gamma_{k,t} + \delta(\eta_t^{HF} \times r_{j,t-1}) + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$, where $k$ is the firm's sector. The credit rating group is coded so that $r_{j,t-1}$ corresponds to a rating of $A-$ or less. Standard errors are clustered by firm and quarter in all specifications.

**(a)** Investment: 4-quarter response, post-1990q1 sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{RR}$ | -3.39** | -2.81** | -2.79** | |
| | (1.49) | (1.32) | (1.32) | |
| $\eta_t^{RR} \times s_{j,t-1}$ | | | -0.85*** | -1.00*** |
| | | | (0.29) | (0.28) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.228 | 0.260 | 0.260 | 0.274 |
| $N$ | 189794 | 189794 | 189794 | 189794 |

**(b)** Investment: 4-quarter response, pre-1990q1 sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{RR}$ | -6.67** | -4.33* | -4.31* | |
| | (2.67) | (2.48) | (2.48) | |
| $\eta_t^{RR} \times s_{j,t-1}$ | | | -1.48*** | -1.61*** |
| | | | (0.27) | (0.14) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.285 | 0.323 | 0.323 | 0.344 |
| $N$ | 111913 | 111913 | 111913 | 111909 |

**Table 4:** Response of investment to a monetary policy tightening in the pre- and post-1990q1 periods. The top panel reports estimates for the post-1990 period, while the bottom panel reports estimates for the pre-1990 period. Columns (1) to (3) report estimates from: $\Delta y_{j,t} = \alpha_j + \beta\eta_t^{RR} + \delta(\eta_t^{RR} \times s_{j,t-1}) + \Gamma_z Z_{t-1} + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$. $\Delta y_{j,t}$ is the change in $log(k_{j,t})$ over the year following the shock. Additionally, $\eta_t^{RR}$ is the shock to the Federal Funds rate, identified using the narrative approach of Romer and Romer (2004) instead of data on fed funds futures; $s_{j,t-1}$ is the share of bank loans in total debt at the end of quarter $t-1$; $Z_{t-1}$ are macro controls (the log change in the industrial production index and the log change in the CPI, both lagged one period); and $X_{j,t-1}$ is a vector containing the log change in real sales, the log of total book assets, the ratio of net current assets to total assets, the loan share, all lagged one period, and a set of dummies for fiscal quarters. Column (4) reports estimates from a model with sector-time fixed effects: $\Delta y_{j,k,t} = \alpha_j + \gamma_{k,t} + \delta(\eta_t^{RR} \times s_{j,t-1}) + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$, where $k$ is the firm's sector. In all specifications, the loan share is expressed in terms of its deviation from the within-firm average, and standardized in the regression sample. Standard errors are clustered by firm and quarter.

**(a)** Borrowing: 4-quarter response, post-1990q1 sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{RR}$ | -1.03*** | -1.11*** | -1.11*** | |
| | (0.26) | (0.27) | (0.27) | |
| $\eta_t^{RR} \times s_{j,t-1}$ | | | 0.60* | 0.66* |
| | | | (0.34) | (0.34) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.110 | 0.111 | 0.111 | 0.122 |
| $N$ | 189794 | 189794 | 189794 | 189794 |

**(b)** Borrowing: 4-quarter response, pre-1990q1 sample

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\eta_t^{RR}$ | -5.62*** | -5.54*** | -5.55*** | |
| | (1.15) | (1.14) | (1.14) | |
| $\eta_t^{RR} \times s_{j,t-1}$ | | | 0.38 | 0.12 |
| | | | (0.83) | (0.82) |
| Macro controls | yes | yes | yes | no |
| Firm controls | no | yes | yes | yes |
| Sector-time FE | no | no | no | yes |
| Time clustering | yes | yes | yes | yes |
| $R^2$ | 0.150 | 0.153 | 0.153 | 0.173 |
| $N$ | 111913 | 111913 | 111913 | 111909 |

**Table 5:** Response of borrowing to a monetary policy tightening in the pre- and post-1990q1 periods. The top panel reports estimates for the post-1990 period, while the bottom panel reports estimates for the pre-1990 period. Columns (1) to (3) report estimates from: $\Delta y_{j,t} = \alpha_j + \beta\eta_t^{RR} + \delta(\eta_t^{RR} \times s_{j,t-1}) + \Gamma_z Z_{t-1} + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$. $\Delta y_{j,t}$ is the change in $log(1 + d_{j,t})$ over the year following the shock. Additionally, $\eta_t^{RR}$ is the shock to the Federal Funds rate, identified using the narrative approach of Romer and Romer (2004) instead of data on fed funds futures; $s_{j,t-1}$ is the share of bank loans in total debt at the end of quarter $t-1$; $Z_{t-1}$ are macro controls (the log change in the industrial production index and the log change in the CPI, both lagged one period); and $X_{j,t-1}$ is a vector containing the log change in real sales, the log of total book assets, the ratio of net current assets to total assets, the loan share, all lagged one period, and a set of dummies for fiscal quarters. Column (4) reports estimates from a model with sector-time fixed effects: $\Delta y_{j,k,t} = \alpha_j + \gamma_{k,t} + \delta(\eta_t^{RR} \times s_{j,t-1}) + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$, where $k$ is the firm's sector. In all specifications, the loan share is expressed in terms of its deviation from the within-firm average, and standardized in the regression sample. Standard errors are clustered by firm and quarter.

# A Description of the model of section III

This section describes a model of the determination of debt structure within firm. There are a continuum of firms, characterized by their net worth (or internal funds), which we denote by $e$. An entrepreneur with internal funds $e$ finances a project by borrowing from two lenders: a bank, and the market. The only friction of the model is that there is limited liability; the entrepreneur can choose to default on her debt obligations. However, doing so may involve output losses, if the project is liquidated. This motivates the key distinction between bank and market lenders: bank loans can be restructured in times of financial distress, in order to avoid inefficient liquidation losses. Market debt, on the other hand, cannot. I come back to key assumptions below, after describing the key elements of the model.

