# The Transmission of Monetary Policy through Bank Lending: The Floating Rate Channel*

**Filippo Ippolito**
Universitat Pompeu Fabra,
Barcelona GSE & CEPR

**Ali K. Ozdagli**†
Federal Reserve Bank of Boston

**Ander Perez-Orive**
Federal Reserve Board

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**Abstract**

We examine both theoretically and empirically a mechanism through which *outstanding* bank loans affect the firm balance sheet channel of monetary policy transmission. Unlike other debt, most bank loans have floating rates mechanically tied to monetary policy rates. Hence, monetary policy-induced changes to floating rates affect the liquidity, balance sheet strength, and investment of financially constrained firms that use bank debt. We show that firms—especially financially constrained firms—with more unhedged bank debt display a stronger sensitivity of their stock price, cash holdings, sales, inventory, and fixed capital investment to monetary policy. This effect disappears when policy rates are at the zero lower bound, which further supports the floating rate mechanism and reveals a new limitation of unconventional monetary policy. We argue that the floating rate channel can have a significant macroeconomic effect due to the large size of the aggregate stock of unhedged floating-rate business debt, an effect that is at least as important as the bank lending channel that operates through *new* loans.

Keywords: monetary policy transmission, firm balance sheet channel, bank debt, floating interest rates, financial constraints, hedging

JEL classification: G21, G32, E52

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† Corresponding author. ali.ozdagli@bos.frb.org, 600 Atlantic Ave, Boston MA 02210.

# 1 Introduction

The firm balance sheet channel is one of the main mechanisms through which monetary policy is thought to interact with credit market imperfections to influence firms' investment, hiring, and output, and it operates by affecting firms' balance sheet strength and ability to access new external finance (Bernanke and Gertler (1995), Mishkin (1995)). In this paper we examine, both theoretically and empirically, a mechanism in which outstanding bank loans are an important component of the firm balance sheet channel, motivated by two observations typically overlooked in the monetary economics literature: Monetary policy drives the reference rate underlying floating-rate loan arrangements (Figure 1), and the vast majority of corporate loans from banks feature floating interest rates (Figure 2). Does monetary policy have a strong effect on firms' liquidity positions and their ability to finance future projects by causing changes in the debt service burden of existing floating-rate bank loans? We answer this question through the lens of both stock prices and balance sheet variables by theoretically analyzing a firm that can borrow at floating and fixed rates, and by empirically studying firm-level information on the usage of bank debt and floating-rate debt and a new database of firms' hedging activity.

[FIGURES 1 & 2 ABOUT HERE]

We introduce a theoretical framework that considers a firm's choice of debt structure, investment, and dividends. To be able to address our main questions, it is crucial that our analysis features long-term debt, an interest rate exposure decision through a floating vs. fixed rate debt choice, and financing constraints. We start with a stylized two-period model that has the advantage of offering an analytical solution, while still providing the key insights of our thesis. While the optimal investment of a financially unconstrained firm is insensitive to internal funds, the amount of internal funds matters for the investment of a constrained firm. In the presence of floating-rate debt, policy rate changes affect the firm's interest expense on existing debt and therefore internal funds. This differential effect on investment between constrained and unconstrained firms translates into a corresponding differential stock market reaction to an unexpected change in monetary policy.

We integrate these ideas into a more general dynamic model that also takes into account important issues such as monetary policy persistence, rationally anticipated monetary policy shocks, effects of costly distress, and the quantitative strength and duration of the effects of our mechanism. First, the dynamic model provides a quantitative assessment of the floating rate channel which is broadly consistent with the economic significance that we obtain in our empirical regressions. Second, the dynamic model suggests that the results from the stylized simple model are robust to considering persistent and rationally anticipated monetary policy shocks. Third, the model has predictions about the effects that changes in interest rates have on the expected likelihood and cost of financial distress and shows that this link amplifies movements in stock prices. Finally, the theoretical framework makes it clear that a very general notion of financial constraints is sufficient to generate our results. In particular, it suffices that financially constrained firms display some sensitivity of their investment to internal funds and that they are more productive on the margin than unconstrained firms.[1]

Our empirical findings provide support to the predictions of the model. We first document that corporations borrow from banks mostly at a floating rate, whereas they mostly issue other forms of debt at a fixed rate.[2] Using market-based monetary policy surprise measures as in Kuttner (2001) and Gürkaynak, Sack, and Swanson (2005), we find that while a typical firm's stock price decreases about 4 to 5 percent in response to a 100 basis point (bp) surprise increase in the federal funds rate, the stock price of a firm that has one standard deviation more bank debt relative to assets decreases about 1.6 percent more. Crucially, all of the additional stock price decline due to the use of bank debt comes from the sample of unhedged firms, consistent with the floating rate channel, as seen in Figure 3. Our results are robust to controlling for the determinants of bank debt usage and hedging and to using instrumental variables analysis to deal with any possible endogeneity of the bank debt usage and hedging decisions.[3]

[FIGURE 3 ABOUT HERE]

In the absence of financial frictions, our evidence could be interpreted as a simple cash transfer between a firm's shareholders and its creditors, with no real effects. In the presence

[1] Although our focus is on the effects through existing loans, this channel may be conceptually similar to one operating through new loans. In this alternative case, the movements in internal funds would be caused by the issuance of new debt or refinancing of existing debt at new interest rates. In principle, both mechanisms are not mutually exclusive and might, in fact, reinforce each other. We discuss in detail in the literature review (Section 1) the differences between both mechanisms.

[2] As Figure 2 illustrates, 76 percent of the debt of firms that borrow solely from banks has a floating rate, compared with 9 percent of debt for those firms that have only nonbank debt. This result is in line with Faulkender (2005), who finds that about 90 percent of syndicated bank loans to chemical corporations are issued at a floating rate, and with Vickery (2008), who finds that about 70 percent of C&I loans from commercial banks have a floating rate in the Federal Reserve's Survey of Terms of Business Lending.

[3] To deal with the possibility that omitted variables drive both the choice of bank debt usage or hedging and the responsiveness to monetary policy, we control for all the firm characteristics that have been shown to influence debt structure: firm size, leverage, profitability, growth opportunities (market-to-book ratio), risk (CAPM Beta, cash-flow volatility, demand sensitivity to interest rates), cash holdings, and financial constraint measures. In addition, we instrument for bank debt usage, following Faulkender and Petersen (2006) and Santos and Winton (2008), using proxies for firm visibility and firm uniqueness, both of which drive the ability to issue public debt (and thus the dependence on bank debt) and can be argued to be orthogonal to our dependent variable.

of financing frictions, however, the additional interest expense may affect the firm's liquidity position, leverage, and overall balance sheet strength, which in turn could affect the firm's ability to finance profitable investment opportunities, as our theory predicts. We find that financial constraints increase the policy rate sensitivity of stock prices of unhedged bank debt users significantly. However, financial constraints do not change this sensitivity for hedged bank debt users, a finding that suggests an amplification of the floating rate channel through the effect of financing constraints.

Next, we provide further evidence consistent with our theoretical mechanism by using data on real and financial decisions of firms. First, we show that the interest coverage ratio of a firm responds significantly more strongly to monetary policy as the share of bank loans over total assets increases, but only for firms that do not hedge against interest rate risk. The effect is sizable and persists for up to six quarters. This finding suggests that the exposure to interest rate fluctuations through unhedged bank debt exposes firms to significant liquidity shocks. We confirm this argument by showing that the cash holdings of financially constrained firms that use bank debt and do not hedge are very sensitive to monetary policy while those of financially unconstrained or hedged bank debt users are not. This finding suggests that a monetary policy tightening might hurt firms exposed to the floating rate channel by draining internal liquid resources of firms with limited access to external finance. Consistent with this implication, we show that there is a strong positive relationship between bank debt usage and the sensitivity of inventory investment, fixed investment, and sales to monetary policy changes for financially constrained firms that do not hedge, but that these effects are significantly smaller or absent when firms hedge interest rate risk or do not face significant financial constraints. The effects are quantitatively large: Six quarters after a 100bp monetary policy tightening, financial constraints are associated with additional decreases in inventories and fixed investment of 22.1% and 15.8%, respectively, for a hypothetical firm fully financed by bank debt and unhedged, but these additional decreases are reduced to less than half when firms are hedged. Taken together, our evidence suggests that the effect of the floating rate channel extends beyond a simple reallocation of cash flows between lenders and shareholders and has significant real implications for the affected firms.

The potential macroeconomic relevance of our monetary policy transmission mechanism is supported by the large amount of debt that is exposed to interest rate risk. We estimate that in the United States the lower bound for the debt exposed to interest rate risk is between \$3.2 and \$4.1 trillion of the \$12.5 trillion of total debt of nonfinancial businesses as of year-end 2015, and represents roughly 20% of annual GDP (\$18.0 tn in 2015).[4] We also provide

[4]Note that this is a lower bound estimate of the amount of debt exposed to interest rate risk, because we are basing our estimates on the fraction of debt that is tied to LIBOR, which is the most common but not the only base rate for floating rate arrangements. An example of a common alternative base rate is the

some measure of the macroeconomic importance of our proposed mechanism by comparing it to the traditional bank lending channel and show that the floating rate channel is at least as important as the traditional bank lending channel.

Finally, as additional evidence regarding the importance of the floating rate channel, we study the recent zero-lower-bound environment. During this period, the reference rates of floating rate loans were bound from below at zero and therefore any effect of bank debt usage should work through channels other than the floating rate channel. We show that bank debt and hedging have had no effect on the monetary policy sensitivity of stock prices during the unconventional policy period. Combined with the importance of the floating rate channel during periods of conventional monetary policy, this finding suggests that the absence of the floating rate channel might have limited the efficacy of unconventional monetary policy during the recent period. This result could shed light on the uncertainty regarding the costs and benefits of unconventional policy, a topic that has gained increased attention recently (e.g., Evans, Fisher, Gourio, and Krane (2015)) as the Federal Reserve contemplates further rate hikes following the recent target rate liftoff.

**Related Literature**

The literature on the credit channel of monetary policy has put forward two main channels to explain why financing constraints of firms might amplify the effects of monetary policy (Bernanke and Gertler (1995)). The first channel, the *firm balance sheet channel*, captures direct and indirect effects of monetary policy on firms' balance sheet strength and ease of access to external finance. Gertler and Gilchrist (1994) find that inventory investment, sales, and short-term debt of an aggregate of small firms are more responsive to changes in monetary policy than those of an aggregate of large firms. Ashcraft and Campello (2007) and Ciccarelli, Maddaloni, and Peydró (2014) control for the possibility that these results might be driven by a contraction of bank lending supply, and both find evidence of a strong firm balance sheet channel. None of these papers specifies the precise mechanisms through which the firm balance sheet channel operates, however, which is an important contribution of our paper. We show that a quantitatively significant firm balance sheet channel operates through the effect of monetary policy on firms' debt service burden when they use bank debt as a source of finance and retain exposure to interest rate risk by not hedging.

Although our focus is on the effects through existing loans, this channel may be conceptually similar to one operating through new loans. In this alternative case, the movements in internal funds would be caused by the issuance of new debt or refinancing of existing debt at new interest rates. In principle, both mechanisms are not mutually exclusive and might, in fact, reinforce each other. There are however some important differences between

prime rate (displayed in Figure 1), which is also closely tied to policy rates.

both mechanisms that we should highlight. First, we find that short-term debt does not significantly increase the sensitivity of firms' stock prices to monetary policy, in contrast to bank debt. This suggests that a channel operating through the refinancing of maturing debt might not be as strong as our mechanism. Second, there are important amplifying mechanisms in our channel which would be absent in a channel operating through new loans. For example, the literature has long recognized that long-term debt can create important agency costs, such as underinvestment and risk-shifting (Myers (1977), Bodie and Taggart (1978), and Himmelberg and Morgan (1995)), which means that a monetary policy tightening might worsen these agency costs, particularly through an increased debt service burden under long-term floating rate bank debt. As another example, the effect of floating rate bank debt on the interest coverage ratio is more likely to lead to covenant violations, which have important implications for firms' capital expenditures, as shown in Nini, Sufi, and Smith (2012). Finally, while the pass-through of policy rates to floating interest rates of long-term debt is complete and occurs at frequent resetting dates, the pass-through to short-term bank financing rates has been shown to be slow (De Bondt, Mojon, and Valla (2005), Illes and Lombardi (2013)).

The second channel, the *bank lending channel*, has focused on why bank lending to firms might be special for the transmission of monetary policy to the real economy (Bernanke and Blinder (1988), Bernanke and Gertler (1995), Stein (1998), Van den Heuvel (2002), and Bolton and Freixas (2006)). All of these theories focus on how the supply of new bank credit might be affected by monetary policy due to the presence of bank financing frictions.[5] Our proposed mechanism focuses instead on the transmission through loans outstanding at the time of monetary policy actions. Also, our mechanism is unrelated to how much banks suffer from financing constraints, so it could be active through all banks at all times, unlike existing mechanisms, whose potency may be restricted to a subset of banks during periods of credit market distress.

Our proposed mechanism is closely related to the burgeoning literature that introduces a similar transmission channel for households. Analogous to our mechanism, this literature suggests that monetary policy has real implications by influencing households' cost of servicing their floating rate debt and, as a result, their disposable income and consumption (Calza, Monacelli, and Stracca (2013), Di Maggio, Kermani, and Ramcharan (2014)).

The extensive literature on the relationship between firm fundamentals and debt structure helps us control for determinants of bank debt usage with sufficient accuracy, thereby

[5] Consistent with a role for bank financial health, the contraction in the supply of lending following a tightening of monetary policy has been found to be stronger in small, less liquid, and more leveraged banks (Kashyap and Stein (2000), Kishan and Opiela (2000), and Jimenez, Ongena, Peydró, and Saurina (2012)), and in banks that are not affiliated with multibank holding companies (Ashcraft (2006)).

alleviating concerns regarding omitted variables. Most of the theoretical literature argues that banks have an advantage in the resolution of information asymmetries and renegotiation of debt contracts compared to holders of public debt because banks have better monitoring ability and do not suffer from coordination problem of dispersed bondholders.[6] Hence, firms with a high degree of information asymmetry should rely more on bank debt. In contrast, the models in Diamond (1991) and Rajan (1992) suggest that this prediction holds for high and medium credit quality firms, whereas for low-quality firms the costs of bank monitoring may outweigh the benefits that would make public debt –e.g., junk bonds– more preferable. This nonlinear relationship between credit quality and bank debt usage helps alleviate the concern that our results may be driven by financial constraints. Consistent with this argument, we confirm that our results are not driven by credit quality proxies used in the empirical literature on debt structure (Denis and Mihov (2003) and Lin, Ma, Malatesta, and Xuan (2013)), such as firm size, profitability, and market-to-book ratio (growth opportunities), as well as by other measures that capture the financial situation of a firm, such as leverage, cash holdings, and risk (CAPM beta and cash flow volatility), or by debt maturity.[7]

There is also a good understanding of the determinants of hedging, which allows us to control for them and to use some of the arguably exogenous determinants as instruments. Existing theory predicts that hedging activities are positively related to the severity of financing constraints (Stulz (1984), Froot, Scharfstein, and Stein (1993)). Although some recent evidence, and our own data, cast doubt on the sign of this relationship (Stulz (1996), Rampini, Sufi, and Viswanathan (2014)), it is clear that financial constraints can be an important driver of hedging, and we control for them using various measures. Still, several determinants of hedging do not have a direct relationship with the responsiveness of stock returns to monetary policy, which enables us to use them as instruments. In particular, we follow the instrumental variables approach in Campello, Lin, Ma, and Zou (2011), who focus on institutional features of the U.S. tax system. The kinks or discontinuities of the tax schedule create a convexity of tax rates, which enables firms to reduce their expected tax liabilities by hedging in order to minimize income volatility (Smith and Stulz (1985), Graham and Smith (1999), and Petersen and Thiagarajan (2000)).

One important question is why most bank lending arrangements involve a floating rate instead of a fixed rate despite the fact that many firms hedge the interest rate risk associated with these loans. One answer could arise from the trade-off between firms' needs and banks'

[6] See Diamond (1984), Fama (1985), Holmstrom and Tirole (1997), Boot and Thakor (2009), Rajan (1992), Bolton and Scharfstein (1996), Bolton and Freixas (2000).

[7] In addition, we instrument for bank debt usage, following Faulkender and Petersen (2006) and Santos and Winton (2008), using proxies for firm visibility and firm uniqueness, both of which drive the ability to issue public debt and can be argued to be orthogonal to our dependent variable.

cost of capital. A firm that wants to borrow at a fixed rate may have limited access to other fixed-rate sources of financing, such as bonds, whereas the bank might prefer to lend at floating rates, in which case hedging bridges the gap between the desire of the bank and the firm. As discussed by Vickery (2008), there are at least two reasons why banks might prefer to lend at floating rates. First, rising interest rates can cause deposit outflows from the banks, and it is costly for banks to replace these outflows with other sources of financing. Lending at a floating rate would provide a partial hedge against these outflows. Second, floating rate business loans can be used to hedge the maturity mismatch between deposits and long-term mortgage loans. Another piece of evidence that banks are likely willing to lend corporations only at floating rate comes from the fact that even for firms that have access to both bonds and bank debt, most of the bonds are fixed rate whereas most of their bank debt is floating rate. If the floating vs. fixed rate choice for bank debt were driven by firm characteristics, the firms would likely choose similar rate arrangements for their bonds and bank loans, which does not seem to be the case.

Finally, this paper is related to a recent literature that uses the relationship between stock prices and monetary policy to shed light on questions that are otherwise difficult to answer. For example, the relationship between stock prices and monetary policy surprises is used by Gorodnichenko and Weber (2014) to identify the cost of price stickiness; by English, Van den Heuvel, and Zakrajsek (2014) to study the effect of monetary policy on bank profitability through maturity transformation; and by Chodorow-Reich (2014) to study the effect of unconventional monetary policy on financial institutions.

The rest of the paper is organized as follows. In Section 2 we introduce and analyze our theoretical results. In Section 3 we describe our data. Our empirical results on stock returns and on balance sheet variables are discussed in Sections 4 and 5, respectively, and in Section 6 we analyze the macroeconomic relevance of our proposed channel. Finally, Section 7 concludes.

# 2 Theoretical Framework

## 2.1 Simple Model

This section aims to provide a simple setting with a closed form solution that motivates the floating rate channel we study in our empirical analysis. Therefore, we make some simplifying assumptions that are relaxed in our dynamic setting in Section 2.2. In particular, firms do not issue equity, there is no costly distress, and firms are identical except for their debt structure and financial constraints.