## I.A Production structure and timing

Each entrepreneur operates a technology which takes physical assets $k$ as an input, and produces output:

$$y = \phi k^{\zeta}$$

Here, $\phi$, the productivity of the technology employed by the entrepreneur, is a random variable, the realization of which is unknown to both the entrepreneur and the lenders at the time when investment in physical assets is carried out. In what follows, I denote the CDF of $\phi$ by $F(.)$. $\zeta$ governs the degree of returns to scale of the technology operated by the entrepreneur. Assets depreciate at rate $\delta \in [0, 1]$. After production has been carried out and depreciation has taken place, the following ressources are available to the entrepreneur to either consume or repay creditors:

$$\pi(\phi) = \phi k^{\zeta} + (1 - \delta)k \tag{10}$$

I make the following assumptions about the production structure:

**Assumption 1.** *The firm's production technology has the following characteristics:*

- *Production has decreasing returns to scale: $\zeta < 1$;*
- *The productivity shock $\phi$ is a positive, continuous random variable with density $f$. Moreover, $f(0) = 0$ and the hazard rate of $\phi$ is strictly increasing.*

The first part of the assumption is standard in models of firm investment, and guarantees that firms have a finite optimal scale of operation. The second part of the assumption consists in restrictions on the distribution of productivity shocks. Restricting the shock $\phi$ to be a postive random variable implies that there is a positive lower bound on ressources, $(1-\delta)k$, so that riskless lending may occur, to the extent that $\delta < 1$. The increasing hazard rate is a technical assumption which guarantees the unicity of lending contracts.[35]

The entrepreneur finances investment in physical assets, $k$, from three sources: internal finance $e$, with which it is initially endowed; bank debt, $b$, and market debt $m$. The resulting balance sheet constraint is thus simply:

$$k = e + b + m.$$

The timing of actions and events, for an entrepreneur with internal finance $e$, is summarized in Figure A1. The model has two periods. At $t = 0$, the entrepreneur, the bank lender and the market lender agree about a debt structure $(b, m)$, and promised repayments, $R_b$ to the bank, and

[35] The proof is available in the appendix to the earlier version of this paper, Crouzet (2017).

$R_m$ for the market lender. Investment in $k$ then takes place, and the productivity of the firm, $\phi$, is realized. At time $t = 1$, debt payments are settled; that is, the firm can choose to make good on promised repayments, restructure its debt, or proceed to bankruptcy.

Finally, in this section, I only assume that all agents are utility maximizers and have preferences that are weakly increasing in their monetary payoffs. In the next section, I will focus on optimal choices in the case of a risk-neutral entrepreneur; however, all the results presented in this section on the settlement of debt are entirely independent of the assumption of risk-neutrality, and hold for general preference specifications so long as preferences are increasing in payoffs. In particular, the set of feasible debt structures characterized in this section is identical across preference specifications.

### I.B Debt settlement

The debt settlement stage takes place once the productivity of the firm has been observed by all parties. I model the debt settlement process as a two-stage game. In the first stage, the entrepreneur can choose between three alternatives, summarized in Figure A2: repay in full both its bank and market creditors; make a restructuring offer to the bank; or file for bankruptcy. If the entrepreneur chooses to repay in full both its creditors, her payoff is:

$$\pi_P(\phi) = \pi(\phi) - R_m - R_b \tag{11}$$

while the payoff to the bank and market lender are, respectively, $R_b$ and $R_m$, as initially promised. I next turn to describing each party's payoff under the two other alternatives, bankruptcy and restructuring.

#### I.B.i Bankruptcy

If the entrepreneur chooses to file for bankruptcy, the project is terminated and liquidated, and the proceeds from liquidation are distributed to creditors. Once bankruptcy is declared, the entrepreneur has no claim to liquidation proceeds; that is, her liquidation payments are assumed to be 0, so that the monetary payoff to the entrepreneur in bankruptcy is:[36]

$$\pi_B(\phi) = 0. \tag{12}$$

I make the following assumption about the impact of liquidation on output:

**Assumption 2** (Liquidation losses)**.** *Under bankruptcy, the proceeds $\tilde{\pi}(\phi)$ to be distributed to creditors and the entrepreneur are a fraction $\chi$ of the project's value:*

$$\tilde{\pi}(\phi) = \chi\pi(\phi) \quad , \quad 0 \leq \chi < 1.$$

Liquidation leads to inefficient losses of output; that is, the liquidation value of the project is strictly smaller than the value of the project under restructuring or repayment. Specifically, liquidation losses are equal to $(1 - \chi)\pi(\phi)$. Consistent with the evidence in Bris et al. (2006) discussed below, this assumption captures fact that bankruptcy proceedings are typically costly, both administratively and because they halt production activities. Moreover, asset values of firms after cash auction proceedings are typically only a fraction of pre-bankruptcy values. This is the

[36] This is without loss of generality. Allowing for the entrepreneur to be a residual claimant in bankruptcy would not alter the results, since in the debt settlement stage, bankruptcy would never be declared in states in which the entrepreneur has sufficient resources to repay both lenders. I omit this possibility to alleviate notation.

key friction in the static model with risk-neutrality: absent bankruptcy losses, lending would be unconstrained, as I will discuss below.

I assume that bankruptcy proceeds are distributed among creditors according to an agreed-upon priority structure, in line with the Absolute Priority Rule (APR) that governs chapter 7 proceedings in the US.[37] In this section, I assume that bank debt is senior to market debt.[38] Under this priority structure, the payoff to bank lenders and market lenders, are:

$$\begin{aligned} \tilde{R}_b^K(\phi) &= \min\left(R_b, \chi\pi(\phi)\right), && (13) \\ \tilde{R}_m^K(\phi) &= \max\left(\chi\pi(\phi) - R_b, 0\right). && (14) \end{aligned}$$

The first line states that the bank's payoff in bankruptcy is at most equal to its promised repayment $R_b$. The second payoff states that market lenders are residual claimants. Note that this formulation does not, a priori, preclude cases in which $\tilde{R}_m(\phi) \geq R_m$, that is, market lenders receiving a residual payment larger than their initial claim. I will however show that this never occurs in the equilibrium of the debt settlement game.

### I.B.ii Restructuring

Instead of filing for bankruptcy, I assume that the entrepreneur can enter a private workout process with her creditors. Because going bankrupt implies losses of output, it may sometimes be in the interest of creditors and the entrepreneur to arrive at a compromise. I make the following restriction to the workout process.

**Assumption 3** (Bank debt flexibility)**.** *The entrepreneur may only restructure debt payments owed to the bank, $R_b$; payments to the market lender, $R_m$, cannot be renegotiated.*

This is the key distinction between bank and market lending in the model; I delay its discussion to the next paragraph, and first describe its implications for the debt settlement process. I assume that the private workout operates as follows: the entrepreneur makes a one-time offer to the bank which takes the form of a reduction in promised repayments $l_b \leq R_b$. In case the offer is accepted, the bank obtains $l_b$, and the entrepreneur obtains:

$$\pi_R(\phi) = \pi(\phi) - R_m - l_b(\phi). \quad (15)$$

If, on the other hand, the bank refuses the entrepreneur's offer, the private workout fails, and the project is liquidated. In this case, the payoff to the bank is given by equation (13). The participation constraint of the bank is thus:

$$l_b \geq \tilde{R}_b^K(\phi).$$

The entrepreneur will choose her restructuring offer to maximize her net payoff under restructuring, subject to the participation constraint of the bank. Formally:

$$\begin{aligned} \pi_R(\phi) &= \max_{l_b} \quad \pi(\phi) - R_m - l_b \quad \text{s.t.} \quad l_b \geq \tilde{R}_b^K(\phi) \\ &= \begin{cases} \pi(\phi) - R_b - R_m & \text{if } R_b \leq \chi\pi(\phi) \\ (1-\chi)\pi(\phi) - R_m & \text{if } R_b > \chi\pi(\phi) \end{cases} \end{aligned} \quad (16)$$

[37] See White (1989) for institutional details on the APR.

[38] I come back to the issue of the optimality of bank seniority in conclusion. It is likely that, in this model, bank seniority is the optimal priority structure from the standpoint of the firm; numerically, it is the case for all the versions of the model which I have explored.

Intuitively, this result indicates that the entrepreneur will choose to make a restructuring offer only when its cash on hand is small enough, relative to promised repayments to the bank. Note that the larger the value of $\chi$, the higher the restructuring threshold; that is, potential bankruptcy losses effectively allow the entrepreneur to extract concessions from the bank.

### I.B.iii Debt settlement equilibria

Given the realization of $\phi$, the entrepreneur chooses whether to repay, restructure or file for bankrucpy, by comparing her payoffs $\pi_P(\phi)$, $\pi_B(\phi)$ and $\pi_R(\phi)$ under each option. The following lemma describes the resulting perfect equilibria in pure strategies of the debt settlement game described in Figure A2. There is a unique equilibrium for each realization of $\phi$; however, the set of possible equilibria, parametrized by $\phi$, depends on the terms of the debt contracts.

**Lemma 1** (Debt settlement equilibria)**.**

*If $\frac{R_m}{1-\chi} < \frac{R_b}{\chi}$ (**R-contracts**), there are some realizations of $\phi$ for which the entepreneur chooses to use her restructuring option. Specifically, the entrepreneur chooses to repay her creditors when $\pi(\phi) \geq \frac{R_b}{\chi}$; to restructure debt when $\frac{R_m}{1-\chi} \leq \pi(\phi) < \frac{R_b}{\chi}$; and to file for bankruptcy when $\pi(\phi) < \frac{R_m}{1-\chi}$ .*

*If $\frac{R_m}{1-\chi} \geq \frac{R_b}{\chi}$ (**K-contracts**), there are no realizations of $\phi$ such that the entrepreneur attempts to restructure debt with the bank. Instead, she chooses to repay her creditors when $\pi(\phi) \geq R_m + R_b$, and otherwise, she files for bankruptcy.*

*Moreover, in bankruptcy or restructuring, market and bank lenders never obtain more than their promised repayments: $\tilde{R}_m(\phi) \leq R_m$ and $\tilde{R}_b(\phi) \leq R_b$, regardless of whether the debt contract is an $R-contract$ or a $K-contract$.*

The proof for this and all following lemmas are reported in the appendix to the earlier version of this paper, Crouzet (2017). Figure A3 illustrates sets of equilibria for each type of contract. In the case of a K-contract ($\frac{R_b}{\chi} < \frac{R_m}{1-\chi}$), no restructuring ever occurs, and bankruptcy losses cannot be avoided when the cash on hand of the firm, $\pi(\phi)$, falls below the threshold at which the firm prefers declaring bankruptcy over repayment, $R_m + R_b$. This occurs because the stake of the flexible creditors, $R_b$, is too small for restructuring to bring about sufficient gains for the entrepreneur to avoid default on market debt.

On the other hand, in the case of an R-contract, ($\frac{R_b}{\chi} \geq \frac{R_m}{1-\chi}$), the flexibility of bank debt sometimes allows the entrepreneur to make good on its payments on market debt (this corresponds to restructuring region below $R_m + R_b$ in Figure A3). Some R-equilibria will see the entrepreneur exert a degree of bargaining power over the bank: indeed, the bank will be forced to accept a settlement, even though the firm has enough cash on hand to make good on both its promises (this corresponds to the restructuring region above $R_m + R_b$ in Figure A3). This region corresponds to strategic restructurings on the part of the entrepreneur, who takes advantage of the fact that the bank can never extract from her more than its reservation value under restructuring, $\chi\pi(\phi)$, in any private workout.

### I.B.iv Equilibrium debt structure

I next maintain the two following assumptions:

**Assumption 4.** *The enterpreneur is risk-neutral, and her assets completely depreciate after productivity is realized and output is produced: $\delta = 1$.*

I first assume that assets fully depreciate at the end of period 1, that is, $\delta = 1$. Given the static nature of the model, this is a natural assumption, and it furthermore simplifies the analytical characterization of the optimal debt structure. It is however is not crucial to any of the results below. The second assumption I maintain in this section is that the entrepreneur is risk-neutral. Under assumption 4, the optimal debt structure of an entrepreneur with own equity $e$ solves:

$$\hat{\pi}(e) = \max_{b,m \in \mathcal{S}(e)} \mathbb{E}\left[\tilde{\pi}(\phi; e, b, m)\right],$$

where $\tilde{\pi}(\phi; e, b, m)$ denotes the profits accruing to the entrepreneur, conditional on the debt structure $(b, m)$ and therefore the associated contract $(R_b, R_m)$, and the realization of the shock $\phi$. Here, $\mathcal{S}$ denotes the "lending menu," that is, the set of feasible debt structures given the net worth of the entrepreneur, $e$. This lending menu is described and characterized analytically in an earlier version of this paper, Crouzet (2017). In particular, I show that $\mathcal{S}(e)$ can be partitioned into two subsets, $\mathcal{S}_K(e)$ and $\mathcal{S}_R(e)$. The set of feasible debt structures $(b, m) \in \mathcal{S}_K(e)$ lead to K-contracts (i.e. debt structures without any renegotiation ex-post), while debt structures $(b, m) \in \mathcal{S}_R(e)$ lead to R-contracts (i.e. debt structures with renegotiation ex-post.)

With risk-neutrality, we have that:

**Lemma 2.** *for $(b, m) \in \mathcal{S}(e)$, the objective function of the entrepreneur is given by:*

$$\mathbb{E}\left[\tilde{\pi}(\phi; e, b, m)\right] = \underbrace{\mathbb{E}(\pi(\phi)) - (1 + r_b)b - (1 + r_m)m}_{\text{total expected surplus from investment}} - \underbrace{(1 - \chi)\int_0^{\underline{\phi}(e,b,m)} \pi(\phi)dF(\phi)}_{\text{expected liquidation losses}}, \tag{17}$$

*where:*

$$\underline{\phi}(e, b, m) = \begin{cases} \frac{R_K(b,m,e)}{(e+b+m)^\zeta} & \text{if } (b, m) \in \mathcal{S}_K(e) \\ \frac{R_{m,l}(b,m,e)}{(1-\chi)(e+b+m)^\zeta} & \text{if } (b, m) \in \mathcal{S}_R(e) \end{cases}$$

Under risk-neutrality, profit maximization for the entrepreneur is equivalent to the maximization of total expected surplus, net of the losses incurred in case liquidation is carried out. In particular, in the absence of bankruptcy costs (that is, when $\chi = 1$), profit maximization for the firm is equivalent to maximization of total surplus. In this case, it is clear that the optimal debt structure is always a corner solution, with the entrepreneur borrowing only from the lender with the smallest cost of funds.

Crouzet (2017) then establishes that, when loans are more costly ($r_b > r_m$), the two following key results about optimal debt structure. First, firms select into debt structures with either full bond (market) finance, or debt structures with a mix of loans and bonds.