We consider a two-period (three-date) economy with dates $t = \{0, 1, 2\}$. Firms invest a fixed amount $K_0$ at time $t = 0$, which produces a return $f(K_0)$ in $t = 1$, and a variable amount $K_1$ in $t = 1$, which produces a return $f(K_1)$ in $t = 2$. For simplicity, we assume that $K_0$ is financed exclusively with long-term debt, which can be floating rate debt (bank loans), $L_0$, or fixed-rate debt (bonds or hedged bank loans), $B_0$. Let $l = L_0/K_0$ be the fraction of floating rate debt, so that

$$K_0 = L_0 + B_0 = lK_0 + (1 - l) K_0. \tag{1}$$

Floating rate debt requires the payment of interest $r_1 L_0$ at time $t = 1$, and of interest and principal $(1 + r_2) L_0$ in $t = 2$. Fixed rate debt requires the payment of a fixed coupon $r_c B_0$ at time $t = 1$, and of the fixed coupon and principal $(1 + r_c) B_0$ in $t = 2$.

We model monetary policy in the simplest way possible to provide a clear exposition of our mechanism. The rate $r_1$ suffers an unexpected change after choices are made in $t = 0$, and we identify this shock as a monetary policy action. We assume that $r_2$ is unaffected by monetary policy.[8]

A firm's internal funds at the end of the first period (in $t = 1$) is

$$N_1 = f(K_0) - r_c B_0 - r_1 L_0. \tag{2}$$

The firm can borrow $b_1$ in $t = 1$, subject to an exogenous borrowing constraint

$$b_1 \leq \bar{b}, \tag{3}$$

where $b_1$ is one-period debt that requires a repayment of $(1 + r_2) b_1$ in $t = 2$. The firm invests again in $t = 1$ an amount

$$K_1 = N_1 + b_1 - d_1, \tag{4}$$

where $d_1$ are dividends paid in $t = 1$. A timeline of events is described in Figure 4.

[FIGURE 4 ABOUT HERE]

The firm maximizes the present value of dividends in $t = 0$. Dividends, $d_t$, are paid in

[8] This is essentially a comparative statics exercise, informally referred to as an "MIT shock" by, for example, Guerrieri and Uhlig (Handbook of Macroeconomics, forthcoming) and commonly used in the macroeconomics literature (see (Gertler and Kiyotaki (2010), Eggertson and Krugman (2012), or Guerrieri and Lorenzoni (2016)). Moreover, while monetary policy affects $r_1$ directly, it could have persistent effects and cause changes in $r_2$ as well. We consider interest rate persistence and rationally anticipated interest rate shocks in the dynamic model of Section 2.2.

$t = 1$ and $t = 2$, and given by

$$d_1 = N_1 + b_1 - K_1, \quad \text{and} \tag{5}$$

$$d_2 = f(K_1) - R_c B_0 - R_2 L_0 - R_2 b_1 = f(K_1) - R_c (1 - l) K_0 - R_2 l K_0 - R_2 b_1, \tag{6}$$

where $R_1 = 1 + r_1$, $R_2 = 1 + r_2$, and $R_c = 1 + r_c$ represent the gross interest rates.

A firm that is financially constrained in $t = 1$ ($b = \bar{b}$) will optimally set $d_1 = 0$ and invest

$$K_1 = N_1 + \bar{b}. \tag{7}$$

An unconstrained firm instead invests according to the neoclassical investment rule,

$$f'(K_1) = 1 + r_2. \tag{8}$$

We are interested in how the firm value and investment react to changes in $r_1$ once the long-term financing choices are made. The following proposition is central to our empirical analysis:

**Proposition 1** *Floating rate debt usage increases the monetary policy sensitivity of stock prices and investment of financially constrained firms. In particular,*

*(i) floating rate debt usage increases the policy rate sensitivity of stock prices for all firms, but the effect is stronger for financially constrained firms and*

*(ii) floating rate debt usage increases the policy rate sensitivity of investment ($K_1$) of financially constrained firms, while it does not affect the sensitivity of investment of financially unconstrained firms.*

Appendix A provides a formal proof of this proposition, and here we offer an intuitive explanation. The investment of financially constrained firms in $t = 1$, given by equation (7), depends on the firm's internal funds $N_1$ at that point (equation (2)), which in turn are influenced by the interest expense incurred ($r_c B_0 + r_1 L_0$). An increase in interest rate $r_1$ leads to a reduction in the firm's internal funds at the end of $t = 1$ if the firm uses any floating rate debt, which in turn leads to lower investment, $K_1$, in the following period. It is clear from equation (2) that this effect is stronger for firms with more floating rate debt $L_0$. Financially unconstrained firms, however, invest in $t = 1$ an amount given by (8), which equates the marginal product of capital to the interest rate in the second period, $r_2$. For their investment, therefore, their internal funds in $t = 1$ and the amount of floating rate debt $L_0$ are irrelevant.[9]

[9] If monetary policy has persistent effects, the investment of the unconstrained firm can react to monetary

The amount of floating rate debt can affect the firm's stock market valuation through two channels. First, an increase in interest rates increases the interest payments on floating rate debt at the expense of dividends paid to shareholders, which affects all firms irrespective of their financial constraints. Second, as discussed previously, financially constrained firms suffer, in addition, a reduction in their second-period investment $K_1$ as a result of the increased interest expense and reduced internal funds, which further hurts future dividends and current stock valuation.[10]

Summing up, this simple model shows how the floating rate channel affects both the investment and the stock value of financially constrained firms more than those of unconstrained firms.

## 2.2 Dynamic Model

The simple model introduced in Section 2.1 formalizes the essential intuition of our mechanism and delivers closed-form expressions. We now integrate those ideas into a more general dynamic model that also takes into account important issues such as monetary policy persistence, effects of costly distress, and the quantitative strength and duration of the effects of our mechanism. To be able to address these issues, we build on Gomes, Jermann, and Schmid (2016) and introduce a partial equilibrium dynamic model of firm investment and financing decisions that features long-term debt, an interest rate exposure decision through issuance of floating or fixed rate debt, and financing constraints, in an environment with uncertainty arising from interest rate (monetary policy) shocks and operating cost shocks.[11] The model considers both financially constrained and financially unconstrained firms, and we use the model's stationary distribution of firms to run standard regressions capturing the effect of monetary policy on stock returns and investment.

### 2.2.1 Financially Constrained Firms

**Technology**

Capital $k_t$ invested in period $t-1$ produces output in period $t$ and depreciates fully in one period. Each firm produces according to the function

$$y_t = Ak_t^{\alpha}, \tag{9}$$

policy through changes in $R_2$ as well. This classic interest rate channel, however, does not depend on how much floating rate debt the firm has and therefore is not relevant to our floating rate channel.

[10] The dynamic model in Section 2.2 describes how effects on the expected likelihood and cost of financial distress constitute another channel through which changes in interest rates interact with the presence of floating rate debt and financial constraints to explain movements in stock prices.

[11] Gomes, Jermann, and Schmid (2016) consider the implications of nominal debt in a model with inflation dynamics. Our paper abstracts from these issues, as they are not part of our mechanism, and considers an economy where debt repayments are determined in real terms.

where $A$ is a constant productivity parameter. Firm-level profits are also subject to additive idiosyncratic shocks, $z_t$, so that operating profits are equal to

$$\pi_t = y_t - z_t. \tag{10}$$

We assume that $z_t$ is i.i.d. across firms and time, and takes values over the interval $[0, \overline{z}]$, with $\int_0^{\overline{z}} \phi(z)\, dz = \int_0^{\overline{z}} d\Phi(z)$. We think of these as direct negative shocks to firms' operating income and not necessarily output. They summarize the overall firm-specific component of their business risk. They are not proportional to the size of the firm, suggesting some element of fixed costs and allowing for the possibility of negative profits.

**Financing**

Firms fund themselves by issuing both equity and multi-period debt, which can be floating or fixed rate. Let $b_t$ denote the stock of outstanding debt at the beginning of period $t$. To capture the fact that outstanding debt is of finite maturity, we assume, as in Gomes, Jermann, and Schmid (2016), that in every period $t$ a fraction $\lambda$ of the principal is paid back. The remaining $(1-\lambda)$ fraction remains outstanding and cannot be repaid early, so as a result the debt has an expected life of $1/\lambda$. In addition to principal amortization, the firm is also required to pay a periodic coupon $c_t$ per unit of outstanding debt. The coupon depends on the amount of floating rate debt:

$$c_t = \theta_t r_t + (1-\theta_t)(\overline{r} + \psi), \tag{11}$$

where $\theta_t$ is the share of debt that is floating rate, which pays an interest rate $r_t$ set by monetary policy. The fixed interest rate $\overline{r} + \psi$ payable to the remaining $1-\theta_t$ fraction of debt is equal to the unconditional average of the floating interest rate plus a fixed amount $\psi > 0$ that captures the cost of hedging. The law of motion for floating rate debt is given by

$$\theta_{t+1} b_{t+1} = \theta_t (1-\lambda) b_t + \theta_{t+1}^{NEW} (b_{t+1} - (1-\lambda) b_t), \tag{12}$$

where for simplicity we assume that all new debt, $b_{t+1} - (1-\lambda) b_t$, has to be either fixed or floating rate, so that $\theta_{t+1}^{NEW} \in \{0, 1\}$. Debt is assumed to be safe, so the coupon paid, $c_t$, does not feature a risk spread. We assume that firms are subject to a borrowing constraint:

$$b_t \leq \overline{b}. \tag{13}$$

To be able to discuss the firm's equity issuance, we first define $n_t$ to be the internal funds of the firm at the beginning of the period, given by

$$n_t = \pi_t - (c_t + \lambda)\, b_t. \tag{14}$$

When internal funds, $n_t$, are positive, the firm pays dividends equal to $d_t = \rho n_t$, where $\rho$ is a reduced-form way of capturing firms' dividend policy.[12] When $n_t$ is negative, however, the firm is considered to be in violation of a net worth financial covenant imposed by creditors and has to issue equity ($d_t < 0$). Instances of $n_t < 0$ thus capture periods of financial distress. When $n_t < 0$, debtholders force the firm to issue equity to finance the negative internal funds. Following Gomes (2001), equity issues carry a proportional issuance cost $\eta$, so that the dividend net of equity issuance costs is given by

$$d_t = \left(1 + \eta \mathbf{1}_{\{n_t<0\}}\right) \rho n_t, \tag{15}$$

where $\eta > 0$ and $1_{\{n_t<0\}}$ is an indicator function of strictly negative internal funds.[13] We interpret $\eta$ in our context as a comprehensive parameter that captures different costs of financial distress. They can be considered as reallocation of part of the firm's surplus from shareholders to lenders upon violation of such a covenant due to a transfer of control rights to creditors, as flotation costs of issuing equity, or as other costs of financial distress.[14] Because we only allow for covenant violations as "technical defaults," bondholders are always paid in full, which allows us to avoid the calculation of the price of risky debt. This simplifying assumption allows us to impose a cost on firms with low internal funds, and builds on similar notions of financial distress introduced in Asquith et al (1994) or Strebulaev (2007).[15] Other more explicit ways of modelling debt default would have similar implications for our purposes.

Our model choice assumes that firms are unable to issue equity in circumstances other than instances of negative internal funds, and, even then, only in an amount needed to cover those negative internal resources. The empirical motivation for this choice is that there are

[12] In the absence of this passive dividend payout rule, financially constrained firms in our model would not pay any dividends, but this would be in stark contrast with the data. Our payout rule captures a reduced form version of agency frictions and information asymmetry that encourage dividend payments in the real world (Lintner (1956), Fama and French (2001), Floyd, Li and Skinner (2015)).

[13] Gomes (2001) also estimates a fixed cost component in equity floation costs, which we ignore for clarity of exposition as it is unlikely to have any significant qualitative effects on our results.

[14] The recent surge in literature on covenant violations shows that these events have important implications for firm's financing and investment behaviors and that they happen much more frequently than bankruptcies (Chava and Roberts (2008), Nini, Smith and Sufi (2012), and Acharya, Almeida, Ippolito, and Perez (2014)). One of the most important effects highlighted by this literature is the firms' need to deleverage following a covenant violation, through, amongst other means, equity issuances, as in our model.

[15] In Strebulaev (2007), for example, the managers of firms whose financial condition deteriorates sufficiently must take corrective action in the form of costly fire sales of assets.

very few secondary issues of equity in the data.[16] On a more conceptual basis, adding a realistically calibrated endogenous equity choice would be unlikely to alter our results, and would come at the cost of a loss of tractability.

**Optimization**

Firms maximize the present value of dividends $d_t$ paid to shareholders. The dynamic programming problem for a firm consists of a choice of dividends $d_t$, next period capital $k_{t+1}$, debt $b_{t+1}$, and the share of new debt which is floating rate $\theta_{t+1}^{NEW}$, taking as given the two exogenous shocks: idiosyncratic productivity shock $z_t$ and interest rate $r_t$, the latter of which follows a Markov process.[17]

We claim, and check in our numerical simulations, that financially constrained firms are permanently credit constrained so that (13) is binding, $b_{t+1} = \bar{b}$, and, as a result, the amount of capital, $k_{t+1}$, follows the law of motion[18]

$$k_{t+1} = \ (1 - \rho) n_t + \lambda \bar{b}. \tag{16}$$

Finally, dividends are given by rule (15). The only choice that is not a corner solution is the share of new debt which is floating rate, $\theta_{t+1}^{NEW}$, which is our main focus.

The value of the firm to its shareholders, denoted $V_c$, is the present value of the dividend distributions:

$$V_c (k_t, b_t, \theta_t, z_t, r_t) = \max_{\theta_{t+1}^{NEW}} \left\{ d_t + E_t \frac{1}{1 + r_{t+1}} \int_0^{\overline{z}} V_c (k_{t+1}, b_{t+1}, \theta_{t+1}, z_{t+1}, r_{t+1}) \, d\Phi (z) \right\} \tag{17}$$

where the conditional expectation $E_t$ is taken over the distribution of shocks to $r_{t+1}$.[19]

### 2.2.2 Financially Unconstrained Firms

Financially unconstrained firms are identical to constrained firms except in their ability to access external finance. In particular, unconstrained firms can also fund themselves by issuing both equity and multi-period debt, and they face no restriction in the amount of debt

[16] According to SDC Platinum data (Calomiris and Tsoutsoura, 2010), nonfinancial non-utility firms have about 100 seasoned equity offerings per year, which implies that only about 2% of firms issue equity in a given year.

[17] Note that the assumption on the process for $r_t$ means that agents do not learn about the interest rate on $b_{t+1}$ until date $t + 1$.

[18] We ensure that the largest possible operating cost shock $\overline{z}$ is low enough so that $k_{t+1}$ is always positive.

[19] We ensure the nonnegativity of $V$, without loss of generality, by assuming that there is a positive probability of a very valuable growth option that materializes in the future and has a fixed value orthogonal to the current state of the firm. A nonnegative $V$ implies that equity holders will never want to default voluntarily on their credit obligations.

finance they can obtain and no costs of issuing equity. The associated value of the firm is

$$V_u\left(k_t, b_t, \theta_t, z_t, r_t\right) = \max_{d_t, k_{t+1}, b_{t+1}, \theta_{t+1}^{NEW}} \left\{ d_t + E_t \frac{1}{1+r_{t+1}} \int_0^{\overline{z}} V_u\left(k_{t+1}, b_{t+1}, \theta_{t+1}, z_{t+1}, r_{t+1}\right) d\Phi\left(z\right) \right\}, \tag{18}$$

where for simplicity we assume that $d_t = n_t$.[20]

The Modigliani-Miller Theorem applies, and firms' investment decisions are independent of their financing arrangements. Their investment choice satisfies

$$1 + E_t\left(r_{t+1}\right) = f'\left(k_{t+1}\right). \tag{19}$$

#### 2.2.3 Simulation Strategy and Regression Specification

We are interested in understanding how the exposure to floating interest rate debt affects the reaction of firms' stock price and investment differently depending on their degree of financial constraints. To do so, we run regressions on the simulated model economy by generating a random path of the interest rate, $r_t$, for 75 quarters, common to all firms, and one random path of the operating cost shock for each of the $1,000$ firms we simulate.[21] A period ($t$ to $t+1$) is to be identified with one quarter, and includes typically two Federal Open Market Committee (FOMC) cycles that determine interest rates in the United States.

To test our hypotheses, we run the following specification for stock returns, where subscript $i$ refers to each firm:

$$\begin{aligned} r_{i,t}^S = {} & \alpha_0 + \alpha_1 s_t + \alpha_2 \theta_{i,t} + \alpha_3 s_t \theta_{i,t} + \alpha_4 1\left(_{\text{constrained}}\right)_{i,t} + \alpha_5 1\left(_{\text{constrained}}\right)_{i,t} s_t \\ & + \alpha_6 1\left(_{\text{constrained}}\right)_{i,t} \theta_{i,t} + \alpha_7 1\left(_{\text{constrained}}\right)_{i,t} s_t \theta_{i,t} \\ & + \boldsymbol{\gamma}_1 \mathbf{controls}_{i,t} + \boldsymbol{\gamma}_2 1\left(_{\text{constrained}}\right)_{i,t} \mathbf{controls}_{i,t} + \boldsymbol{\gamma}_3 s_t \mathbf{controls}_{i,t} \\ & + \boldsymbol{\gamma}_4 \left(_{\text{constrained}}\right)_{i,t} s_t \mathbf{controls}_{i,t} + \varepsilon_t, \end{aligned} \tag{20}$$

where $r_{i,t}^S$ is the stock return of firm $i$ over quarter $_t$, and $s_t = r_t - E_{t-1}\left[r_t\right]$ is the rate surprise. The indicator function $1\left(_{\text{constrained}}\right)_t$ takes a value of 1 if the firm is financially constrained, as described in Section 2.2.1, and a value of 0 if the firm is unconstrained, as described in Section 2.2.2. Our theory predicts that in regression (20) $\alpha_3$ and $\alpha_7$ should be negative, i.e., contractionary rate surprises should reduce the market value of the firm and more so

[20] Note that there is no optimal distribution of dividend payments of financially unconstrained firms across time, as long as they can invest funds at the same interest rate as shareholders.

[21] We discard the first 30 periods of the simulation to avoid the influence of initial conditions. We introduce 500 financially constrained firms and 500 unconstrained firms, consistent with our empirical analysis in the following sections that uses the median of our financial constraints proxies as the cut-off point to separate financially constrained and unconstrained firms. This is also close to the fraction of firms reported by Hadlock and Pierce (2010) as not financially constrained (10%) and likely not financially constrained (50%).

for financially constrained firms.[22] The vector $\textbf{controls}_{i,t}$ includes firm leverage $\frac{b_t}{k_t}$ and firm size $n_t$. The definitions of all the variables used are standard in the investment and capital structure literatures, and are described in detail in Appendix B.