**Lemma 3** (Market finance vs. mixed finance)**.** *Assume that banks have a larger marginal cost of funds than markets, that is, $r_b > r_m$. Let $(\hat{b}(e), \hat{m}(e))$ denote the optimal debt structure of an entrepreneur with equity $e$. There exists $e^* > 0$ such that:*

- *if $e > e^*$, $(\hat{b}(e), \hat{m}(e)) \in \mathcal{S}_K(e)$; moreover, the optimal debt structure features "pure market finance":*

$$\hat{m}(e) > 0 \quad , \quad \hat{b}(e) = 0;$$

- *if $e < e^*$, $(\hat{b}(e), \hat{m}(e)) \in \mathcal{S}_R(e)$; moreover, the optimal debt structure features "mixed finance":*

$$\hat{m}(e) \geq 0 \quad , \quad \hat{b}(e) > 0.$$

Second, firms that use a mix of loan and bonds can either exhaust their loan limit, or be at an interior solution.

**Lemma 4** (The optimal debt structure when $e \leq e^*$)**.** *Assume $r_b > r_m$. Consider an entrepreneur with internal funds $e < e^*$ and let $\hat{s}(e) = \frac{\hat{b}(e)}{\hat{b}(e)+\hat{m}(e)}$ denote the fraction of total liabilities that are bank debt in her optimal debt structure, and let $\hat{d}(e) = \hat{b}(e) + \hat{m}(e)$ denote total borrowing. Then, there exists $\tilde{e} < e^*$ such that:*

- *For $0 \leq e < \tilde{e}$, the bank borrowing constraint is binding at the optimal debt structure, $\frac{\partial \hat{s}}{\partial e} > 0$ and $\frac{\partial \hat{d}}{\partial e}$;*
- *For $\tilde{e} \leq e \leq e^*$, the optimal debt structure of the firm satisfies:*

$$\hat{s}(e) = 1 - \frac{\Gamma}{1 + r_m} \frac{(\hat{k}_{int})^{\zeta}}{\hat{k}_{int} - e}, \quad \hat{d}(e) = \hat{k}_{int} - e \tag{18}$$

*where the expression of $\Gamma$ and $\hat{k}_{int}$ are given in the appendix of Crouzet (2017). In particular, $\frac{\partial \hat{s}}{\partial e} \leq 0$ and $\frac{\partial \hat{d}}{\partial e} \leq 0$.*

## I.C Discussion

The model's fundamental distinction between bank lending and market lending is that bank lenders are capable of flexibility in times when the firm is not able (or willing) to repay her debt. A natural question is then whether this assumption is borne out in the data. Gilson, Kose, and Lang (1990) examine a sample of 169 financially distressed firms. They show that about half (80 or 47% of the total) firms successfully restructure outside of formal judicial proceedings, while the other half (89, or 53% of the total) file for bankruptcy. They show that successful restructurings out of court involve, in 90% of cases, a firm that has outstanding bank loans, while only 37.5% of successful restructuring involves firms with oustanding public debt. Moreover, they show that the existence of bank loans is the single most important determinant of whether firms successfully restructure out of court, more so than other firm characteristics such as firm size, age or leverage. A theoretical justification of the observation that bank debt is easier to restructure is developped by Gertner and Scharfstein (1991), who argue that when coordination problems among dispersed holders of public debt lead to a failure to efficiently restructure that debt. Bolton and Scharfstein (1996) also study how free-riding problems can lead to inefficiencies during debt restructuring involving a large number of creditors. The assumption of bank debt flexibility can thus be thought of as a reduced-form manner of capturing the coordination and free-riding problems discussed elsewhere in the literature.

Additionally, the model makes the assumption that the formal liquidation of a project – which occurs only if restructuring has failed – leads to inefficient losses. In the model, this occurs when $\chi < 1$; when $\chi = 1$, liquidation leads to a transfer of ownership but not losses in values. Bris, Welch, and Zhu (2006) study a sample of 61 chapter 7 and 225 chapter 11 filings between 1995 and 2001. In particular, they report measures of the ratio of pre to post-bankruptcy asset values (excluding legal fees). For chapter 11 proceedings, which provides a legal framework for debt restructuring but does not involve liquidation, the mean of the ratio of pre to post-bankruptcy asset values in their sample is 106.5%; that is, on average, this ratio increases after chapter 11 proceedings. For chapter 7 proceedings, this is not the case: asset values decline as a result after the bankruptcy. Here, Bris, Welch, and Zhu (2006) offer two measures of post-bankruptcy asset values. The first measure is liquidation value of the firm after collateralized lenders have seized the assets to which they had a lien outside of bankruptcy proceedings. With this measure, asset values post-bankruptcy are 17.2% of pre-bankruptcy asset values, on average. The second measure tries attempts to include the value of collateralized assets; average post-bankruptcy values are then estimated to represent 80.0% of pre-bankruptcy values; the median ratio is 38.0%.

While the model's debt settlement stage does not clearly distinguish between private and formal (chapter 11) workouts, it assumes that they are costless, whereas liquidation (chapter 7) is assumed to be costly. In this respect, the model's assumptions are thus consistent with the results of Bris, Welch, and Zhu (2006). In general, assuming that debt renegotiation (private or under a chapter 11 filing) is costly should not alter the key qualitative results of the model. So long as renegotiation costs are strictly smaller than those associated to liquidation, renegotiation will be beneficial to the firm provided that promised repayment to bank lenders are sufficiently large, as in Figure A3.

# B Appendix Tables and Figures

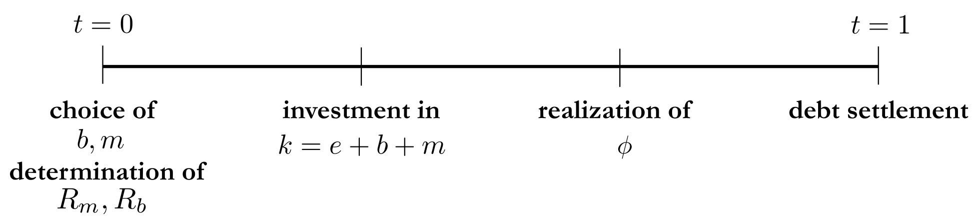



**Figure A1:** Timing of model.

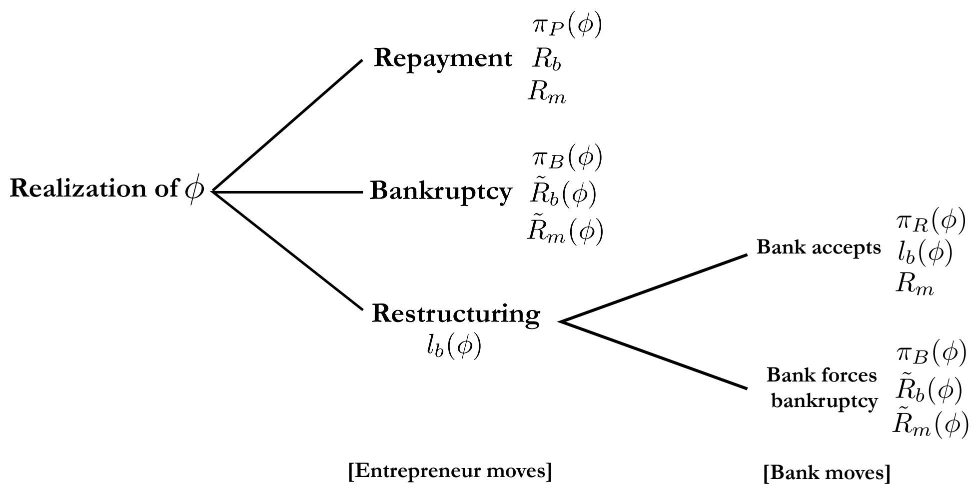



**Figure A2:** Debt settlement.

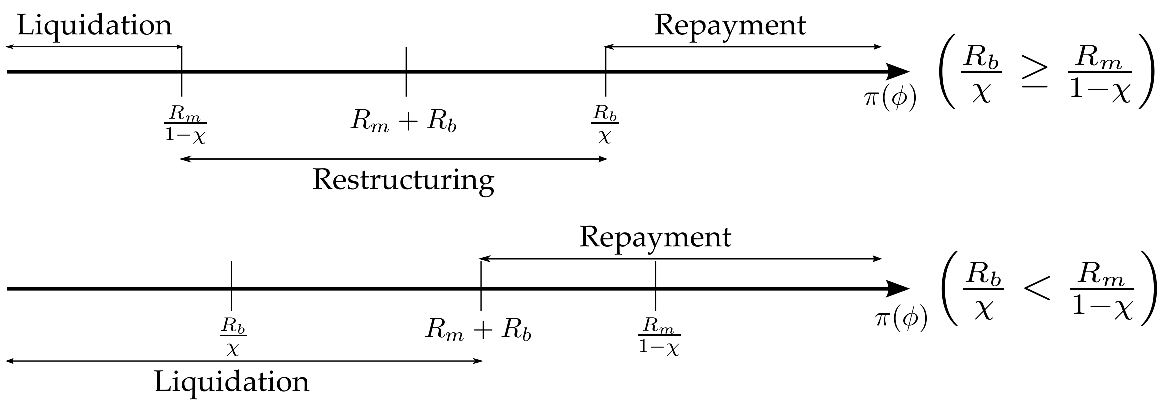
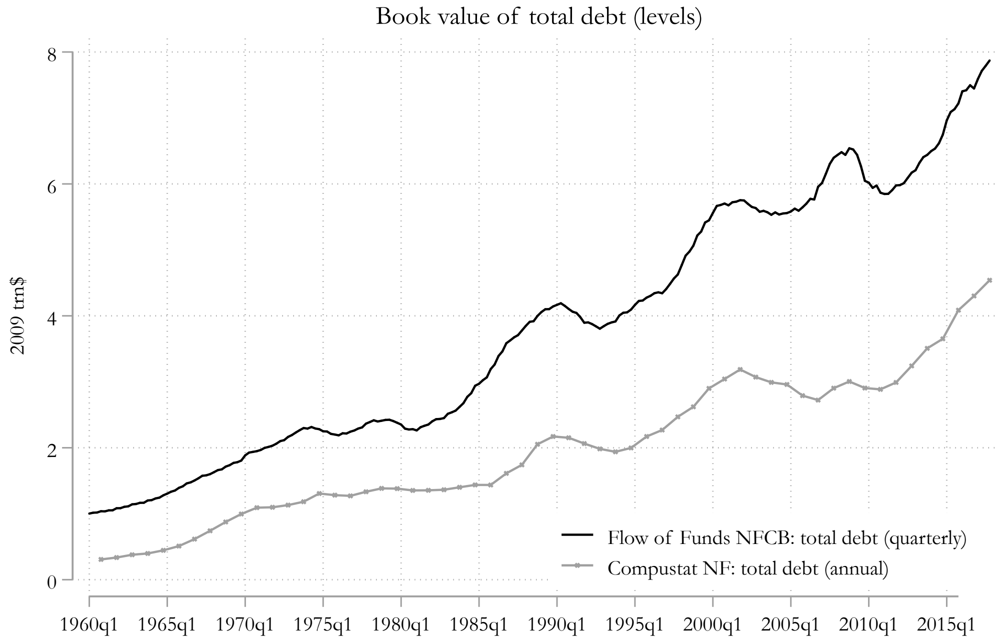
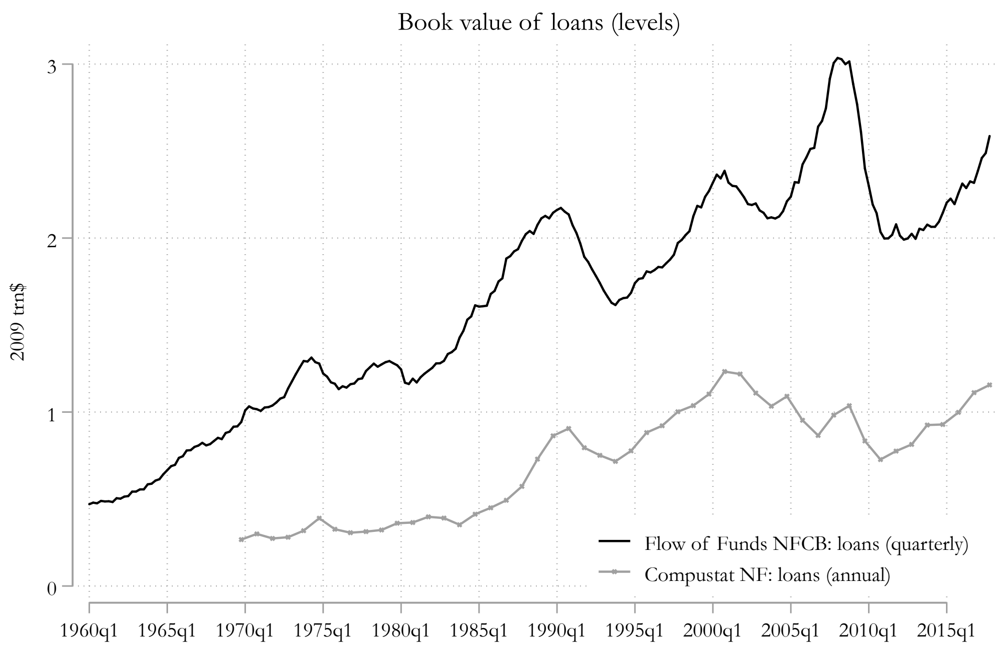



**Figure A3:** Debt settlement equilibria.




**(a)**




**(b)**

**Figure A4:** A comparison of total debt outstanding for the NFCB sector, between Flow of Funds (public plus private) and Compustat (public) firms. Data are from Flow of Funds table L.103 and from the Compustat Fundamentals Annual. For Flow of Funds, total debt is defined as the sum of debt securities (item FL104122005) and loans (item FL104122005). For Compustat annual, total debt is defined as the sum of debt in current liabilities (item dlc) and total long-term debt (item dltt), and loans are defined as the sum of notes payable (np) and other long-term debt (dlto). Notes payable are not reported as a separate item before 1970q1 and so we start the sample for total loans there. The Compustat sample is restricted to the Non-Financial (NF) sector, while the Flow of Funds data measures only the liabilities of the NFCB sector. All series are deflated using the CPI.