The corresponding equation for investment is

$$\begin{aligned}\frac{i_{i,t}}{k_{i,t-1}} &= \beta_0 + \beta_1 \Delta r_t + \beta_2 \theta_{i,t} + \beta_3 \Delta r_t \theta_{i,t} + \beta_4 1(_{\text{constrained}})_t + \beta_5 1(_{\text{constrained}})_t \Delta r_t \\ &\quad + \beta_6 1(_{\text{constrained}})_t \theta_t + \beta_7 1(_{\text{constrained}})_t \Delta r_t \theta_{i,t} + \boldsymbol{\gamma}_1 Q_{i,t} + \varepsilon_t, \end{aligned} \tag{21}$$

where we add Tobin's Q ($Q_{i,t}$) as a determinant of investment and include it as a control variable. We use interest rate changes $\Delta r_t$ in our investment regression but interest rate *surprise* changes $s_t$ in our stock price regression, given that stock prices are forward looking, an approach we also employ for our empirical analysis. Finally, we also study whether changes in interest rates affect the interest rate coverage ratio and the likelihood and costs of financial distress. The definitions of these variables can also be found in Appendix B.

#### 2.2.4 Calibration

In order to assess the quantitative properties of the model we calibrate it at a quarterly frequency. Some model parameters are set to obtain a reasonable match between the model simulated data moments and their real data counterparts, while others are set to common values in the literature. Table I summarizes our baseline parameter choices. Overall, most of our parameter choices are relatively conservative, to avoid concerns that any of the results might be driven by an overstatement of some of the factors that drive the floating rate channel.

[TABLE I ABOUT HERE]

We first specify the production technology. We normalize the firm's productivity parameter $A$ to 1, and, in line with most of the literature, set the capital share $\alpha$ to 0.4.[23] The idiosyncratic operating cost shock is an i.i.d. process that can take values $z_{i,t} \in$

[22] In our empirical regressions using real data in Sections 4 and 5 we scale bank debt over total assets, as we think it is a better proxy for a firm's bank debt usage in comparison other sources of financing, including debt and equity, but also provide robustness checks at the end of Appendix F using bank debt over total debt. In our simulated model, total assets feature much more variation than bank debt does, which makes most of the variation in bank debt usage come from variation in total assets. For this reason, we scale bank debt by total debt in the model simulated benchmark regressions. Alternatively, one could introduce a capital adjustment cost to subdue the movements in total assets. This would complicate the model without additional insights. Having said this, we provide robustness checks in Table A15 in Appendix B using bank debt over total assets in our simulated model regressions. All our results go through, although statistical and economic significances are slightly weaker.

[23] Corrado, Hulten and Sichel (2009) estimate the income shares of labor and capital in the U.S. over the period 1993-2005 to be 60% and 40%, respectively. We normalize labor to one.

$\{0, 0.09, 0.18, 0.27, 0.36\}$ with equal probability. This stochastic process delivers a probability of negative internal funds $n_t$ of 7.8%, which is in line with the empirical estimate of the quarterly likelihood of a covenant violation. Nini, Smith and Sufi (2012) estimate that on average 6.9% of firms are in violation of a financial covenant in any given quarter in the Compustat sample between 1997 and 2008.

Debt maturity, which is driven by the repayment rate $\lambda$, has a significant influence on the strength of our channel. Debt in our model comprises both bank loans and bonds, both of which are relevant from a macroeconomic perspective. The Federal Reserve's Flow of Funds states that of the $7.5 trillion of outstanding nonfinancial corporate business debt in the United States, around $5 trillion are corporate bonds and $2.5 trillion are corporate loans.[24] Estimates for bank loan maturities are in the order of 4-5 years.[25] Estimates for average corporate bond maturities are significantly larger, ranging from 11 to 13 years.[26] We choose $\lambda = 0.035$, which delivers an average maturity in our simulations of 7.1 years, below the weighted average empirical estimate using the data above of around 9 years. This is a conservative calibration given that our results would be stronger with larger average maturity due to a longer lasting effect of monetary policy shocks through existing floating rate debt.

We select a cost of hedging $\psi$ of 0.5%, which is in line with the average swap spread for maturities between 5 and 30 years estimated by Jermann (2016) in the period 1998-2008.[27]

The borrowing constraint parameter $\bar{b}$ is set to be in line with firms' average market leverage, calculated as total debt over total debt plus the market value of equity. Colla, Ippolito, and Li (2013) find that average market leverage for Compustat leveraged firms is 0.25, the same value we obtain.[28]

The payout ratio $\rho$ for firms with positive earnings is set to be in line with the average payout ratio of U.S. corporations. Floyd, Li and Skinner (2015) estimate that the payout ratio, calculated as dividends plus share repurchases over income before extraordinary items

[24] These calculations ignore noncorporate business debt, for which maturity data is very scarce. We discuss the aggregate importance of noncorporate debt in Section 6.1.

[25] Hollander and Verriest (2016) estimate an average maturity of 5 years for syndicated bank loans in the US between 2005 and 2008, and Gomes, Jermann and Schmid (2016) calibrate debt maturity on the basis of the observed maturity of commercial and industrial loans to be 5 years. Paligorova and Santos (2014) calculate an average maturity at origination of 4 years for corporate bank loans between 1990 and 2010.

[26] Gilchrist and Zakrajsek (2012) find that the maturity at origination for public corporate bonds was on average 13 years, between 1971 and 2010. Kwan and Carleton (2011) find that privately placed bonds have a shorter maturity of around 11 years on average, in a sample between 1985 and 1994.

[27] The U.S. dollar swap spread is the difference between the fixed rate paid on an interest rate swap and the yield on a U.S. Treasury security of equivalent maturity. Jermann (2016) highlights that this spread has been around 0% following 2008, a feature he associates with limits to arbitrage.

[28] A more comprehensive measure that includes private firms is calculated by Gomes, Jermann and Schmid (2016) using Flow of Funds data, who obtain average corporate debt ratios (scaled by assets at current cost) slightly above 50% between 2005 and 2009.

for all nonfinancial US firms in Compustat, to be on average 73% over 2000-2012. Our payout is on average equal to 46% of profits.[29] A large dividend payout worsens firms' financial constraints by keeping their internal funds low. To dispel concerns that our financially constrained firms are excessively constrained, we keep the payout ratio significantly lower than what we observe in the data.

[TABLE I ABOUT HERE]

Our measure of the cost of issuing equity, $\eta$, is meant to broadly capture costs of financial distress for shareholders. In our model, it is associated with financial covenant violations. Nini, Smith and Sufi (2012) study violations of financial debt covenants, and show that they are associated with a decrease in market to book ratios of around 15% on average, and a loss of net worth of around 13% of total assets. Covenant violations often lead managers to deleverage by issuing equity (Nini, Smith and Sufi (2012)), which is reflected in our model, and our parametrization also builds on literature estimates of flotation costs. Gomes (2001) estimates that flotation costs are equal to around 3% of the issue amount plus a fixed component. Other studies show that underwriting fees range between 3% and 8% of the issue amount and that an information asymmetry effect causes a decrease in stock value of more than 2% on average (Lee and Masulis (2009)). We set $\eta$ conservatively so that the average equity issuance costs incurred in a period in which $n_{\mathbf{t}} < 0$ are in the order of 6% of total assets, in line with the estimates described above. Our results are stronger with larger $\eta$, and hence this is a conservative estimate.[30]

Finally, we describe the stochastic process for the interest rate $r_t$, which is driven by monetary policy. We estimate that the Federal Funds Target Rate has a quarterly autocorrelation of 0.96, a mean of 0.04, and a normalized standard deviation of 48.9%, using data from 1994 to 2008. In our simulations, $r_t$ follows a Markov process in which the interest rate can take values in $r_t \in \{1\%, 2\%, 3\%, 4\%, 5\%\}$, with transition probabilities that deliver a quarterly autocorrelation of 0.95, and a mean and standard deviation of 0.03 and 43.8%, respectively. We choose a smaller mean due to smaller interest rates during our sample period in our empirical analysis.

[29] Note that our dividend rule establishes that the firm pays out $\rho = 0.9$ of internal funds, and that internal funds are equal to profits minus principal debt repayments that period. This is why the payout ratio based on profits is significantly lower than the value of $\rho$.

[30] Note that there is no bankruptcy in our model, so our costs of covenant violation events are also meant to capture bankruptcy costs. Estimates for the costs of bankruptcy as a share of total assets are in the range of 20% (Altman (1984), Bris, Welch and Zhu (2006)), to 36% (Alderson and Betker (1995)).

### 2.2.5 Results and Discussion

Is the increase in the responsiveness of $V$ and $k_{t+1}$ to monetary policy when a firm increases its usage of floating rate debt stronger for financially constrained firms? If so, what is the mechanism behind this effect?

[TABLE II ABOUT HERE]

Our results for stock returns are displayed in Panel A of Table II. An increase in the share of floating-rate debt as a share of total debt increases the responsiveness to monetary policy of the stock returns for both constrained and unconstrained firms. In the case of unconstrained firms, the effect occurs because a tightening of monetary policy in the presence of floating rate debt increases the share of cash flows allocated to bondholders, at the expense of shareholders. That channel is also present for constrained firms, but, in addition, they suffer two other consequences. First, a monetary policy tightening when a firm is exposed to interest rate variations through floating rate debt increases interest expense, decreases cash flows, and increases the likelihood of suffering bankruptcy costs (which in our model correspond to having a negative liquidity position that needs to be covered by issuing costly equity). Second, a financially constrained firm that suffers an increase in its interest expense through its floating rate debt will suffer a loss in its net worth and its investment capacity will decrease, suffering from lower future profits and dividends. The economic magnitudes are large. While increasing floating-rate debt usage from 0% to 100% of total debt is associated with an *additional* effect of a 1 bp surprise tightening of monetary policy on stock returns of unconstrained firms of around 21 to 23 bp, the same increase in floating-rate debt usage increases the responsiveness of financially constrained firms by around 28 (21.58+7.25) bp, leading to a roughly one-third larger additional effect that is strongly statistically significant. For reference, an unconstrained firm with no floating-rate debt suffers around a 20 bp stock return fall on average following a 1 bp policy rate increase.[31] We also repeat the simulated regression exercise using a lower distress cost in column 3, which we will discuss in more detail at the end.

Our results for investment are displayed in Panel B of Table II. An increase in the share of floating-rate debt as a share of total debt increases the responsiveness to monetary policy of the investment of constrained firms but has no consistent effect for unconstrained firms. In the case of unconstrained firms, investment depends only on the interest rate, as the Modigliani-Miller conditions apply to these firms and their capital structure is irrelevant for investment decisions. Constrained firms' investment, however, is determined by their liquid

[31] Notice that the coefficient on $Surprise_t$ in column 2, which displays the regression with controls, does not have a meaningful interpretation because we interact all controls with surprise.

resources, which in turn are affected by their interest expenses. A monetary policy tightening when a firm is exposed to interest rate variations decreases cash flows and decreases the resources available for investment. For financially constrained firms, increasing floating-rate debt usage from 0% to 100% of total debt is associated with an additional decrease in investment caused by a 1 bp tightening of monetary policy of around 0.1 to 0.2 bp at a four-quarter horizon, and 0.4 bp at a six-quarter horizon.

[TABLE III ABOUT HERE]

Table III studies how changes in interest rates interact with the presence of floating rate debt and financial constraints to affect the interest rate coverage ratio and the likelihood of financial distress. Increasing floating-rate debt usage from 0% to 100% of total debt is associated with an increase in the likelihood of an episode of financial distress caused by a 1 percentage point tightening of monetary policy of around 2.4 percentage points (column (1)), and with an increase in costs of financial distress caused by a 1 percentage point tightening of monetary policy of around 1.6% of the market value of assets (column (2)). The importance of the relationship between interest rates, floating rate debt, and financial constraints suggests that this link may amplify the relationship between floating rate debt usage and policy sensitivity of stock prices. We find evidence consistent with this conjecture. In particular, when we run a simulation in which we decrease equity issuace costs by 33%, and rerun our stock return regressions (column (3) of Panel A of Table II), we find that increasing floating-rate debt usage from 0% to 100% of total debt is associated with an additional effect of a 1 bp surprise tightening of monetary policy on stock returns of constrained firms of around 20 bp (15.99+3.54). This effect is lower than the 28 bp effect in column 1 that uses our benchmark distress costs. Further evidence consistent with the specific mechanism we suggest in our floating rate channel is displayed in column (3) of Table III, which shows that the presence of floating rate debt has a strong influence on the sensitivity of the interest rate coverage ratio to monetary policy shocks.

# 3 Data Description and Summary Statistics

Our theoretical results imply that the presence of floating rate debt has significant influence on the transmission of monetary policy to firm stock prices and balance sheet variables, especially for financially constrained firms. Since a majority of bank debt is floating rate and most of the nonbank debt is fixed rate, our results suggest that bank debt may play a special role in monetary policy transmission due to its floating rate nature. Testing these implications in the data requires not only information on firms' investment, liquidity position, and stock prices, which are readily available from sources that have been widely used before, but also information on how much bank debt and floating rate debt a firm uses and on firms' hedging behavior. We address this challenge by using a new dataset on debt structure (Capital IQ) and by creating a new dataset on the hedging behavior of publicly listed companies. This section describes these efforts in detail.

## 3.1 Firm-level Data

The sample for our main analysis consists of U.S. firms covered by CRSP, Compustat, and Capital IQ (CIQ), excluding utilities (SIC codes 4900–4949) and financials (SIC codes 6000–6999). While CRSP and Compustat are well known and widely used, the CIQ database is relatively new. CIQ compiles detailed information on capital and debt structure from the footnotes of 10-K Securities and Exchange Commission (SEC) filings. In particular, from CIQ we obtain data on the amount of bank debt firms have in their liabilities. Our main measure of bank debt usage, $BankDebt/At$, is defined as total bank debt, which we calculate as drawn credit lines (CL) plus term loans (TL), divided by the total value of book assets (Compustat item AT). For robustness, we also employ two additional measures of bank debt usage: CL plus TL divided by total debt, and TL plus CL plus undrawn credit lines, divided by the total value of book assets. We focus annual CIQ files because they are more densely populated.

We focus on the period from 2004 to 2008 because of the lack of wide coverage of bank debt data in CIQ before 2003 and because the federal funds target rate hit the zero lower bound in 2008, after which the quantitative easing program of the Federal Reserve replaced the federal funds target rate as the main monetary policy tool.[32] In an extension in Section 6.3, in which we study the quantitative easing period separately, we extend our sample to also cover 2008 to 2011. We remove observations with negative revenues, missing information on total assets, or a value of total assets under $10 million.

For our stock price analysis, we also discard penny stocks, defined as those with a price of less than $5, as in Amihud (2002). Moreover, we follow the convention in the literature (De Bondt and Thaler (1990), Kashyap, Lamont, and Stein (1994) or Polk and Sapienza (2009)) and focus on firms whose fiscal year ends in December so that balance sheet information about different firms is available to investors at the same time. Various degrees of staleness of balance sheet information across different firms might affect our results, especially because some firm characteristics might be seasonal, not only over the calendar year, but also over the fiscal year.[33] Our main results remain similar when we include all firms. We use two-day

[32] Because data availability limits our sample, in Appendix C we make sure that the reaction of stock prices to monetary policy shocks in our sample is similar to the effect of monetary policy on stock prices before 2003 and in the CRSP universe.

[33] For example, Oyer (1998) finds that in addition to varying with the calendar business cycle, manufac-

stock returns for each firm on each of the FOMC meeting dates.

For our analysis of balance sheet variables, we use quarterly data.[34] After the above filters, the sample for our analysis of stock returns contains 9,746 firm-year observations comprising 2,368 unique firms, and the sample for our analysis of balance sheet variables contains 45,694 firm-quarter observations comprising 3,146 unique firms. Exact variable definitions are given in Table A1 in the Appendix. Following common practice in the empirical finance literature, all variables are winsorized at the 1 percent level in both tails of the distribution to prevent extreme values from overinfluencing our regressions.[35] Throughout the analysis, we use demeaned firm-level variables in regressions with interaction terms to facilitate the interpretation of the coefficient estimates of the policy action as the reaction of the average firm.

Table IV provides key statistics for the balance sheet variables we employ in our study. Across the entire sample (column 1), bank debt represents on average 7.22 percent of the book value of assets and 37.51 percent of total debt. For the subset of firms with some bank debt (columns 3 and 4), the above ratios rise to 10.33 percent and 58.89 percent for nonhedgers and 15.52 percent and 50.35 percent for hedgers. In both samples, approximately half of bank borrowing is in the form of drawn credit lines and the other half in the form of term loans.

[TABLE IV ABOUT HERE]

A comparison between leveraged firms without bank debt (column 2) and leveraged firms with bank debt (columns 3 and 4) reveals that firms with bank debt do not seem to display characteristics that suggest that they are clearly more sensitive to monetary policy, compared to leveraged firms without bank debt (i.e., those that use other sources of debt). They have similar size, age, and likelihood of being rated. Nevertheless, within bank debt users, the unhedged ones (column 4) have slightly lower size, age, and probability of being rated compared to leveraged firms without bank debt, although they have similar profitability and riskiness, as captured by lower average CAPM beta and cash flow volatility. We will discuss the differences between hedgers and nonhedgers in more detail in the next subsection where we discuss the interest rate hedging data.

turing firms' sales are higher at the end of the fiscal year.

[34] As a result, we have four observations per year, which is half as much as the event study with stock prices allows because there is usually more than one FOMC announcement per quarter. Imposing a December fiscal year-end would reduce the number of observations even further. Moreover, the availability of balance sheet information to investors is not as important for real variables as it is for stock prices, because the information is internally available to managers. Therefore, we also include firms whose fiscal year ends in March, June, September, or December, so that our variables match the measure of monetary policy that we use for that analysis, which is a quarterly aggregate of monetary policy changes.

[35] See, for example, Fama and French (1992) and Sufi (2009).

We also obtain information on the percentage of firms' debt that is floating or fixed rate from CIQ. Unlike the bank debt variable, which is measured with precision (Colla, Ippolito and Li (2013)), the floating rate debt variable is measured with some error and we only use it as an approximation. It is manually collected by CIQ from the footnotes in 10-K filings, which could lead to errors that are hard to detect systematically. Indeed, the sum of floating plus fixed rate debt often does not add up to total debt. The 5th percentile of the ratio of floating plus fixed rate debt to total debt is 0.83, and the 95th percentile is 1.04.