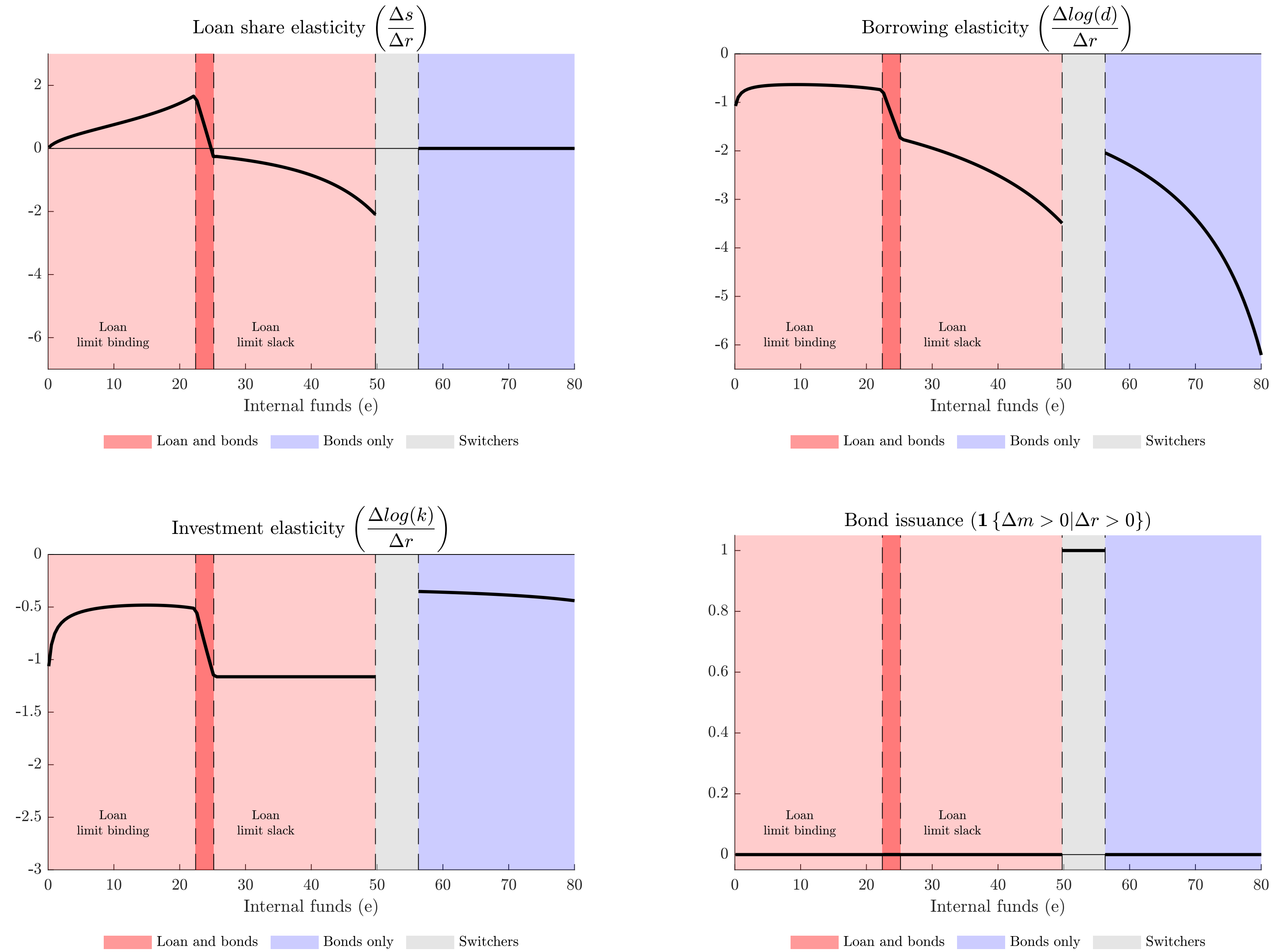



**Figure A5:** Interest rate elasticities in the model of section III.B, in the case of no bank lending channel ($\gamma_b'(r) = 0$.) The elasticities reported are the percent change in a variable of interest (or the percentage point change, for the loan share) for a 100$bps$ increase in the risk-free rate, $r$. These elasticities are plotted as a function of internal funds $e$, the state variable. The blue shaded region corresponds to firms that only issue bonds both before and after the interest rate hike. The red shaded regions correspond to firms that issue a mix of bank loans and both both before and after the interest rate hike. The darker red region corresponds to firms who switch to an interior debt structure after the interest rate hike. Finally, the light gray region corresponds to firms that switch from issuing both loans and bonds, to issuing only bonds, after the interest rate hike. The calibration of the model is the same as in Figure 7.

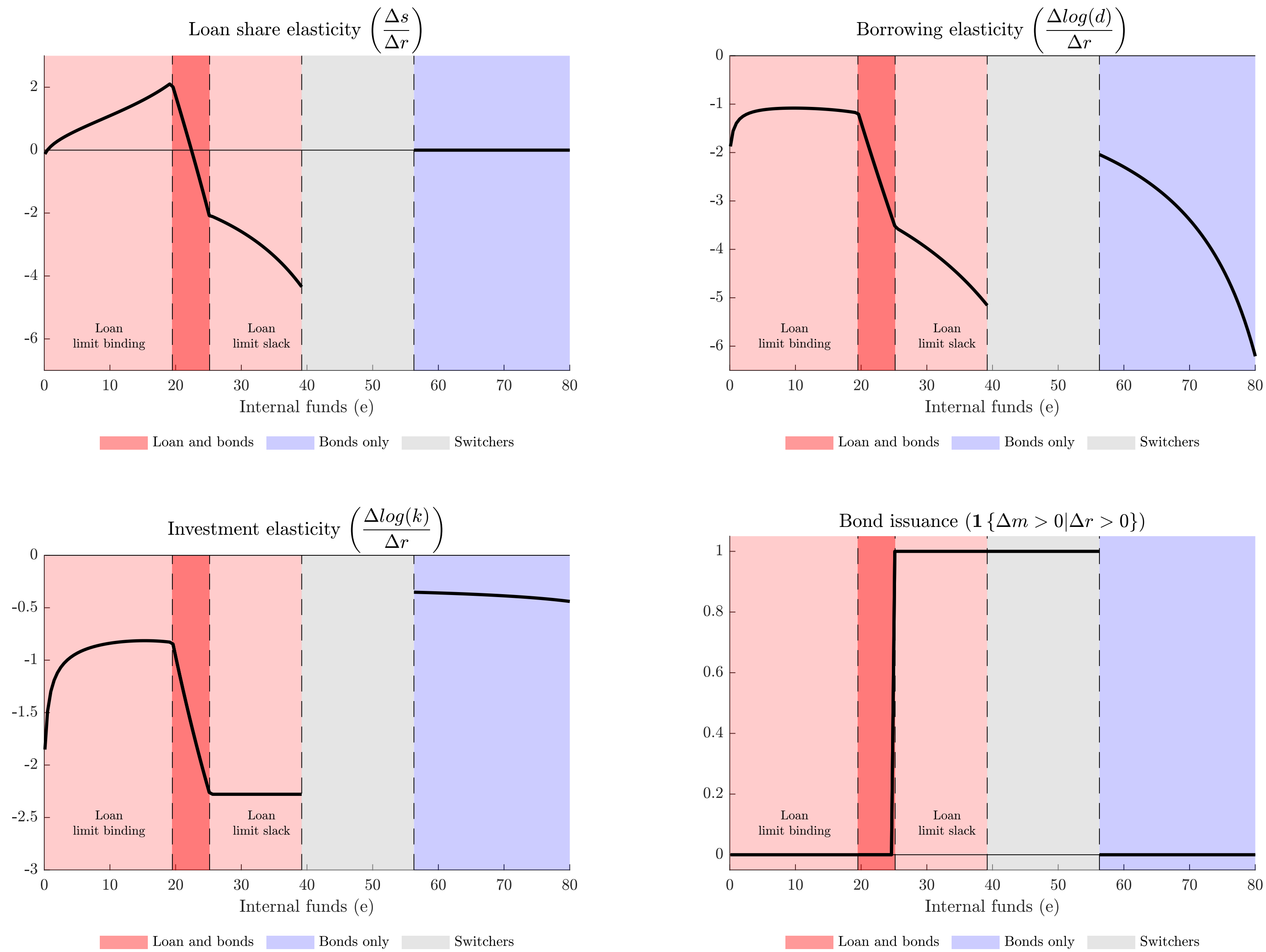
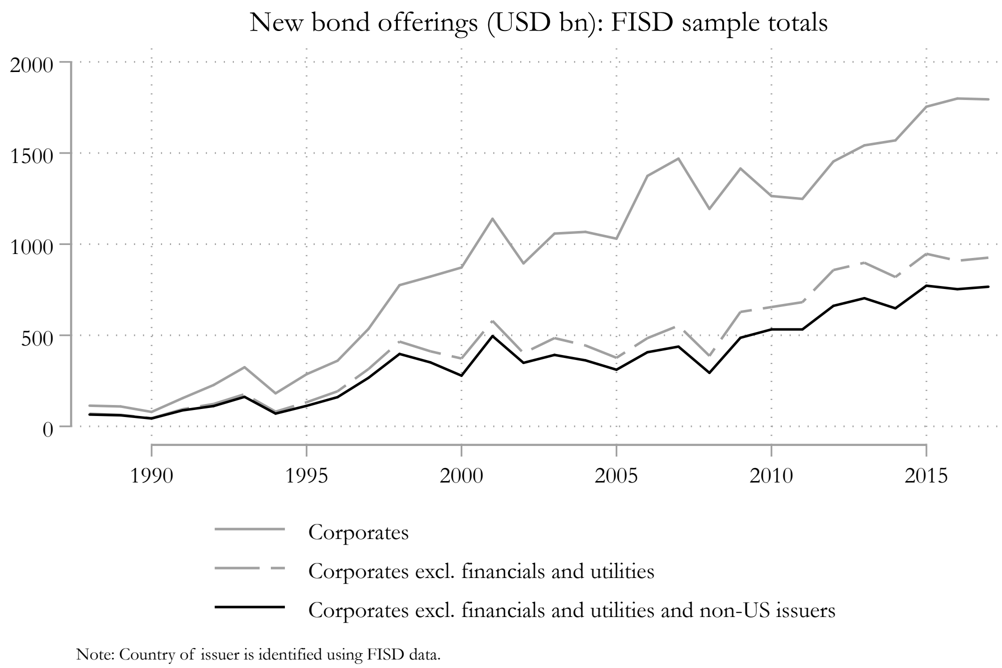



**Figure A6:** Elasticities with respect to interest rates in the model of section III.B, with an active bank lending channel ($\gamma_b'(r) > 0$.) The elasticities reported are the percent change in a variable of interest (or the percentage point change, for the loan share) for a 100$bps$ increase in the risk-free rate, $r$. These elasticities are plotted as a function of internal funds $e$, the state variable. The blue shaded region corresponds to firms that only issue bonds both before and after the interest rate hike. The red shaded regions correspond to firms that issue a mix of bank loans and both both before and after the interest rate hike. The darker red region corresponds to firms who switch to an interior debt structure after the interest rate hike. Finally, the light grey region corresponds to firms that switch from issuing both loans and bonds, to issuing only bonds, after the interest rate hike. The calibration of the model is the same as in Figure 7, except for the interest rate elasticity, which is set to $\gamma_b(r) = \gamma_b^0 + r - r_0$, where $\gamma_b^0 = 0.02$, and $r_0 = 0.05$, as in the baseline calibration.



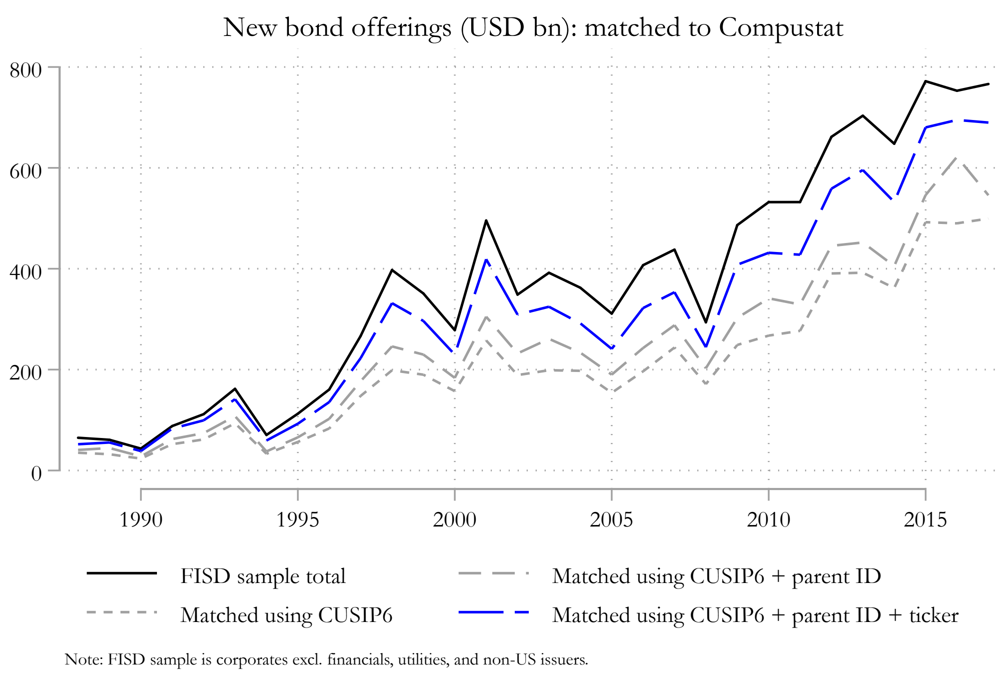




**Figure A7:** Mapping between FISD issuance data and the Compustat sample. The top graph shows FISD universe totals; the black line reports total issuance by domestic firms in the non-financial sector. The bottom graph shows total issuance by firms in this sample that are successfully matched to Compustat. The match is done using CUSIP 6-digit codes where possible (and after consolidating FISD data to the parent company level), and further matches are obtained using tickers.