This caveat notwithstanding, our floating rate debt measure is useful to illustrate a key distinction of bank vs. non-bank debt. A comparison between columns 2 with columns 3 and 4 also reveals that bank debt is more likely to feature floating interest rates than non-bank debt. Floating rate debt represents 12.75 percent of the value of the assets of bank debt users, compared with 1.59 percent for the firms with only non-bank debt. Figure 2 explores in more detail the relation between bank debt and floating rate debt. On the horizontal axis, firm-year observations are grouped into percentile bins of bank debt as a percentage of total debt. On the vertical axis, we report floating rate debt as a percentage of total debt. The figure shows a striking correlation between bank debt and floating rate debt. For those firms for which the entire stock of debt consists of bank debt, about 76 percent of it is floating rate. For those firms whose debt is entirely from non-bank sources, however, only around 9 percent of debt is floating rate. These figures are consistent with Faulkender (2005), according to which 89.9 percent of bank loans are issued with a floating rate, compared to only 7% of floating rate bonds. Aslan and Kumar (2012) report that *all* of the syndicated bank loans in their comprehensive sample drawn from the Loan Pricing Corporation's (LPC) Dealscan database from 1996 through 2007 have floating interest rates.

Given that the CIQ bank debt variable is measured with precision and that the evidence above suggests that a vast majority of bank debt features floating interest rates, while most non-bank debt is issued with fixed rates, we focus in our analysis on bank debt as a proxy for the amount of floating rate debt in firms' balance sheet. For robustness, we also make sure that our results are similar when we use CIQ's floating rate debt measure.

## 3.2 Interest Rate Hedging Data

We collect data on interest rate hedging activities of U.S. firms using a text-search algorithm that scans 10-K corporate filings with the SEC. Disclosure of derivative hedging is mandatory under the 1998 Financial Reporting Release (FRR) No. 48 of the SEC and the 2001 SFAS No. 133. We do a detailed search of multiple phrases consistent with the use of interest rate derivatives (such as "hedge against interest rate," "hedge interest rate," "interest rate swap"), and then, for those filings for which we have a preliminary reading consistent with interest rate hedging, we check for false positives by controlling for negations, such as "not use any interest-rate swaps," "not use interest-rate swaps," "not currently use any interest-rate swaps," "not hedge interest rate," "not use derivative financial instruments as a hedge against interest rate," "termination of interest rate swap," "fixed to floating interest rate swap," or "do not currently use interest rate swap." Appendix D provides examples of the types of discussions on hedging activities that we find in the 10-K files.

Table IV reports the summary statistics for our hedging dummy. Overall, about 35 percent of firm-years in our sample feature the usage of floating to fixed rate hedging. For bank debt users (columns 3 and 4) this number is closer to 50 percent whereas for leveraged firms without bank debt (column 2) this number is only 26 percent. In other words, firms that use bank debt are about twice as likely to hedge than those that only use other types of debt. The binary nature of our hedging variable has two implications for our analysis. First, the difference between bank debt users and other firms is likely an understatement of the relative effect of hedging. Faulkender's (2005) finding that floating-to-fixed rate hedging affects only 0.5% of the bonds suggests that the net effect of hedging for firms without bank debt is negligible. This is a reason that makes bank debt a more suitable variable for the study of the floating rate channel compared to CIQ's floating rate debt measure (in addition to the measurement error mentioned before): in our regressions with floating rate debt (instead of bank debt), two hedgers with the same amount of floating rate debt will be treated the same even if one of them has mostly bank debt and the other has mostly non-bank debt although the effect of hedging on the latter group is negligible. This leads to a noisier estimation of the floating rate channel when using floating rate debt. Second, since not necessarily all bank debt will be hedged at once, our hedging dummy overvalues the protective effect of hedging and hence the associated coefficient of interest (Hedging*(Bank Debt /At)) is likely underestimated. Therefore, our results should be considered a lower bound for the effect of hedging and the floating rate channel. We also report statistics about (Hedging*(Bank Debt /At)) and (Hedging*(Floating Rate Debt /At)) in Table IV as the coefficient of this variable is of primary interest to us in the following sections.

It is instructive to compare three groups of firms– leveraged without bank debt (column 2 of Table IV), bank debt hedgers (column 3), and bank debt non-hedgers (column 4). Bank debt hedgers are significantly more leveraged, more profitable, older, less risky, as measured by cash flow volatility and CAPM beta, and less financially constrained than the other two groups, although their size, on average, is not significantly different. Their decision to hedge might be precisely because they have large amounts of bank debt, and they might hold less cash because interest rate hedging reduces the precautionary demand for liquidity. They also have significantly lower growth opportunities (lower inventory, sales and PPE, and low market-to-book), but are already very profitable with their assets already in place.

The leveraged firms without bank debt have on average higher market-to-book asset ratios relative to bank debt users, and also significantly more cash holdings.

Finally, it is possible that firms' hedging choice is associated with bank characteristics. For example, certain banks are more likely to force their borrowers to hedge their interest rate risk. In order to deal with this concern, we calculate the exposure of a large subset of our firms to their different lenders using LPC Dealscan, which reports the lending allocations for banks in a syndicate. We construct several firm-year variables that capture the weighted average of a series of characteristics of the banks a firm is borrowing from. We obtain the bank balance sheet data from the quarterly FFIEC Call Reports, which all regulated U.S. commercial banks are required to file. The results are reported in Table IV. We find that the banks lending to firms that hedge are very similar to those lending to firms that do not hedge, when studying bank characteristics such as size, capital ratio, deposit ratio, or liquidity ratio.

## 3.3 Monetary Policy Data

Because the equity market will already have responded to anticipated policy actions, we follow the approach of Kuttner (2001) and Bernanke and Kuttner (2005) to dissect the monetary policy actions into the unexpected (*surprise*) component and the anticipated (*expected*) component on an FOMC meeting or an announced change in the federal funds target rate. The identification of the surprise element in the target rate change relies on the price of the current month 30-day federal funds futures contracts, a price that encompasses market expectations of the effective federal funds rate. We follow this method because federal funds futures outperform target rate forecasts based on other financial market instruments or based on alternative methods, such as sophisticated time series specifications and monetary policy rules.[36] Another advantage of looking at one-day changes in near-dated federal funds futures is that federal funds futures do not exhibit predictable time-varying risk premia (and forecast errors) over daily frequencies.[37] We obtain the data for the decomposition of the federal funds target rate changes from Kenneth Kuttner's webpage, which provides data covering up to June 2008 because "since late 2008 the funds rate has been very close to zero, and the FOMC no longer reports a point target for the rate."[38] Appendix E summarizes the process which generates this decomposition.

[36] See Evans (1998) and Gürkaynak, Sack and Swanson (2005) for details.
[37] See, for example, Piazzesi and Swanson (2008).
[38] http://econ.williams.edu/faculty-pages/research/

# 4 The Floating Rate Channel: Evidence from Stock Prices

Our evidence in support of the floating rate channel is based on stock prices and balance sheet data. Both types of data have advantages and disadvantages, and studying both provides a more robust test of our proposed channel. Stock prices, to the extent that they efficiently reflect firms' underlying fundamentals, can provide a more precise identification of a specific transmission mechanism because they react rapidly to policy changes and can be measured immediately after the policy shock occurs, compared to balance sheet variables, such as fixed investment or inventory investment, which might react slowly due to adjustment costs and are measured a long time after the shock has occurred. Their slow reaction might prevent the identification of the full policy impact if the effects occur with a significant lag. And because they are not available immediately, other shocks and mechanisms might come into play, making identification difficult. Additionally, stock prices provide a welfare-relevant measure of the effects, by capturing their present value. Moreover, understanding how and why stock prices react to monetary policy has been an important question since, at least, Tobin (1969) and Modigliani (1971) due to its important implications for consumption and investment. For these reasons, we follow Gorodnichenko and Weber (2014), English, Van den Heuvel, and Zakrajsek (2014) and Chodorow-Reich (2014), who also study stock prices to shed light on the transmission of monetary policy. Balance sheet variables, on the other hand, allow us to test more specific implications of our proposed transmission channel, enabling us to more convincingly distinguish our mechanism from alternative ones.

We start by focusing on stock prices, and proceed in three steps. We first show that bank debt usage makes firms significantly more responsive to monetary policy, and then show that this additional responsiveness is concentrated in the firms that do not hedge their interest risk, and especially so in the financially constrained ones.

## 4.1 The Effect of Bank Debt Usage

As our first step, we analyze whether a firm $i$'s stock price change $Ret_{i,t}$ over the day $t$ in which a monetary policy shock $Surprise_t$ occurs and the day after depends on the importance of bank debt as a source of financing, $(BankDebt/At)_{i,t-1}$.[39] For this purpose, we use the following regression,

[39] We measure returns over a 2-day window for two reasons. First, as Figure 3 shows, it takes more than a day for the full effect of bank debt usage to be incorporated in stock prices. Moreover, the FOMC blackout period, during which Federal Reserve employees are not allowed to comment on current monetary policy, ends on the day following the FOMC announcement, potentially making the inference based on a wider than two-day event window not as reliable.

$$
\begin{aligned}
Ret_{i,t} &= \beta_0 + \beta_1 Surprise_t + \beta_2 \left(BankDebt/At\right)_{i,t-1} \\
&\quad + \beta_3 Surprise_t * \left(BankDebt/At\right)_{i,t-1} \\
&\quad + \gamma Controls_{i,t-1} + \lambda Surprise_t * Controls_{i,t-1} + \varepsilon_{i,t}, \qquad (22)
\end{aligned}
$$

where $Controls_{i,t-1}$ is a vector of firm characteristics. In this regression, $Ret_{i,t}$ and $Surprise_t$ refer to stock returns and monetary policy surprise on the day of the FOMC announcement at date $t$. Since $(BankDebt/At)_{i,t-1}$ is available yearly and since we want $(BankDebt/At)_{i,t-1}$ and $Controls_{i,t-1}$ to be available to investors simultaneously, we use the last fiscal year-end data available before the date of the monetary policy event in order to capture the information available to investors at the time of the monetary policy announcement, in line with most of the cross-sectional asset pricing literature dating back at least to Fama and French (1992). With a slight abuse of notation, in the case of firm characteristics, $t-1$ refers to the most recent fiscal year-end prior to the federal funds rate target announcement date, meaning that we use December accounting variables for all the FOMC meeting dates and the corresponding stock returns in the following year. In the case of $Surprise_t$ and $Ret_{i,t}$, $t$ refers to the monetary policy announcement date, of which there are eight scheduled ones in any given year.[40]

Our firm-level controls include book leverage, firm size, the market-to-book ratio, profitability, and interest rate sensitivity, all of which are described in Table A1 in detail.[41] We control for book leverage because bank debt users are more likely to be highly leveraged, and as such might be more sensitive to monetary policy. We control for firm size and market-to-book ratios because these variables are well-known risk factors for asset prices since the seminal paper of Fama and French (1992), and they can also affect the reaction of stock prices to policy surprises because they are related to financial constraints and investment opportunities.[42] Profitability is included because, as shown in Fama and French (1995), the market-to-book ratio is associated with persistent differences in profitability and firms with bank debt tend to be more profitable, as shown in Table IV. In addition, Ehrmann and Fratzscher (2004) report strong evidence that firms with low profitability are more responsive to monetary policy when profitability is measured as cash flow divided by income. Finally, we control for the interest rate sensitivity of operating profits because it might influ-

[40] There are also a couple of unscheduled meetings during this time period. Following Bernanke and Kuttner (2005), we use influence statistics to eliminate meetings that constitute outliers, as described in Appendix C.

[41] We do not control for market leverage because, as shown in Ozdagli (2012), the value of market leverage can be pinned down using book leverage and the market-to-book ratio, leading to collinearity.

[42] We also add CAPM betas, calculated as in Fama and French (1992), as an additional control in some specifications. See Appendix F for details.

ence the propensity to borrow from banks. This would generate a correlation between bank debt usage and the reaction of stock prices to monetary policy even if there were no causal relationship between these variables.[43]

The results of this regression under various alternative specifications are presented in Table A4 and discussed in detail in Appendix F. The main takeaway is that bank debt usage increases the responsiveness of firms' stock prices to monetary policy significantly. Focusing on column 1, we observe that a one standard deviation (0.114) increase in our bank debt usage measure causes the stock price to increase 1.6 ($= -14 * 0.114$) percentage points more in response to a 1 percentage point surprise decrease in the federal funds rate. To put this effect in perspective, the same surprise decrease in the federal funds rate causes the stock price of the firm with the average amount of bank debt over assets (7.22%) to increase about 4.97 percent on average. This result is very robust, and survives various specifications that control for potential omitted variables. In particular, we eliminate the possibility that the additional responsiveness occurs because firms that use bank debt are potentially more highly leveraged, more severely financially constrained, or more reliant on short-term debt, by controlling for the relevant firm characteristics. We also use firm and industry characteristics that predict access to public debt markets as instruments and show that our results remain similar. We also replace bank debt usage, $(BankDebt/At)$, with $(BankDebt/Debt)$ , to deal with the possibility that using book leverage as a separate control variable is not enough to argue that the effect of bank debt goes beyond the effect of other types of debt. Overall, we conclude that bank debt usage is important for the responsiveness of a firm to monetary policy and this importance cannot be attributed to other firm characteristics.

## 4.2 The Floating Rate Channel of Bank Debt

The results obtained in Section 4.1 suggest that bank debt is special for the transmission of monetary policy to stock prices. In this section, we present evidence that suggests that a significant part of the effect is driven by the floating rate nature of bank debt, a transmission mechanism that we introduced in our theoretical motivation in Section 2 and call the *floating rate channel*.

The floating rate nature of most bank debt suggests that monetary policy actions should be reflected mechanically in the interest expense associated with existing bank loans because

[43] Our particular concern is that firms that use bank debt are special in that they are on average riskier and more interest rate sensitive, which would suggest that we may overestimate the direct impact of bank debt. While controlling for the interest rate sensitivity of operating profits of firms, as we do later, should address these concerns, we look deeper into the relationship between a firm's riskiness and its bank financing behavior in Table A2. Contrary to our concerns, columns 1 and 2 show that bank debt usage is weakly negatively associated with cash flow volatility (a statistically insignificant relationship) and that there is no statistically significant relationship with the interest rate sensitivity of operating profits.

these actions induce changes in the reference rates used in the floating rate agreements.[44] Following this logic, our empirical strategy provides evidence for the floating rate channel by exploiting the variation across firms in their floating-to-fixed interest rate hedging of their bank debt or floating rate debt. If the floating rate channel is quantitatively relevant, we should observe that the effect of bank debt usage on the sensitivity of stock prices to monetary policy should diminish significantly for firms that engage in floating-to-fixed interest rate hedging.

We restrict our sample to those firms that have variable rate debt outstanding in excess of 1% of total assets, to isolate those firms that might have an incentive to engage in interest rate risk hedging as insurance against fluctuations in the interest payments of the existing debt, rather than as a speculative investment opportunity. We divide this sample into those firms that hedge interest rate risk and those that do not, and we test the prediction that firms that use bank debt or floating rate debt and that hedge against interest rate risk should be, all else equal, less responsive to monetary policy shocks than those that do not hedge, by running specification (22) separately on each subsample.

The results of our main tests, provided in panel A of Table V, are consistent with our predictions.[45] In columns 1 and 2, we test whether hedging affects the impact of bank debt usage on the sensitivity to monetary policy. We find that while for the subsample of hedgers bank debt usage does not affect the sensitivity of stock prices to monetary policy, those that do not hedge are significantly more responsive to surprise changes in the federal funds rate. In particular, column 1 shows that the effect of bank debt usage becomes about twice as significant for the subsample of non-hedgers in comparison to our results for the full sample in Section 4.1, whereas the effect for the subsample of hedgers in column 2 becomes both economically and statistically insignificant.[46] Columns 3 and 4 show that this result is robust to the inclusion of a full set of firm level controls, both interacted with surprise and uninteracted, the introduction of firm fixed effects, and clustering errors at the date-industry level. Finally, we interact all regressors in regression (22) with the hedging dummy in order

[44] The period starting in the fall of 2008 in which the Federal Funds Target Rate reached the zero lower bound was one in which the floating rate channel of monetary policy was unlikely to be operative. Figure 2 clearly shows that both the LIBOR rate and the prime rate have been very stable during this period. We pursue this question in Section 6.3 and show that the floating rate channel was mute during this time period.

[45] In these regressions, we are using the control variables in our main specification from column 3 of Table A4, which are the ones commonly used in the asset pricing literature, and include interest rate sensitivity for completeness.

[46] This does not necessarily mean that for non-hedgers bank debt does not play any role for the transmission of monetary policy. It could be the case that multiple transmission channels exist that operate in opposite directions and cancel each other out on average for this particular group of firms. An example of a transmission mechanism that would make bank debt using firms less responsive to monetary policy is one in which bank-firm relationships enable firms to benefit from some degree of insurance against changes in credit availability (Puri, Rocholl and Steffen (2013)).

to assess statistical significance of the difference between hedgers and non-hedgers using the following regression

$$\begin{aligned} Ret_t = \beta_0 + \beta_1 Surprise_t + \beta_2 Surprise_t * (BankDebt/At)_{t-1} \\ + \beta_3 Surprise_t * (BankDebt/At)_{t-1} * Hedge_t \\ + \lambda Surprise_t * Controls_{t-1} * Hedge_t \\ + \text{Uninteracted terms and second order interactions} + \varepsilon_t, \end{aligned} \tag{23}$$

in which we drop the reference to the firm-level subindex $i$ for ease of exposition. We find that the difference between hedgers ($Hedge_t = 1$) and non-hedgers ($Hedge_t = 0$), captured by $\beta_3$, is statistically significant.

Since we argue that the floating rate channel works via floating rate nature of bank debt, we test the robustness of our results by directly looking at floating rate debt. Accordingly, we repeat our exercise by replacing bank debt with floating rate debt in columns 5-8, and obtain similar qualitative results: usage of floating rate debt increases the responsiveness of stock prices to monetary policy only for those firms that do not hedge interest rate risk. We also note that the results are slightly weaker than the ones obtained with bank debt usage. As discussed in Section 3.2, this relative weakness is expected because non-bank floating rate debt is less likely to be hedged (Faulkender (2005)) and our hedging variable is a dummy variable that captures whether the firm hedges any of its floating rate debt rather than the total amount of floating rate debt that has been hedged. In our regressions, two hedgers with the same amount of floating rate debt will be treated the same even if one of them has mostly bank debt and the other has mostly non-bank debt. In addition, there is a moderate degree of mismeasurement in our floating rate variable. Both factors lead to a potential underestimation of the floating rate channel when using floating rate debt.

[TABLE V ABOUT HERE]

Finally, panel B of Table V presents the coefficients of $Surprise_t * Controls_{t-1}$ for different groups. None of these coefficients differ between hedgers and non-hedgers as much as the coefficients of $Surprise_t * (BankDebt/At)_{t-1}$ or $Surprise_t * (FloatingRateDebt/At)_{t-1}$ do. This is also confirmed by the large p-value of the test that the differences of coefficients for these variables between hedgers and non-hedgers - i.e., $\lambda$ in equation (23) - are jointly zero. This result confirms that the floating rate nature of bank debt is the important channel to focus on.

As an additional robustness check, we note that our sample period included a large number of rate increases, in 20 out of 43 meetings. This may create the concern that our results are specific to rate increases, which would put the external validity of our results into question. Therefore, we repeat the exercise in Table V after discarding those FOMC statements with positive rate changes from the sample. Our results, presented in Table A5, remain very similar quantitatively, alleviating concerns regarding external validity.

As a placebo experiment, we use the same specification but replace the dependent variable with the last two-day returns before the FOMC. Because of the blackout period leading to an FOMC announcement and the resulting few number, if any, of FOMC related news prior to an announcement, this would be a suitable pseudo-control sample where we expect no significant difference in policy sensitivity caused by bank debt usage. This expectation is confirmed in Table A6, according to which the coefficient of $Surprise_t * (BankDebt/At)_{t-1}$ is indistinguishable between hedgers and nonhedgers and, if anything, it goes in the opposite direction for $Surprise_t * (FloatingRateDebt/At)_{t-1}$.

## 4.3 Instrumental Variables Regression

In this section, we address the concern that the previous regression estimates might be biased due to the potential endogeneity of firms' hedging decisions. Endogeneity concerns have to do mostly with omitted variables bias, rather than reverse causality, as it is unlikely that stock returns today can affect past hedging decisions. In principle, omitted variables bias in our context could be either positive or negative. First, firms whose operating earnings are more interest rate sensitive (because the demand for their goods or services is more interest rate sensitive, for example) might be more reluctant to expose themselves to interest rate risk through floating rate liabilities, and decide to hedge more. Through this effect, the coefficient of $Surprise_t * (BankDebt/At)_{t-1}$ should be more negative for hedgers, leading to an underestimation of the differences between hedgers and non-hedgers. Second, it might be that, because hedging is costly, firms facing greater financial constraints are less likely to hedge, as suggested by Rampini, Sufi, and Viswanathan (2014). If financial constraints directly increase the policy sensitivity of stock prices and financially constrained firms are less likely to hedge, we could be overestimating the difference between hedgers and non-hedgers. To reduce endogeneity bias concerns we introduce in this section an instrumental variables approach.[47]

Campello, Lin, Ma, and Zou (2011) show that the kinks and discontinuities stemming from institutional features of the U.S. tax system can address the endogeneity in interest rate hedging decisions, and use this idea to study the consequences of interest rate hedging for

[47] We deal with these concerns also by including proxies for the main potential omitted variables, such as financial constraints and interest rate sensitivity of operating profits. For example, Table V includes interest rate sensitivity as a control. In addition, Appendix G discusses the relationship between hedging and financial constraints in more detail and shows that our results are also obtained in a regression in which hedging and financial constraints are included together.

loan spreads. The kinks or discontinuities of the tax schedule, especially at the zero income level due to loss offset provisions, create a convexity of tax rates as a function of taxable income. As as result, firms can reduce their expected tax liabilities by minimizing income volatility.[48] Because interest rate exposure increases income volatility, the convexity of tax rates provides firms with incentives to hedge against interest rate fluctuations (*relevance condition*). At the same time, tax convexity is unlikely to have a direct first-order effect on the sensitivity of stock prices to monetary policy shocks (*exclusion restriction*). The same instrument has been used in other papers, such as Chen and King (2014), to study the effect of hedging on the cost of public debt. We elaborate below on the reasons why our instrument is likely to satisfy the exclusion restriction.

Our hedging variable is instrumented by (tax) *Convexity*, derived from the following formula as in Graham and Smith (1999), and Campello, Lin, Ma, and Zou (2011),

$$\begin{aligned} Convexity \;=\; & 4.88 + 0.019 \times Vol - 5.50 \times Corr \\ & -1.28 \times DITC + 3.29 \times \; DNOL + 7.15 \times \; DSmallNeg \\ & +1.60 \times \; DSmallPos - 4.77 \times \; DNOL \times \; DSmallNeg \\ & -1.93 \times \; DNOL \times \; DSmallPos \end{aligned} \tag{24}$$

where $Vol$ is the volatility of taxable income, $Corr$ is the first-order serial correlation of taxable income, $DITC$ is a dummy for the existence of investment tax credits, $DNOL$ is a dummy for net operating losses, and $DSmallNeg$ ($DSmallPos$) is a dummy for small negative (positive) taxable income less than $500,000. We calculate the volatility of taxable income and the serial correlation of taxable income on a rolling basis, using historical annual data up to the year of interest, starting in 1989. The $Convexity$ measure comes from the regression in Graham and Smith (1999) where the dependent variable is the expected percentage tax savings from a five percent reduction in the volatility of taxable income and thereby provides a measure for the incentive of a firm to reduce income volatility, for example, through hedging.

Campello et. al. (2011) argue that this tax convexity measure satisfies the relevance and exclusion restrictions for the effect of interest rate hedging on loan spreads. We believe that their arguments also suggest that the tax convexity is an adequate instrument in our setting. As described in Campello et. al. (2011), the tax convexity formula uses data around a zero-income tax kink and instrument identification in that region comes from the nonlinear

[48] See discussions in Smith and Stulz (1985), Graham and Smith (1999), and Petersen and Thiagarajan (2000).

form of the income taxation function, rather than the income level itself. For example, a small negative or small positive taxable income indicates the proximity of the firm to the zero income tax kink, which would make it more beneficial for the firm to reduce the income volatility to minimize taxes, whereas the proximity to this kink is unlikely to have a direct effect on stock price sensitivity to the monetary policy beyond its effect on hedging incentives. Similarly, the existence of net operating loss, $DNOL$, increases the incentives to hedge (DeAngelo and Masulis, 1990) but these effects are smaller for those firms with small positive and small negative taxable income, $DNOL \times \; DSmallNeg$ and $DNOL \times \; DSmallPos$, because a hedging firm tightens its distribution of profits, reducing the expected benefit provided by its carryforwards. Moreover, a more negative serial autocorrelation would make the firm more likely to switch between profits and losses, giving higher incentive to hedge. It is unlikely that these variables have a direct effect on stock price sensitivity to monetary policy. Finally, our addition of profitability as an additional control should address any remaining concerns that tax convexity might be correlated with policy sensitivity of stock prices through profitability.[49]

Nevertheless, as in Campello et. al. (2011), we repeat the instrumental variable approach excluding cash flow volatility to be on the conservative side, and we show that our results are not affected. We also use a variant of this approach with the lagged hedging dummy as an instrument, which would be a suitable instrument to the extent that it is not forward looking.[50] We follow a simple linear instrumental variable regression as advocated by Angrist and Pischke (2009, Ch. 4) and use $Z$, $Surprise * Z$, and $Surprise * (BankDebt/At) * Z$ as instruments where $Z$ is the lagged hedging dummy, the convexity variable, and the components of the latter.

[TABLE VI ABOUT HERE]

Panel A of Table VI presents our results for bank debt usage. In column 1, we present the standard fixed effects regression where we interact our bank debt usage with hedging for the subsample of observations that have values for lagged hedging dummy and column 3 does the same thing with $Convexity$. Both of these results are comparable to Table V quantitatively, and also imply that hedgers' reaction to monetary policy barely increases with greater bank debt usage. Column 2 shows that the results remain very similar when we use lagged hedging dummy and its interaction with $Surprise$ and $Surprise * (BankDebt/At)$ as an instrument

[49] Theoretically, profitability could bias our results in either direction. As Graham and Rogers (2002) put it: "Profitability might be inversely related to hedging if less profitable firms have a higher probability of encountering distress. Conversely, the option value of equity might encourage unprofitable firms to hedge less than their nondistressed counterparts."

[50] We thank an anonymous referee for this suggestion.

for hedging, the difference across columns is very small both in terms of magnitude and statistical significance, as indicated by large Hausman p-value from Hausman test (0.934).[51]

Column 4 of Panel A repeats the same exercise using the variables underlying the convexity measure, except $Vol$, and column 5 also includes $Vol$ as the instrumental variable. Column 6, on the other hand, uses the actual $Convexity$ measure from formula (24). The results in columns 4, 5, and 6 are very similar to each other although we lose statistical significance in column 6, not surprisingly because our sample is different from Graham and Smith (1999) where formula (24) comes from. While the instrumental variable results seem quantitatively different from standard fixed effect regressions, the Hausman test cannot reject the hypothesis that they are the same, suggesting that the endogeneity of hedging is not a big concern. The final column repeats the instrumental variable regression using both lagged hedging dummy and $Convexity$, with results very similar from the standard regressions. Moreover, the qualitative result from all these regressions is the same because the sum of the coefficients of $Surprise_t * (BankDebt/At)_{t-1}$ and $Surprise_t * (BankDebt/At)_{t-1} * Hedge_t$ add up to a number statistically insignificantly different from zero, implying that bank debt usage does not significantly affect the sensitivity of stock prices to monetary policy shocks for hedgers.

Panel B of Table VI repeats the same exercise for floating rate debt usage and the results are very similar to those from Panel A. Therefore, we conclude that our results are, at least qualitatively, robust to the potential endogeneity of the interest rate risk hedging decision.

### 4.4 The Floating Rate Channel for Constrained vs. Unconstrained Firms

In the absence of financial frictions, our evidence on the floating rate channel would be interpreted as a simple transfer of cash between a firm's shareholders and its creditors because monetary policy affects the benchmark rates underlying floating rate liabilities. In this case, the effect of bank debt usage on stock prices would simply represent the expected present value of this transfer over the lifetime of the loan. In the presence of financing frictions, however, the impact could be amplified through the effect of variations in the interest expense on the firm's liquidity position and overall balance sheet strength, which in turn could affect the firm's ability to finance profitable investment opportunities.[52]

[51] For the first stage regression results, we refer the reader to Table A7. The coefficients of instruments go in the expected direction, i.e. past hedging predicts future hedging, and higher convexity and values of variables that predict higher convexity are associated with higher hedging activity. The autocorrelation of cash flows turns out to be more significant in the case of floating rate debt. A high $R^2$ and $F$-statistic also lend support to the relevance condition.

[52] Other frictions might also result in real implications of the interaction of monetary policy actions and floating rate debt. For example, an existing debt overhang problem (Myers 1977) might be worsened by an increase in the claims of banks following a monetary policy tightening. Or an asset substitution problem

To explore this, we analyze the stock price reaction of hedgers vs. non-hedgers within groups of firms with different degrees of financial constraints. We explore whether hedging affects the policy sensitivity of stock prices of financially constrained bank debt users more than it does those of less financially constrained bank debt users, which would be consistent with the amplification of the floating rate channel through the effect of financing constraints. Therefore, we run our original regression (22) separately for hedgers and non-hedgers that face different degrees of constraints, measured by age and the Hadlock and Pierce (2010) (HP) index.

[TABLE VII ABOUT HERE]

The first two rows of Table VII give the coefficients of interest from these regressions. We predict that our floating channel is mute among the hedgers regardless of the degree of financial constraints which is confirmed by the coefficient of $Surprise * (BankDebt/At)$ in columns 3, 4, 7, and 8 in Table VII as these coefficients are statistically and economically insignificant. Moreover, our amplification mechanism through financial frictions predicts that financially constrained non-hedgers should react the strongest. This is confirmed by columns 1, 2, 5, and 6 in Table VII as the coefficient of $Surprise*(BankDebt/At)$ is larger in magnitude among the more constrained (young and high-HP) non-hedgers in comparison to less constrained non-hedgers. In other words, financing constraints only matter significantly for the effect of bank debt usage on the responsiveness to monetary policy when firms are exposed to interest rate risk because they do not hedge.

For completeness, Table A8 repeats this exercise with the Whited-Wu constraint index and presents very similar results. The results do not go through with the Kaplan-Zingales index, which is consistent with the fact that the poor performance of the KZ index is the reason that Hadlock and Pierce developed their HP index.[53] Table A9 also compares firms with different liquidity positions, using the current ratio and the coverage ratio, and shows that nonhedgers with poor liquidity are the ones with highest policy rate sensitivity, con-

(Jensen and Meckling (1976)) might arise as the same increase in interest rates might increase the convexity of shareholders' claims and enhance a distortion towards risky investment. In addition, we refer in this paper to the real economic outcomes directly caused by firms' decisions, but we should note that even in the absence of changes in firms' decisions the cash-flow reallocation caused by the floating rate channel can have macroeconomic effects to the extent that debtholders and equityholders have different consumption-savings behavior because of differences in demographic characteristics or risk aversion. These additional effects are outside the scope of our paper.

[53] We prefer the HP measure among other candidates, such as Kaplan and Zingales (KZ, 1997) and Whited and Wu (WW, 2006), because Hadlock and Pierce (2010) show that the KZ and WW indices have very little power to predict financial constraints and any power they have comes from firm size and age, the two variables they use to create their composite HP index.

sistent with our other results.[54] Since the coverage ratio is directly related with a firm's interest expense, we study this variable in more detail in Section 5.1.

This evidence suggests that the effect of our new floating rate channel goes beyond a simple reallocation of cash flows between lenders and shareholders following monetary policy events, possibly reflecting a financial amplification mechanism that works through a firm's interest expense on existing floating rate debt and its liquidity position. If so, our floating rate channel might bear implications for the financing and production choices of the firms as well. We explore this next in Section 5.2.

# 5 The Floating Rate Channel: Evidence from Balance Sheet Variables

## 5.1 Impact on Firms' Liquidity Position

In this section, we explore the mechanism through which our floating rate mechanism affects firms' balance sheet strength. We conjecture that monetary policy can have a strong impact on the liquidity positions of firms exposed to interest rate risk because their cash flows will be affected by changes in their interest expense. We focus on the behavior of the interest rate coverage ratio and cash holdings of firms following monetary policy events. We present here a summary of our results, and refer the reader to Appendix H for a detailed description of the tests.

The interest rate coverage ratio, defined as the ratio of a firm's interest expense to the sum of interest expense plus cash flow, is a proxy for firm financial distress often used in the empirical literature on firm financial constraints (Whited (1992), Gertler and Gilchrist (1994), and Campello and Chen (2010), for example).[55] A high coverage ratio indicates that the firm may face difficulties trying to meet interest rate payments with current cash flows and may need to access external finance, make use of retained earnings, or decrease investment and hiring to avoid default. The main channel through which our floating rate mechanism operates is by affecting this coverage ratio.

We test whether a higher bank debt usage as a share of total assets increases the respon-

[54] We also consider cash-to-assets ratio as an additional measure of liqudity. For the study of financial constraints, however, this measure is likely to suffer from endogeneity because financially constrained firms tend to hoard cash (Opler et. al., 1999; Bates, Kahle, Stulz, 2009). Consistent with this we see that bank debt usage has the strongest effect for nonhedgers with high cash holdings. Note that this does not invalidate the results in the next section which uses the 'change' in cash which is a suitable measure to capture the change in liqudity position of a given firm.

[55] Part of the literature (see eg. Fazzari, Hubbard and Petersen (2000) or Gertler and Gilchrist (1994)) measures the interest coverage ratio as cash flow over interest expense, instead of as interest expense over cash flow as we (and others, such as Whited (1992)) do. We find that our choice is more natural in our context, as it allows us to discuss increases in interest expense in terms of increases in our coverage ratio.

siveness of firms' interest rate coverage ratios following monetary policy actions, due to the higher likelihood of this debt being floating rate.[56] Our mechanism predicts that bank debt usage increases the sensitivity of the coverage ratio for non-hedgers, but does not affect the sensitivity of hedged bank debt users.

[TABLE VIII ABOUT HERE]

The results are displayed in Table VIII. Consistent with our prediction, the estimate of the coefficient on $(Sum)\,Change_t * BankDebt/At_{t-1}$ for the hedged sample is statistically insignificant at all horizons, while for the unhedged sample it is always positive after the second quarter following the monetary policy shock, and statistically significant at horizons of 3 and 5 quarters. The difference between the estimates across subsamples is large and statistically significant at horizons of 5 and 6 quarters. In terms of economic magnitude, a 100bp tightening of monetary policy is associated with an increase in the coverage ratio of 0.09 (0.12) for an unhedged firm fully financed with bank debt, relative to a hedged firm fully financed with bank debt, at a horizon of 5 (6) quarters. This effect on coverage ratio is important not only because sufficiently large increases in the coverage ratio following a monetary policy tightening might force firms to access additional financing to meet interest rate payments and fund their investment and hiring plans but it might also increase the likelihood of a covenant violation, which has important implications for firms' capital expenditures, as shown in Nini, Sufi, and Smith (2012).

In the presence of financing constraints, firms might need to tap into retained earnings instead. To test this prediction, we compute the change in cash holdings, and evaluate whether the impact of bank debt usage on the sensitivity of cash holdings to monetary policy is significantly stronger for financially constrained firms than for unconstrained firms in the sample of unhedged firms, and whether this difference is absent or is at least significantly smaller in the sample of hedged firms. We classify firms as financially constrained (unconstrained) if their value of the Hadlock and Pierce (2010) (HP) index is above (below) the median, and report the difference between the estimates across constrained and unconstrained firms, within each of the subsamples of hedgers and non-hedgers, and also report the statistical significance of the difference.

[TABLE IX ABOUT HERE]

[56] Monetary policy actions are calculated as cumulative quarterly change in the interest rate, as in Ashcraft and Campello (2007) and Jiménez, Ongena, Peydró, and Saurina (2012, 2014), instead of the cumulative surprise component because cash flow and the interest rate expense on existing debt is not forward-looking the way stock prices are.

Our results are displayed in Table IX, in which coefficient estimates for $\beta_3$ for the four subsamples of firms (hedgers/non-hedgers, constrained/unconstrained) and the estimates for the difference between groups, the coefficient on $\widehat{Change}_t\,(BankDebt/At)_{t-1}\,Constrained_t$, are shown for horizons of four and six quarters.[57] Being financially constrained only matters, in a statistically significant way, for the response of cash holdings of bank debt users to monetary policy when firms do not hedge their interest rate risk. More specifically, after four quarters following a 1 percentage point increase in the federal funds rate, a constrained firm fully financed with bank debt experiences on average a 4.2 percent stronger drop in its cash holdings relative total assets than an unconstrained firm if both firms are unhedged. This difference increases to 9.5 percent at a horizon of 6 quarters. Constraints, however, do not affect the responsiveness of cash holdings to monetary policy of bank debt users if they are hedged, at any horizon.