**(a)** Time-series variables

| | $\eta_t^{HF}$ | $\eta_t^{RR}$ | $\eta_t^{RR}$ (post-90q1) |
|---|---|---|---|
| mean | -0.042 | 0.005 | 0.045 |
| s.d. | 0.124 | 0.588 | 0.284 |
| min | -0.479 | -4.046 | -0.570 |
| max | 0.261 | 2.514 | 0.759 |
| $N$ | 72 | 153 | 72 |
| $corr(\eta_t^{HF}, \eta_t^{RR}) = 0.34$ $(p = 0.003)$ | | | |

**(b)** Firm-level variables: summary statistics

| | $\Delta log(k_{j,t+1})$ | $\Delta log(1 + d_{j,t})$ | $s_{j,t}$ | $\mathbf{1}(\Delta m_{j,t} > 0)$ |
|---|---|---|---|---|
| mean | 0.009 | 0.001 | 0.301 | 0.023 |
| s.d. | 0.114 | 0.085 | 0.345 | 0.204 |
| 5th pctile | -0.068 | -0.103 | 0.000 | 0.000 |
| median | 0.001 | 0.000 | 0.149 | 0.000 |
| 95th pctile | 0.124 | 0.113 | 1.000 | 0.000 |
| $N$ | 202395 | 202395 | 202395 | 202395 |

**Table A1:** Summary statistics. The top panel reports summary statistics for the two monetary policy shock series used in the analysis, and their raw correlation. $\eta_t^{HF}$ refers to shocks identified using high-frequency changes in Fed Funds futures, while $\eta_t^{RR}$ refers to the Romer and Romer shock series. The middle panel reports summary statistics for investment $\Delta log(k_{j,t+1})$, defined as the change in $log(k_{j,t+1})$ between the end of quarter $t-1$ and the end of quarter $t$; borrowing $\Delta log(1 + d_{j,t})$, defined as the change in total debt outstanding, $d_{j,t}$, between the end of quarter $t-1$ and the end of quarter $t$; the loan share $s_{j,t}$; and an indicator for bond issuance $\mathbf{1}(\Delta m_{j,t} > 0)$. The summary statistics are reported for the sample ranging from 1990q1 to 2007q4, when the shock $\eta_t^{HF}$ is available.

**(a)** Raw correlations

| | $s_{j,t}$ |
|---|---|
| $s_{j,t-1}^{(new)}$ | $0.277^{***}$ |
| $s_{j,t-2}^{(new)}$ | $0.250^{***}$ |
| $\mathbf{1}(\Delta m_{j,t-1} > 0)$ | $-0.124^{***}$ |
| $\mathbf{1}(\Delta m_{j,t-2} > 0)$ | $-0.108^{***}$ |

$^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**(b)** Controlling for other covariates

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| $s_{j,t-1}^{(new)}$ | $0.13^{***}$ | $0.08^{***}$ | $0.12^{***}$ | $0.08^{***}$ | $0.12^{***}$ | $0.08^{***}$ | | |
| | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | (0.01) | | |
| $s_{j,t-2}^{(new)}$ | | $0.07^{***}$ | | $0.07^{***}$ | | $0.07^{***}$ | | |
| | | (0.01) | | (0.01) | | (0.01) | | |
| $\mathbf{1}(\Delta m_{j,t-1} > 0)$ | | | | | | | $-9.08^{***}$ | $-8.29^{***}$ |
| | | | | | | | (0.48) | (0.47) |
| $\mathbf{1}(\Delta m_{j,t-2} > 0)$ | | | | | | | | $-4.91^{***}$ |
| | | | | | | | | (0.58) |
| Firm controls | no | no | yes | yes | yes | yes | yes | yes |
| Sector-time FE | no | no | no | no | yes | yes | yes | yes |
| Time clustering | yes | yes | yes | yes | yes | yes | yes | yes |
| $R^2$ | 0.555 | 0.617 | 0.573 | 0.631 | 0.606 | 0.681 | 0.518 | 0.552 |
| $N$ | 27446 | 12552 | 26921 | 12419 | 26829 | 12231 | 97892 | 72368 |

Standard errors in parentheses; $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**Table A2:** Validation of the loan share measure $s_{j,t}$. The top panel reports the raw correlation of the loan share, $s_{j,t-1}$ with measures of debt composition from securities-level databases. $s_{j,t-1}^{(new)}$ and $s_{j,t-2}^{(new)}$ are the ratio of the dollar value of new loan contracts (from Dealscan data) to the sum of new loan contracts plus new bonds issued (from FISD), lagged, respectively, one and two years. $\mathbf{1}(\Delta m_{j,t-1})$ and $\mathbf{1}(\Delta m_{j,t-2})$ are dummies for whether a firm issued a bond in year $t-1$ or in year $t-2$, constructed from FISD. Columns (1) through (4) report estimates of the coefficients $\delta_1$ and $\delta_2$ in specifications of the form: $s_{j,t} = \alpha_j + \gamma_t + \delta_1 s_{j,t-1}^{(new)} + \delta_2 s_{j,t-2}^{(new)} + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$, where $\alpha_j$ is a firm fixed effect; $\gamma_t$ is a time effect; $X_{j,t-1}$ is a vector of firm-level controls (the log change in real sales, the log of total book assets, the ratio of net current assets to total assets, lagged leverage, and a set of dummies for fiscal quarters, all lagged one period.) Columns (1) through (2) report results without firm-level controls, and columns (3) and (4) report results with firm-level controls. Columns (5) and (6) report estimates from a specification with industry-time effects: $s_{j,k,t} = \alpha_j + \gamma_{k,t} + \delta_1 s_{j,t-1}^{(new)} + \delta_2 s_{j,t-2}^{(new)} + \Gamma_x X_{j,t-1} + \varepsilon_{j,t}$, where $k$ the firm's sector. Standard errors are clustered by firm and quarter in all specifications. The sample is annual Compustat firms from the non-financial sector, from 1990 to 2017.