Taken together, the evidence in this section highlights the nature of our floating rate mechanism as a source of economically significant liquidity shocks for firms.

## 5.2 Real Implications

In this section, we test whether the stronger effect of the floating rate channel for financially constrained firms identified using stock prices, the interest rate coverage ratio, and cash holdings, is associated with significant real outcomes in the affected firms. We focus on the implications for firms' inventory investment, fixed investment, and sales.

The nature of our floating rate mechanism as a liquidity event means it is particularly likely to manifest itself in the behavior of inventory investment, one of the most liquid components of firms' balance sheets. We follow Kashyap, Lamont and Stein (1994) and adopt their empirical specification for our inventory investment regressions, which we report in Table X.

[TABLE X ABOUT HERE]

There is a statistically strong negative relationship between bank debt usage and the sensitivity of inventory investment to monetary policy changes for firms in the unhedged-constrained category. The economic magnitude of the relationship is large for this subgroup: after 6 quarters following a 1 percentage point increase in the Federal funds rate, increasing bank debt usage from 0% to 100% of total assets is associated with a decrease in inventories of on average 21.2%. Bank debt usage instead does not affect the sensitivity of inventory investment to monetary policy in a statistically significant way if firms are financially un-

[57] The difference between groups is obtained by interacting all variables, including fixed effects, with the financial constraint dummy.

constrained or if they are not exposed to interest rate risk in their bank debt because they hedge.

Previous empirical studies have shown that the inventory investment of financially constrained firms is more sensitive to monetary policy than that of large and rated firms (Gertler and Gilchrist (1994), Kashyap, Lamont and Stein (1994)). Our evidence shows that financial constraints only increase firms' sensitivity to monetary policy if these firms are exposed to interest rate risk through their bank debt, suggesting that our floating rate mechanism is a potentially important driver of this result. This result might be particularly relevant from a macroeconomic perspective given that inventories constitute the most volatile component of GDP (Blinder and Maccini (1991), Davis and Kahn (2008)).

We next study the behavior of sales, which we interpret, in line with existing literature, as a proxy for firm-level output (Gertler and Gilchrist (1994), Bond, Elston, Mairesse, and Mulkay (2003)). The results are displayed in Table XI, and are in line with our previous evidence. Being financially constrained has twice the impact on the sensitivity of sales to monetary policy of unhedged bank debt users than on the sensitivity of hedged bank debt users. Increasing bank debt usage from 0% to 100% of assets is associated with an additional decrease in sales after four (six) quarters of 19.1% (17.8%) following a 100bp monetary policy tightening when the firm is financially constrained and unhedged, relative to when it is unconstrained and unhedged. For hedged firms, this same difference is only 7.9% (9.7%).

[TABLE XI ABOUT HERE]

Finally, we explore the behavior of fixed investment. A large body of empirical research documents the difficulty of finding a relationship between fixed investment and interest rates (Caballero (1999), Sharpe and Suarez (2014)), suggesting that the impact of monetary policy on fixed investment, to the extent that it is significant, might occur mostly through indirect channels such as the one discussed in this paper. To test this prediction, we expand our baseline empirical specification to include the main factors that have been identified in the empirical literature to matter for firm investment (Eberly, Rebelo and Vincent (2012)), which are Tobin's Q, cash flow, and lagged investment.

The results are displayed in Table XII. Consistent with our mechanism, financial constraints have a significant effect on the impact of bank debt usage on monetary policy sensitivity of fixed investment only for the subsample of firms that do not hedge against interest rate risk. The economic magnitude of the relationship is large for this subgroup: after 6 quarters following a 1 percentage point increase in the Federal funds rate, a hypothetical financially constrained firm that is fully financed with bank debt suffers a change in total capital which is on average 15.8 percentage points lower than the one a financially unconstrained bank debt user experiences. Financial constraints however do not significantly influence the responsiveness of fixed investment to monetary policy for the subsample of firms that are not exposed to interest rate risk. The effects after four quarters are not statistically significant, which might not be surprising given that investment in tangible capital is more likely to suffer from adjustment costs compared to inventory investment, and this might delay any possible effects.[58]

[TABLE XII ABOUT HERE]

Taken together, the evidence discussed in this section suggests that the effect of the floating rate channel goes beyond a simple reallocation of cash flows between lenders and shareholders and has real implications for the affected firms. The impact of our channel on employment, which we have not analyzed due to the absence of reliable quarterly data on number of workers in our databases, might be significant as well, depending on the costs of adjusting the workforce along both the intensive and extensive margins. Finally, our strong results on the sensitivity of cash holdings in Section 5.1 suggest other latent and subtle mechanisms that are harder to test for: firms may choose to build large cash buffers instead of investing in anticipation of future increases in the rates on their floating rate debt and these ex-ante effects on investment and employment could be large.

It is important to point out two potential caveats of the analysis in this section. First, while the identification of our proposed effects can be argued to be strong in our stock return regressions, endogeneity biases are more likely to remain in our regressions dealing with balance sheet variables because of the substantial lag between the monetary policy event date and the date in which the effects are measured (4 or 6 quarters later). Second, our estimation might also be affected by the fact that there are several FOMC announcements in the 4 or 6 quarters after our FOMC announcement of interest, which makes it harder to establish causality. As such, our results on real variables are suggestive.

[58] The coefficient $\alpha_3$ on the interacted term $\widehat{Change}_t\,(BankDebt/At)_{t-1}$ is positive for most subsamples and horizons, and in Table A10 we find that it is also often positive when using a surprise measure of monetary policy. This means that bank debt usage makes fixed investment relatively less sensitive to monetary policy on average, at horizons of between 4 and 6 quarters, for some subsamples. One possible explanation for this finding is that banks protect their borrowers from a tightening in credit conditions in the context of the lending relationships that they form with their clients. See Rajan and Zingales (1998) and Ehrmann, et al. (2001) for a discussion of the role of lending relationships in alleviating the impact of contractionary monetary policy actions on bank borrowers. In the context of the recent crisis, several papers provide evidence that one channel through which banks protect their relationship borrowers in times of credit market distress is through precommitted credit (Ivashina and Scharfstein (2010), and Campello, Giambona, Graham, and Harvey (2011)). This credit insurance role is compatible with our floating rate channel, and both channels might be operating in parallel.

# 6 How Important is the Floating Rate Channel?

## 6.1 The Aggregate Business Exposure to the Floating Rate Channel

The macroeconomic relevance of our monetary policy transmission mechanism depends on the aggregate amount of business debt that is exposed to interest rate risk. The Flow of Funds states that there were roughly \$12.5 trillion of outstanding nonfinancial business debt in the United States at the end of 2015. Of this amount, around \$5 trillion are corporate bonds, a majority of which are issued with fixed interest rates.[59] Of the remaining \$7 trillion, 2.5 trillion correspond to corporate loans, of which around 75% are estimated to be referenced to LIBOR.[60] Noncorporate business loans account for \$4.5 trillion, and Duffie and Stein (2015) estimate that 30-50% of them are tied to LIBOR. Note that this is a lower bound estimate of the amount of debt exposed to interest rate risk, because we are basing our estimates on the fraction of debt that is tied to LIBOR, which is the most common but not the only base rate for floating rate arrangements. An example of a common alternative base rate is the prime rate (displayed in Figure 3), which is also closely tied to policy rates.

The effective exposure to interest rates also depends on firms' usage of interest rate swaps, but the data suggests that hedging does not substantially alter the aggregate exposures. In our own sample, less than 50% of bank debt users use some amount of hedging. Bretscher, Schmid, and Vedolin (2016) estimate the precise amounts of debt being hedged in a hand-collected sample and find that the percentage of floating rate debt swapped to a fixed rate is under 10% for large public firms. Small and medium-sized firms outside these samples, which are not publicly listed and hold a large share of bank debt, make little use of hedging derivatives (Vickery (2008)).

Putting this information together, we arrive at an estimate of between \$3.2 and \$4.1 trillion of outstanding debt exposed to a floating interest rate, or between 26 and 33% of the total.[61] This means that aggregate U.S. business nonfinancial debt exposed to LIBOR

[59] In our own sample, we find that for those firms whose debt is entirely from non-bank sources only around 9 percent of debt is floating rate. These figures are consistent with Faulkender (2005), according to whom 7% of bonds are issued with a floating rate. Ogden, Palomino, Sinha, and Yook (2016) put this figure at around 2% in recent years.

[60] See Duffie and Stein (2015). Our own estimates based on our sample of public firms suggest that about 76 percent of bank loans are floating rate. As discussed in Section 3.1, Faulkender (2005) and Aslan and Kumar (2012) estimate even higher percentages in particular subsets of corporate loans. Overall, these values underestimate slightly the total share of loans referenced to rates that are linked to the fed funds rate, such as those loans directly referenced to the fed funds rate or prime rate.

[61] This figure is consistent with other estimates. Chernenko and Faulkender (2011) report that floating rate debt represents 32.7% of total debt of the corporate sector during the 1993–2003 period. The percent of total debt of all firms (in other words, the value-weighted average) in our sample, made up of all Compustat

fluctuations was equivalent to roughly 20% of GDP ($18.0 trn) in 2015, which lends support to the notion that our mechanism has the potential to have significant macroeconomic relevance.

## 6.2 Comparison with the Bank Lending Channel

Is the floating rate channel quantitatively relevant from a macroeconomic perspective? One possible answer comes from studying how large we would expect the effect to be for the overall economy if all firms had borrowed at a fixed rate or had access to hedging. However, because our empirical analysis focuses on local effects it is hard to argue that this analysis provides the true overall effect, given the potential general equilibrium effects underlying this counterfactual.

Instead, we compare the effect of the floating rate channel with that of the bank lending channel, as studies on the latter typically focus on local effects as well. In Appendix I we introduce an analysis based on results from the existing literature and find that a firm that usually borrows $100 from financial intermediaries will experience a long-run cumulative $0.3 external financing shortfall, as an upper bound, if the federal funds rate increases by one percentage point (Oliner and Rudebusch (1996), Holod and Peek (2007)). We also calculate that the same rate hike would cause, through the floating rate channel, a cash shortfall of between $0.32 (minimum over a one year period) to $0.88 (maximum over a two year period) on a $100 loan.

Overall, these calculations suggest that the aggregate financing shortfall caused by the floating rate channel of monetary policy is likely to be at least as large as the shortfall caused by the bank lending channel. For both channels, the total actual effect of this shortfall will be determined by similar amplification mechanisms, such as the borrowers' financial health. The floating rate channel will also have one additional subtle, but potentially important, amplification mechanism: it causes an internal cash shortfall, whereas the bank lending channel causes an external cash shortfall. The external cash shortfall (loss of access) due to the bank lending channel forces the firm to forgo investment projects without affecting its equity position. However, the internal cash shortfall due to the floating rate channel will always reduce the firm's equity and liquidity position and hence potentially have stronger effects on the balance sheet health of the firm.

## 6.3 Evidence from the Unconventional Policy Period

As an alternative approach to the importance of the floating rate channel, we apply our benchmark regression to a period during which we do not expect the floating rate channel to be operative, so that any remaining effect can be attributed to other banking channels.

firms excluding utilities and financials, that is bank debt (floating-rate debt) is 31.6% (25.4%) in 2008.

Since late 2008, when the federal funds target rate hit the zero lower bound, the Federal Reserve has focused on alternative policy measures in order to stimulate the U.S. economy. These measures, typically referred to as quantitative easing or unconventional monetary policy tools, have involved large scale purchases of assets with long maturities. As seen in Figure 1, these purchases did not affect the short-term benchmark interest rates underlying the floating rate bank debt arrangements, as these rates are already at their lowest possible level. If the floating rate channel is important we would expect bank debt usage to have a much less prominent role during the unconventional monetary policy period. Therefore, testing the effect of bank debt usage in the unconventional monetary policy period is useful to gauge the importance of the floating rate channel.

The main challenge for this approach stems from finding a measure of the overall stance of unconventional monetary policy in general, and the surprise component of the Federal Reserve's actions in particular. While one could use the Federal Reserve's balance sheet as a proxy, many of the Fed's actions were announced in advance and hence this would not provide a suitable measure of the monetary policy surprises in the unconventional period. Instead, we follow Wright (2012) and use the high-frequency price changes in longer-maturity Treasury futures on a very tight event window around FOMC announcements during the unconventional period to capture the unanticipated changes in the stance of monetary policy, as these tight windows do not include any other macroeconomic news. We prefer this identification strategy for unconventional monetary policy surprises over alternative strategies, such as vector-auto-regressions, because the monetary policy surprises identified in this fashion are less model-dependent and the regression results are easier to interpret and to compare to our event study results from the previous sections.[62]

Wright (2012) uses intraday data on two-, five-, ten-, and thirty-year Treasury bond futures trading in the Chicago Mercantile Exchange and identifies a particular set of FOMC announcement dates. The monetary policy surprises on those dates are computed as the first principal component of yield changes from 15 minutes before each of these announcements to 1 hour and 45 minutes afterwards. The announcement dates range from November 25, 2008 to September 21, 2011 and the associated monetary policy surprises calculated this way are presented in Table 5 of Wright (2012). These surprises are scaled so that one unit of the shock leads to a 12bp increase in the ten-year Treasury according to Wright (2012), and this is roughly equivalent to the effect of a 100bp increase in the fed funds target on the ten-year Treasury yield during the conventional period. While the scale is the same as the

[62] Other event studies that focus on the effects of unconventional monetary policy are either more descriptive in nature and do not provide a measure of the monetary policy surprise (e.g. Gagnon et al. (2010) and Krishnamurthy and Vissing-Jorgenson (2011)), or base the surprise on a subset of the assets employed by Wright (2012) (e.g. Chodorow-Reich (2014)).

shocks presented in Table 5 of Wright (2012), the sign is inverted so that a positive surprise in the following regressions should be interpreted as a contractionary shock, consistent with the other regressions in our paper.

Table XIII repeats our benchmark regression given in equation (22) by substituting the conventional monetary policy surprise with the unconventional monetary surprise after applying the same filters to firms as in our previous analysis. The first column shows that the effect of an unconventional monetary policy surprise that increases the ten-year Treasury yield by 12bp, decreases the stock price of a firm by about 35bp on average. This number is close to the number (55bp) reported in Wright (2012) for the intraday returns of the S&P 500 futures. Any difference stems from our use of panel data regressions with a more comprehensive sample and our use of two-day returns, following the strategy we have employed in the previous sections.

[TABLE XIII ABOUT HERE]

More interestingly, the second column shows that the effect of bank debt usage on the transmission of monetary policy to stock prices not only diminishes but also goes in the opposite direction of what we observe in the conventional period. In terms of economic magnitude, a one standard deviation (0.13) increase in bank debt usage leads to about a 6bp lower reaction, in comparison to a 35bp reaction of the average firm's stock. One explanation for this pattern might be that bank-firm relationships enable firms to benefit from some degree of insurance provided by their lenders against changes in credit availability. The increased importance of this insurance during the recent financial crisis, combined with the absence of the floating rate channel in the unconventional monetary policy period, can lead to the positive coefficient observed in column 2. Another explanation, which is easier to test, is that we simply need to control for additional variables. Indeed, the third column shows that after including our original control variables, we find that bank debt usage has an economically and statistically insignificant effect on the responsiveness of stock prices to monetary policy shocks. Either interpretation of our results is consistent with the reduced effect of bank debt usage in the unconventional policy period due to the absence of the floating rate channel, a channel that previous sections have proven to be particularly important during the conventional monetary policy period.

As a final test, we look at the effect of hedging on the responsiveness of stock prices to monetary policy shocks. If the difference between hedgers and non-hedgers we presented earlier in Table V truly reflects the importance of the floating rate channel for the effect of bank debt usage on the transmission of monetary policy, we should find that hedging should not influence the effect of bank debt usage during the unconventional monetary policy period.

Therefore, the last two columns look at the effect of bank debt usage for hedgers and non-hedgers separately like we did for the conventional period in Table V. We find that the difference between hedgers and non-hedgers actually goes in the opposite direction of what we observe in Table V, with bank debt usage increasing the responsiveness of hedgers and decreasing the responsiveness of non-hedgers. Nevertheless, the effect of bank debt usage is statistically insignificant for both hedgers and non-hedgers. This result is further in line with our argument that the floating rate channel is important for the effect of bank debt usage on the transmission of monetary policy, and that this important channel is mute during the unconventional monetary policy period.

Finally, we would like to discuss the generalizability of our analysis of unconventional policy. Although there does not seem to be any evidence of asymmetric effects for rate increases and decreases in the conventional policy period, as discussed in Section 4.2, our findings about unconventional monetary policy might be limited to instances when the Federal Reserve is loosening. However, unconventional policy may play a more significant role once the Federal Reserve starts tightening using unconventional policy tools. Since this has not happened so far, it would be difficult for us to make a claim about this.

# 7 Conclusion

According to the firm balance sheet channel of monetary policy, a tightening in monetary policy increases the debt-service burden of borrowers and reduces the value of their collateral and internal funds, thereby increasing the external finance premium of financially constrained firms. Our results confirm that bank lending plays an important role in this transmission mechanism. We use firms' hedging activity to provide evidence that an important portion of this transmission is driven by the mechanical relationship between monetary policy and the reference rates for the floating rate arrangements underlying most bank loans to businesses. This channel, which we call the *floating rate channel*, is distinct from earlier channels studied in the empirical literature in that it works through existing debt rather than new debt.

Our results also contribute to the debate about the efficacy of large scale asset purchases (LSAP) as an alternative tool of monetary policy. This debate has identified several channels through which LSAP may affect prices of different financial assets.[63] Financial intermediation does not play a significant role in any of the most relevant channels, which is perhaps not

[63] Krishnamurthy and Vissing-Jorgensen (2012) show that quantitative easing might operate through channels related to signaling, demand for long-term safe assets, inflation, mortgage-backed securities (MBS) prepayment, or corporate bond default risk. See also Gagnon et al. (2011), Joyce et al. (2011), Krishnamurthy and Vissing-Jorgensen (2011), Vayanos and Vila (2009), Hamilton and Wu (2011), Christensen and Rudebusch (2012), Swanson (2011), Li and Wei (2013), and D'Amico and King (2013).

surprising since aggregate bank loan growth relative to total deposits has been low.[64] Our results reveal another reason why LSAP might have a limited impact through bank lending. We find that the floating rate channel is not operative in the unconventional monetary policy period, and hence that bank debt usage plays a much less important role in the transmission of monetary policy during this period, consistent with the fact that the zero lower bound significantly limited the ability of the Federal Reserve to affect the short-term benchmark rates underlying floating rate bank debt.

It is important to point out some potential caveats of our study. First, as with any other microeconomic analysis of the importance of financial frictions, general equilibrium forces could affect the macroeconomic importance of our channel. Large, financially unconstrained firms could be benefiting from the downsizing of distressed or financially constrained firms following a monetary policy tightening, and taking up part of their lost market share, through general equilibrium effects mediating through prices of goods and services or wages, for example. Our local estimates would miss these total effects of comparing our current economy to a hypothetical one in which no firm faced our floating rate channel effect. Second, there might be other factors at play that interact with our floating rate channel. For example, an increase in inflation and inflation expectations induced by looser monetary policy can reduce the real debt burden, as discussed in Jermann, Gomes, and Schmid (2016). This effect would be stronger for fixed rate liabilities than for floating rate liabilities, which would counteract the direct cash flow effect of the floating rate channel and suggest that our estimates are a lower bound.

We hope that our results stimulate further research in this direction to provide a better understanding of how conventional and unconventional monetary policies differ in terms of their transmission to the real economy.

[64] http://www.forbes.com/sites/francescoppola/2014/01/21/banks-dont-lend-out-reserves/

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# APPENDIX

## A - Sensitivity of Stock Returns and Investment to Monetary Policy in the Simple Model

We are interested in how the reaction of the market value of equity and of investment to monetary policy, $\frac{\partial \ln V_0}{\partial \ln R_1}$ and $\frac{\partial \ln K_1}{\partial \ln R_1}$ respectively, change with the share of floating rate debt, $l$, and the role financial constraints play.[65] A firm's $t = 0$ value is given by the present discounted value of dividends,

$$V_0 = \frac{d_1}{R_1} + \frac{d_2}{R_1 R_2}, \tag{25}$$

and this expression can be further simplified because the firm will optimally set $d_1 = 0$, because investors in financially constrained firms will value funds inside the firm more than they do outside the firm. Investors of unconstrained firms are indifferent between receiving a positive dividend $d_1 > 0$ in $t = 1$, or having the firm save that amount at rate $r_2$ and paying it out in $t = 2$, so we can also assume for them that $d_1 = 0$ too. To isolate our mechanism of interest, we assume we are in the steady state, in which

$$r_2 = r_c = r_1. \tag{26}$$

The value of the firm is thus

$$V_0 = \frac{f(K_1) - R_c(1-l)K_0 - R_2 l K_0 - R_2 b_1}{R_1 R_2}, \tag{27}$$

and after applying (26) and simplifying we get

$$V_0 = \frac{f(K_1) - R_2(K_0 + b_1)}{R_1 R_2}, \tag{28}$$

subject to equations (2)–(4). The reaction to a monetary policy shock of an *unconstrained* firm in $t = 1$ (i.e. for whom constraint (3) is not binding) is given by

$$\frac{\partial \ln V_0}{\partial \ln R_1} = -1 - \frac{l K_0}{V_0}, \tag{29}$$

where we have applied the envelope theorem. The first term captures the stronger discounting of future profits, and the second term captures the effect of an increase in the cash flow claims

[65] Note that $\mathrm{d}\ln R_1 \cong \mathrm{d}r_1$.

of debtholders. This sensitivity changes with the usage of floating rate debt according to:

$$\frac{\partial^2 \ln V_0}{\partial \ln R_1 \partial l} = -\frac{K_0}{V_0}, \tag{30}$$

which simply captures the increase in the effect of a raise in interest rates on the transfer of cash-flow rights to debtholders when floating rate debt is larger.

We now turn to the case of a financially *constrained* firm. For simplicity, we assume, without loss of generality, they are not able to borrow at all, so that $b_1 = \bar{b} = 0$. The value of the firm is then

$$V_0 = \frac{f(K_1) - R_2 K_0}{R_1 R_2}. \tag{31}$$

In this case:

$$\frac{\partial \ln V_0}{\partial \ln R_1} = -1 - \frac{l K_0}{V_0} \frac{f'(K_1)}{R_2} \tag{32}$$

where, as with the unconstrained, the first term captures the stronger discounting of future profits. The additional factor in the second term, $f'(K_1)/R_2$, captures the effect of an increase in the interest expense in $t = 1$ on investment in $t = 1$. Therefore, the second term is different for constrained firms because they invest at a marginal rate of investment which is potentially different from $R_2$. As long as $f'(K_1) > R_2$, which is the case because the firm is now assumed to be financially constrained, then this effect is stronger than for unconstrained firms. As a result, when there is some floating rate debt, a change in interest rates has a stronger impact on a firm's equity value if this firm is constrained.

This sensitivity changes according to the usage of floating rate debt according to:

$$\frac{\partial^2 \ln V}{\partial \ln R_1 \partial l} = -\frac{K_0}{V_0} \frac{f'(K_1)}{R_2}, \tag{33}$$

where we can observe how an increase in floating rate debt exposes the firm to a loss in value which is stronger the higher the marginal product of capital in the second period. This marginal product of capital is higher the more financially constrained the firm is. This ensures, as a comparison of (30) and (33) makes clear, that the effect of floating rate debt usage on the sensitivity of stock prices to monetary policy is always greater for financially constrained firms. Intuitively, each additional dollar that a constrained firm needs to pay to floating rate debtholders has a value which is a multiple of $\frac{f'(K_1)}{R_2}$ times more for them, compared to unconstrained firms. Note that the constrained firm's problem becomes the same as unconstrained firm when the constraint is not binding (i.e., $f'(K_1) = R_2$).

The reaction of investment is more straightforward. In particular, we have

$$\frac{\partial \ln K_1}{\partial \ln R_1} = -l \frac{K_0}{K_1}, \tag{34}$$

if the firm is financially constrained, and

$$\frac{\partial \ln K_1}{\partial \ln R_1} = 0, \tag{35}$$

if the firm is financially unconstrained. Equation (34) follows immediately from the fact that for the constrained firm

$$K_1 = N_1 + \bar{b} = f(K_0) - r_c(1-l)K_0 - r_1 l K_0 + \bar{b}, \tag{36}$$

and equation (35) follows from the fact that the investment of the unconstrained firm is determined by the neoclassical investment rule $f'(K_2) = R_2$.

For $r_2 = r_c = r_1$, we have that for a financially *constrained* firm

$$\frac{\partial \ln K_1}{\partial \ln R_1 \partial l} = -\frac{K_0}{K_1}, \tag{37}$$

while for an *unconstrained* firm this derivative is 0. Therefore, the effect of monetary policy on investment is stronger for firms with high floating rate debt, $l$, especially if they are financially constrained, i.e. have low $K_1$.

## B - Simulated Regressions of the Dynamic Model

### B.1. Definition of Variables

The definitions of the variables used in the dynamic model of Section 2.2 are standard in the investment and capital structure literatures, and are given in Table A14.

[TABLE A14 ABOUT HERE]

### B.2. Robustness of Results

Table A15 displays regression results using simulated data from our dynamic model in Section 2.2 in which we use floating rate debt over total assets as our proxy for exposure to floating rate debt, as opposed to floating rate debt over total debt as in our main analysis. All our results go through, although statistical and economic significance is slightly weaker.

[TABLE A15 ABOUT HERE]

## C - Subsample Robustness of the Effect of Monetary Policy on Stock Prices

We start with the reaction of the aggregate CRSP value-weighted index between February

1994 and June 2008. Following Rigobon and Sack (2005), we focus on this period for two reasons. First, starting in February 1994, the FOMC's policy of announcing target rate changes at pre-scheduled dates virtually eliminated the timing ambiguity associated with rate changes prior to this date. Second, after June 2008, the Federal Reserve switched from announcing a specific target rate to announcing a range for the target rate. Table A3 offers a comparison between the responses of equity prices to federal funds rate changes in different samples, after discarding outliers as in Bernanke and Kuttner (2005). Columns 1 and 2 show that on the day of an FOMC announcement, a 100bp surprise increase in the federal funds rate decreases stock prices by around 300bp when we look either at the value-weighted returns or the individual returns of the entire CRSP universe between 1994 and 2008. This result is comparable to the numbers reported in Bernanke and Kuttner (2005). Columns 3 and 4 show that the reaction of equity prices to surprise changes in monetary policy is stronger in the sample of 2003–2008 than in previous years. However, the sign and significance of the coefficient of surprise is the same for both samples. A comparison of columns 4 and 5 reveals that firms in the sample for which we have bank debt usage data have a reaction to monetary policy shocks very similar to that of the overall CRSP universe during the 2003–2008 period.

[TABLE A3 ABOUT HERE]

### D- Examples from 10-K files on hedging activities

The following two paragraphs are examples of the type of discussion on hedging activities that we find in the 10-K files. In fiscal year 2008, BioFuel Energy Corp reports as follows:

> We are subject to interest rate risk in connection with our bank facility. Under the facility, our bank borrowings bear interest at a floating rate based, at our option, on LIBOR or an alternate base rate. (...). In September 2007, the Operating Company, through its subsidiaries, entered into an interest rate swap for a two-year period. The contract is for $60.0 million principal with a fixed interest rate of 4.65%, payable by the Operating Company and the variable interest rate, the one-month LIBOR, payable by the third party.

Similarly, in fiscal year 2006 Netsmart Technologies reports:

> In October 2005, we entered into a revolving credit and term loan agreement with the Bank of America (...). This financing provides us with a five-year term loan of $2.5 million. The term loan bears interest at LIBOR plus 2.25%. We

have entered into an interest rate swap agreement with the Bank for the amount outstanding under the term loan whereby we converted our variable rate on the term loan to a fixed rate of 7.1% in order to reduce the interest rate risk associated with these borrowings.

### E- Monetary Policy Surprise Calculation Procedure

Following Bernanke and Kuttner's analysis, we define an event as either an FOMC meeting or an announced change in the funds target rate. Kuttner (2001) and Bernanke and Kuttner (2005) obtain the corresponding surprise change in the target rate by first calculating the change in the rate implied by the corresponding futures contract, given by 100 minus the futures contract price, and then scaling this result by a factor associated with the number of days of the month in which the event occurred because the payoff of the contract is determined by the average realized federal funds effective rate during the month. Accordingly, the unexpected target rate change, for an event taking place on day $d$ of month $m$, is given by

$$\Delta i^u = \frac{D}{D-d}(f^0_{m,d} - f^0_{m,d-1}),$$

where $f^0_{m,d} - f^0_{m,d-1}$ is the change in the current-month implied futures rate, and $D$ is the number of days in the month. To suppress the end-of-month noise in the federal funds rate, the unscaled change in the implied futures rate is used as the measure of target rate surprise when the event occurs on the last three days of a month. If the event happens on the first day of a month, $f^1_{m-1,D}$ is used instead of $f^0_{m,d-1}$. The expected federal funds rate change is defined as the difference between the actual change minus the surprise:

$$\Delta i^e = \Delta i - \Delta i^u,$$

where $\Delta i$ is the actual federal funds rate change. The data for the decomposition of the federal funds target rate changes can be obtained from Kenneth Kuttner's webpage.[66]

### F - The Effect of Bank Debt Usage on Monetary Policy Sensitivity of Stock Prices

Table A4 presents the results of regression (22) using alternative specifications that become more restrictive across columns. The first column of Table A4 contains the result from a basic random-effects panel regression with no controls and suggests that a one standard deviation (0.114) increase in our bank debt usage measure causes the stock price to increase

[66] http://econ.williams.edu/people/knk1/research

1.6_(= $-14 * 0.114$) percentage points more in response to a 1 percentage point surprise decrease in the federal funds rate. To put this effect in perspective, the same surprise decrease in the federal funds rate causes the stock price of the firm with the average amount of bank debt over assets (7.22%) to increase about 4.97 percent on average.

[TABLE A4 ABOUT HERE]

Columns 2a-2c provide the same regression with different adjustments for well-known risk factors in asset pricing. Column 2a repeats the same regression as column 1 with the excess market return as an additional control variable and shows that the coefficient of $Surprise * (BankDebt/At)$ remains very similar. Column 2b repeats the regression in column 1 after replacing the dependent variable with the stock return in excess of that predicted by the Capital Asset Pricing Model (CAPM), which corrects for the correlation of individual stock returns with the aggregate market return. The coefficient of interest ($-10.5$) is within one standard deviation of the coefficient in column 1 ($-14.1$). However, the coefficient of $Surprise$ changes significantly and actually turns positive. This does not mean that a positive (contractionary) rate surprise causes an increase in the stock price of the average firm. We observe this pattern because part of the market return on the FOMC date can be attributed to monetary policy so the CAPM correction of returns prevents us from measuring the full effect of monetary policy. The same pattern can also be observed when we do the risk adjustment with the Fama-French three-factor model instead of CAPM, as shown in column 2c. To circumvent this problem, we continue with the unadjusted returns as in column 1 and use the CAPM beta as a control variable for the correlation of individual returns with the market return in other regressions of Table A4. For the same reason, instead of correcting returns using the Fama-French 3-factor model we use the firm characteristics underlying the 3-factor model (size, market-to-book, CAPM beta) as control variables.[67] Another advantage of this approach stems from the observation that firm characteristics subsume the effect of the Fama-French risk factors in explaining stock returns, as discussed in Daniel and Titman (1997) and Ferson and Harvey (1999).

In order to address potential identification issues, such as non-spherical disturbances and omitted variables, we progressively add controls, industry fixed effects, both interacted and uninteracted, standard errors clustered at the event-industry level, and firm fixed effects. Non-sphericality would primarily affect the standard errors of our estimates rather than their

[67] For size, we use book value of assets, rather than market value of equity for two reasons. First, the market equity size premium has declined significantly in the last three decades. Second, since Gertler and Gilchrist (1994), balance sheet (rather than market) size has been widely used as a proxy of firms' financial constraints, which is considered an important factor behind the transmission of monetary policy and therefore more suitable for our purpose.

consistency, which is the main reason why we use clustered errors. However, omitted variables can influence our inference by affecting both the standard errors and the consistency of our estimates. Therefore, controls and firm-level fixed effects specifications aim at distinguishing between bank debt being special, or bank debt users being special, for reasons that are not captured in our basic regression in column 1 of Table A4. We also include an instrumental variable analysis.

More specifically, column 3 introduces firm controls and year fixed effects and shows that the coefficient in column 1 remains effectively unchanged. This is also robust to alternative specifications, as shown in columns 4 to 8. In column 4, industry fixed-effects enter the regression both interacted with surprise and uninteracted, with industries classified according to Fama-French 48 sectors available from Kenneth French's website, and errors are clustered at the event-industry level to address possible time-and-cross-section heteroskedasticity in the errors. Column 5 extends the definition of bank debt to include undrawn credit lines.

Another concern stems from the possibility that bank debt usage is caused by cash flow risk, financial constraints or the interest rate sensitivity of firms' demand and our results reflect the importance of these factors rather than bank debt usage, so in column 6 we introduce measures that control for these factors. We follow Faulkender (2005) and measure the interest rate sensitivity of firms' operating profits as the correlation between quarterly firm earnings before interest, tax, depreciation and amortization (EBITDA) and three-month average LIBOR rates. We introduce cash flow volatility and CAPM beta as controls for firm risk, and cash holdings as a measure of the ability of the firm to withstand liquidity shocks associated with monetary policy. Finally, to capture financing constraints, we follow Hadlock and Pierce (2010), who show that firm size and age are very useful predictors of the severity of financial constraints, and introduce a measure based solely on these two firm characteristics.[68] We call this measure of financial constraints the HP index. To further deal with this concern, Column 7 replaces industry fixed effects with firm fixed effects to capture unobserved time invariant omitted firm characteristics. Overall the coefficient of bank debt usage barely changes, which adds robustness to the evidence that bank debt usage makes firms more responsive to monetary policy shocks.

Column 8 includes an instrumental variable regression with fixed effects to deal further with the potential endogeneity problem of bank debt usage. Following Faulkender and

[68] We use Hadlock and Pierce's estimates for 2000-2004 from Table 6 in their paper because this period is closer to our sample. The HP index is calculated as (-0.548*Size) + (0.025*Size^2) – (0.031*Age), where size is the log of inflation adjusted (to 2004) book assets, and age is the number of years for which the firm has stock returns in CRSP to ensure that we have few missing observations. An alternative measure can be derived using the IPO date, but this leads to multiple missing observations, though the results are qualitatively similar. In calculating this index, size is replaced with log($4.5 billion) and age with thirty-seven years if the actual values exceed these thresholds.

Petersen (2006) and Santos and Winton (2008) we instrument for bank debt usage using proxies for firm visibility and firm uniqueness. These authors use these proxies to instrument for firm access to corporate bond markets and argue that firms that are highly visible and less unique are more likely to be rated. As proxies for visibility, they introduce firms' membership of the S&P 500 index or of the New York Stock Exchange (NYSE). As a proxy for uniqueness, they use a measure of the number of firms in their same industry other than itself that have credit ratings. We instead use them as instruments for bank debt usage following the argument that firms that do not have access to bond markets are likely to be stronger users of bank debt. Our last instrument relies on the observation that banking regulation limits the amount of unsecured loans a bank can issue (Ivashina (2009)). Consistent with this observation, Altman, Gande, and Saunders (2010) find that about 70 percent of the bank loans to corporations are secured, in contrast to 3 percent of bonds. Therefore, we would expect that the collateral of a firm is an important determinant of how much the firm can borrow from a bank, and hence use tangibility as an additional instrument.[69] We find that while we lose statistical significance, the coefficients of the regression are effectively unchanged and the Hausman test cannot reject the hypothesis that they are the same, suggesting that endogeneity is not a big concern.

Finally, column 9 provides the same specification as in column 7 but replaces bank debt with floating rate debt. While the statistical significance of floating rate debt drops somewhat, as expected due to the points mentioned in the data section, it is similar in size to the coefficient of bank debt in column 7 and still statistically significant.

A possible concern in Table A4 is that bank debt may be proxying for the use of short-term debt. This concern finds support in the descriptive statistics reported in Table IV which shows that bank debt users have a higher percentage of short-term debt than nonbank-debt users (3.71 percent versus 1.09 percent, calculated as a share of total assets) and that the Pearson pair-wise correlation between these two variables is 0.27. For example, to the extent that changes in monetary policy affect primarily the short end of the yield curve, one can expect firms with a shorter average maturity of debt to be more sensitive to increases in interest rates.

To test this hypothesis, we rewrite the specification provided in equation (22) in terms of short-term debt divided by the book value of assets, $STDebt/At$. Formally, the complete

[69] Because we are interested in how bank debt usage affects firms' sensitivity to monetary policy shocks and because this term in our regression is non-linear, given by $Surprise_t * (BankDebt/At)_{i,t-1}$, we cannot use the traditional instrumental variable approach where the first stage estimates of $(BankDebt/At)_{i,t-1}$ are used to replace our endogenous variable in the second stage, which is dubbed "the forbidden regression" in the literature. Therefore, we use an alternative approach suggested in Angrist and Pischke (2009, Ch. 4) where we use $Surprise_t * (Instrument)_{i,t-1}$ as an instrument for $Surprise_t * (BankDebt/At)_{i,t-1}$.

regression specification is:

$$\begin{aligned} Ret_t &= \beta_0 + \beta_1 Surprise_t + \beta_2 (BankDebt/At)_{t-1} + \beta_3 (STDebt/At)_{t-1} \\ &+\beta_4 Surprise_t * (BankDebt/At)_{t-1} + \beta_5 Surprise_t * (STDebt/At)_{t-1} \\ &+\gamma Controls_{t-1} + \lambda Surprise_t * Controls_{t-1} + \varepsilon_t. \end{aligned} \tag{38}$$

Table A11 provides the empirical results of this test. Columns 1 and 2 show the results of a version of regression (38) in which the terms containing $(BankDebt/At)_{t-1}$ are removed. We observe that the amount of short-term debt in a firm's balance sheet is not significantly associated with the strength of the sensitivity to surprises in the federal funds rate. The coefficient in column 1 ($-10.30$) is not only statistically insignificant but also economically very small: one standard deviation in short-term debt usage leads to only a $(10.30 * 0.05 =)$ 0.5 percentage point increase in the sensitivity to monetary policy of stock prices, a far lower figure than the 1.6 percentage points for bank debt usage. Introducing additional controls in column 2 makes this effect even smaller. Columns 3 and 4 provide a complete specification of (38), including bank debt, both interacted and not interacted with *Surprise*. The coefficient $\beta_5$ remains insignificant, while the coefficient $\beta_4$ retains the sign, size, and significance of the specifications reported in Table A4. We conclude that the higher sensitivity of bank debt users to federal funds rate surprises is not due to their higher exposure to short-term debt.

Finally, one potential concern is that our bank debt usage variable, $BankDebt/At$, might be correlated with other leverage variables and our results reflect the importance of debt in general rather than bank debt in particular. One way we address this concern is by adding book leverage directly in Table A4. As another way to address the same issue, we normalize total bank debt with total debt to create an alternative measure of bank debt usage, $BankDebt/Debt$. We use this new measure to replace our original measure and repeat the regressions in Table A4. The new results, presented in Table A12 in the appendix confirm our results from Table A4. In particular, we find that a one standard deviation in $BankDebt/Debt$ (0.40) leads to approximately a $(0.40 * 3 =)$ 1.2 percentage point increase in the responsiveness of stock prices to monetary policy surprises, which is in the ballpark of our previous result (1.6 percentage points) using $BankDebt/At$.[70] Hence, we continue to use $BankDebt/At$ in the following analysis.

### G - Effect of Hedging: Controlling for Financial Frictions

[70] As before, the floating rate debt coefficient is somewhat smaller due to mismeasurement. A similar issue also appears when we include undrawn credit lines in column 4 because there are some firms in our sample that have very little debt but very large undrawn credit lines.

One concern in our previous regressions is that the estimates might be biased due to an omitted variable bias associated with the relationship between financial constraints and firms' hedging behavior. Some theories predict that hedging activities are positively related to the severity of financing constraints. If external finance is costly, firms may find it optimal to hedge against low cash flow realizations to avoid having to forgo positive net-present-value (NPV) projects (Froot, Scharfstein, and Stein (1993)) or to avoid nonlinear costs of financial distress (Stulz (1984)).[71] The empirical evidence, however, does not provide support for this prediction, and has documented that firms that are more likely to face financial constraints, such as small firms, are *less* likely to manage risk (Stulz (1996)).[72] Motivated by these findings, Rampini, Sufi, and Viswanathan (2014) introduce and test a theory that suggests there is a trade-off between hedging and financing, because both activities compete for the same collateral. In equilibrium, firms that are more financially constrained hedge less. The important role of financing constraints in firms' willingness and ability to hedge suggests that one should control for financial constraints and how these constraints interact with both the ability to raise debt and to hedge.[73]

To deal with this concern, we study how much of the effect of hedging survives after controlling for financial frictions, which we measure using firm age and the HP index. In particular, we estimate an expanded version of regression (23)

[71] Other motivations for the use of hedging have to do with corporate governance and managerial incentives (Chava and Purnanandam (2007)), and with market timing (Faulkender (2005)). More generally, the value creation of hedging has been examined by Nance, Smith, and Smithson (1993), Mian (1996) and Graham and Rogers (2002).

[72] Columns 5 and 6 of Table A2 show that this is the case also in our sample. Larger, rated, more profitable and less financially constrained (low HP index) firms are more likely to hedge than their smaller, unrated, less profitable or more financially constrained counterparts.

[73] One important question is why most bank lending arrangements involve a floating rate instead of a fixed rate despite the fact that many firms hedge the interest rate risk associated with these loans. One answer could arise from the trade-off between firms' needs and banks' cost of capital. A firm that wants to borrow at a fixed rate may have limited access to other fixed-rate sources of financing, such as bonds, whereas the bank might prefer to lend at floating rates, in which case hedging bridges the gap between the desire of the bank and the firm. As discussed by Vickery (2008), there are at least two reasons why banks might prefer to lend at floating rates. First, rising interest rates can cause deposit outflows from the banks and it is costly for banks to replace these outflows with other sources of financing. Lending at a floating rate would provide a partial hedge against these outflows. Second, floating rate business loans can be used to hedge the maturity mismatch between deposits and long-term mortgage loans.

$$\begin{aligned}Ret_t = &\beta_0 + \beta_1 Surprise_t + \beta_2 Surprise_t * (BankDebt/At_{t-1}) \\ &+ \beta_3 Surprise_t * (BankDebt/At)_{t-1} * Hedge_t \\ &+ \beta_4 Surprise_t * (BankDebt/At)_{t-1} * FinFrictions_{t-1} \\ &+ \lambda_1 Surprise_t * Controls_{t-1} * Hedge_t \\ &+ \lambda_2 Surprise_t * Controls_{t-1} * FinFrictions_{t-1} \\ &+ \text{Uninteracted terms and Second Order Interactions} + \varepsilon_t \end{aligned} \tag{39}$$

and check if $\beta_3$, the coefficient of $Surprise_t * (BankDebt/At)_{t-1} * Hedge_t$, remains similar to what we have calculated before in Table V and whether it still eliminates the full effect of the $Surprise_t * (BankDebt/At)_{t-1}$, i.e., $\beta_3 + \beta_2 = 0$. Columns 1 and 2 of Table A13 show that the estimates of $\beta_3$ have a magnitude very similar to the one we have calculated in Table V for the coefficient on the triple interaction term $Surprise_t * (BankDebt/At)_{t-1} * Hedge_t$ and that it nullifies the effect of $Surprise_t * (BankDebt/At_{t-1})$. Similar evidence is obtained in columns 3 and 4 when we use floating rate debt instead of bank debt. These results suggest that the floating rate channel is a unique and distinct channel that works separately from possible effects of financial frictions.

## H - Description of Tests based on Balance Sheet Variables

In this Appendix, we describe in detail the empirical tests discussed in Section 5.

**Interest Coverage Ratio Tests**

We compute the interest coverage ratio at the quarterly level as the sum of interest expenses (Compustat item, XINTQ) and cash flow divided by interest expenses, where cash flow is equal to earnings before extraordinary items (IBQ) plus depreciation (DPQ). We test whether a higher bank debt usage as a share of total assets increases the responsiveness of firms' interest rate coverage ratios following monetary policy actions, due to the higher likelihood of this debt being floating rate. We use the following empirical specification:

$$\begin{aligned}\Delta CoverageRatio_{t-1,t+x} &= \beta_0 + \beta_1 \widehat{Change}_t \\ +\beta_2 (BankDebt/At)_{t-1} &+ \beta_3 \widehat{Change}_t (BankDebt/At)_{t-1} \\ +\gamma Controls_{t-1} &+ \lambda \widehat{Change}_t (Controls_{t-1}) + \varepsilon_t, \end{aligned} \tag{40}$$

where $\widehat{Change}_t$ is the cumulative quarterly change in the interest rate, as in Ashcraft and Campello (2007) and Jiménez, Ongena, Peydró, and Saurina (2012, 2014), instead of the cumulative surprise component because cash flow and the interest rate expense on existing debt is not forward-looking the way stock prices are.[74] Our firm-level controls include book leverage, firm size, market-to-book ratio, profitability, interest rate sensitivity, and short-term debt. We include firm and year-quarter fixed effects, and we cluster errors at the industry-quarter level.[75]

The dependent variable ($\Delta CoverageRatio_{t-1,t+x}$) is calculated as the change between the coverage ratio in the quarter before the monetary policy shock and $x \in \{1, 2, 3, 4, 5, 6\}$ quarters ahead. The timing of effects of the floating rate channel is influenced by the frequency with which interest rates of floating rate bank loans are reset to adjust to movements in the reference rate. Because this frequency can range from 1 day to 1 year (Inklaar and Wang (2013)), the effects might occur with a lag of several quarters, although a majority of commercial and industrial (C&I) loans have a resetting frequency of one month or less, according to the Federal Reserve's Survey of Terms of Business Lending.

As in Sections 4.2 and 4.4, we restrict our sample to include firms that have outstanding variable rate debt equivalent to at least 1% of total assets to eliminate firms that may be using interest-rate derivatives for speculative purposes, and we run specification (40) separately for subsamples of hedgers and non-hedgers.

**Cash Holdings Tests**

We compute the change in cash holdings as the difference between total cash and short-term investments at the end of quarter $t + x$ (where $x \in \{1, 2, 3, 4, 5, 6\}$) and at the end of quarter $t-1$, scaled by total assets at the end of the quarter $t-1$. Changes in cash holdings are expressed in basis points, and we use the same regression specification as (40). Firm controls are taken from the empirical literature that focuses on corporate cash accumulation (Bates, Kahle and Stulz (2009)), and include firm size, leverage, market-to-book ratio, and cash flow risk. We test whether the impact of bank debt usage on the sensitivity of cash holdings to monetary policy (coefficient $\beta_3$) is significantly stronger for financially constrained firms than for unconstrained firms in the sample of unhedged firms, and whether this difference is absent or is at least significantly smaller in the sample of hedged firms. We classify firms as financially constrained (unconstrained) if their value of the Hadlock and Pierce (2010) (HP) index is above (below) the median, and report the difference between the estimates of $\beta_3$ across constrained and unconstrained firms, within each of the subsamples of hedgers

[74] This argument also holds for other balance sheet variables in this section, as they are more likely to respond to the anticipated component of monetary policy changes as well because adjustment costs prevent them from reacting rapidly to changes in expectations about future policy rates, particularly when the change in the expectation happens shortly before the FOMC announcement. Still, our results in this section remain qualitatively similar when we use the sum of the monetary policy surprises on the FOMC announcements dates in a given year, as in Gorodnichenko and Weber (2014).

[75] Year-quarter fixed effects also control for possible seasonality occurring at the quarterly frequency.

and non-hedgers, and also report the statistical significance of the difference.[76] Results are analyzed for horizons of four and six quarters.

**Inventory Investment Tests**

We follow Kashyap, Lamont and Stein (1994) and adopt their empirical specification for our inventory investment regressions, which we augment to introduce monetary policy changes, bank debt usage, and our firm level controls:

$$\ln\left(\frac{Inventories_{t+x}}{Inventories_{t-1}}\right) = \beta_0 + \beta_1 \widehat{Change}_t$$
$$+\beta_2 \left(BankDebt/At\right)_{t-1} + \beta_3 \widehat{Change}_t \left(BankDebt/At\right)_{t-1}$$
$$+\gamma Controls_{t-1} + \lambda \widehat{Change}_t Controls_{t-1}$$
$$+\ln\left(\frac{Sales_{t,t+x}}{Sales_{t-x-1,t-1}}\right) + \ln(\frac{Inventories_{t-1}}{Sales_{t-1}}) + \varepsilon_t. \quad (41)$$

Our firm-level controls include, as before, book leverage, firm size, market-to-book ratio, profitability, interest rate sensitivity, and short-term debt. We add, following Kashyap, Lamont and Stein (1994), the cash to total assets ratio at the end of quarter $t-1$, separately and interacted with change, and also the difference between the log of total sales during quarters $t$ to $t+x$ and the log of total sales during quarters $t-x-1$ to $t-1$, and the log of the inventory to sales ratio at the end of quarter $t-1$. We express our dependent variable in basis points. We include firm and year-quarter fixed effects, and we cluster errors at the industry-quarter level. Results are analyzed for horizons of four and six quarters.

**Sales Tests**

We interpret sales, in line with existing literature, as a proxy for firm-level output (Gertler and Gilchrist (1994), Bond, Elston, Mairesse, and Mulkay (2003)). We employ empirical specification (40) and use the difference between the log of total sales during quarters $t$ to $t+x$ and the log of total sales during quarters $t-x-1$ to $t-1$ as our dependent variable. As before, we introduce year-quarter fixed effects, which also control for possible seasonality occurring at the quarterly frequency.

**Fixed Investment Tests**

To test our prediction on fixed investment, we expand our baseline empirical specification (40) to include the main factors that have been identified in the empirical literature to matter for firm investment (Eberly, Rebelo and Vincent (2012)). These are Tobin's Q, proxied by

[76] As explained in Section 4.4, we choose the HP measure because Hadlock and Pierce (2010) show that other indices have very little power to predict financial constraints, and any power they have comes from firm size and age, the two variables they use to create their composite HP index.

the market-to-book ratio, cash flow, and lagged investment. We run the following regression:

$$\begin{aligned}
\ln\left(\frac{K_{t+x}}{K_{t-1}}\right) &= \alpha_0 + \alpha_1 \widehat{Change}_t + \alpha_2 \left(BankDebt/At\right)_{t-1} + \alpha_3 \widehat{Change}_t \left(BankDebt/At\right)_{t-1} \\
&\quad + \lambda \left(FirmControls\right)_{t-1} + \gamma \widehat{Change}_t \left(FirmControls\right)_{t-1} \\
&\quad + \alpha_4 Q_t + \alpha_5 \left(\frac{CF_t}{K_t}\right) + \alpha_6 \left(\frac{I_{t-1}}{K_{t-1}}\right) + \varepsilon_t, \qquad (42)
\end{aligned}$$

where our dependent variable is computed as the difference between the log of total fixed capital (measured as property, plant and equipment) $x$ quarters ahead, and the log of capital one quarter before the monetary policy event. We express our dependent variable in basis points. Our firm-level controls also include book leverage, firm size, profitability, interest rate sensitivity, and short-term debt, all interacted with $\widehat{Change}_t$ and also introduced separately. We include firm and year-quarter fixed effects, and we cluster errors at the industry-quarter level.

### I - Bank Lending Channel vs Floating Rate Channel

According to the estimations in Holod and Peek (2007), a one percentage point permanent rate hike would be associated with a 0.01 (for publicly-held banks) to 0.1 percentage point (for privately-held banks) decrease in C&I loans as a fraction of total bank assets over a four quarter period. Moreover, C&I loans are about 10 percent of total assets for both public and private banks, and public banks hold about 80 percent of total assets (Nichols, Wahlen, and Wieland (2009)). Therefore, the weighted average effect is a 0.3 percent decrease in C&I loans over a four quarter period ((0.01/0.1)*0.8+(0.1/0.1)*0.2=0.3). This result is also in line with Oliner and Rudebusch (1996): over eight quarters they find a 0.6 percent decrease in C&I loans to small firms who hold half the bank loans whereas no loan decline is observed for large firms, implying a 0.3 percent decrease for total loans. Moreover, since this effect is the same as the effect from Holod and Peek (2007) over the first year, we can conclude that this is the long-run effect of a permanent increase in the federal funds rate. Overall, this suggests that a firm that usually borrows $100 from the bank will experience a cumulative $0.3 shortfall if the federal funds rate increases by one percentage point. This effect includes any amplification mechanism that works through bank balance sheets. Of course, this effect might be an upper bound for the true supply effect because part of the effect can be attributed to the potential decline in loan demand due to reduced demand for goods and services associated with the tightening of monetary policy. Moreover, Oliner and Rudebusch (1996) find that loans to large firms actually increase after a tightening, suggesting a reallocation of credit from small firms to large firms that further alleviates the effects of the bank lending channel.

How does this compare to the floating rate channel? A one percentage point rate hike would increase the interest expense by $1 on a $100 loan. However, some loans are fixed rate and some floating rate loans are hedged, which we will take into account. Since the papers about the bank lending channel in the previous paragraph focus on C&I loans, we will do the same here. As shown in Vickery (2008), about 70 percent of total bank loans in the Federal Reserve's survey of business lending is made at a floating rate which is close to what Figure 2 suggests (about 75 percent) in our sample. If we continue with the same assumption that half of C&I loans are made to small businesses this would imply that about 65 percent of C&I loans to small businesses are at a floating rate (0.65*0.5+0.75*0.5=0.7). Moreover, we find that firms that do not use hedging derivatives hold about 30 percent of the loans in our sample, where almost all firms are large according to the definition of the Quarterly Financial Report for Manufacturing, Mining, and Trade Corporations (QFR) used by Oliner and Rudebusch (1996), which has a cutoff of $25 million in total assets to qualify firms as large in 2014. Small and medium sized firms usually make little use of hedging derivatives (Vickery (2008)). Therefore, as an initial approximation, we assume that no small firm hedges. As a second approximation, we will assume that small firms have the same hedging behavior as the firms with less than 25 million dollars in assets in our sample (37 percent in terms of total loan size) which is an upper bound for hedging derivative usage because these firms are on the upper tail of the size distribution. Using these numbers, we calculate the total percentage of C&I loans that are floating rate and unhedged as a number between 0.32 and 0.44 (0.65*(1-0.37)*0.5+0.75*0.3*0.5=0.32 and 0.65*1*0.5+0.75*0.3*0.5=0.44). Therefore, the average cash shortfall after the one percentage point rate hike would be between $0.32 and $0.44 on a $100 loan over four quarters, or $0.64 to 0.88 over two years, assuming the effect on the interest expense persists over this time horizon, which seems to be the case according to unreported regressions in which we study the effect of bank debt usage and hedging on the response of the interest expense of firms to monetary policy.[77]

[77] One implicit assumption is that the rate on the C&I loans is reset frequently. According to the Survey of Terms of Business Lending of November 2006, 27 percent of the C&I loans are subject to repricing at any time, 28 percent of the loans have daily repricing, and 23 percent of the loans have a repricing period of 2-30 days.

# TABLES AND FIGURES

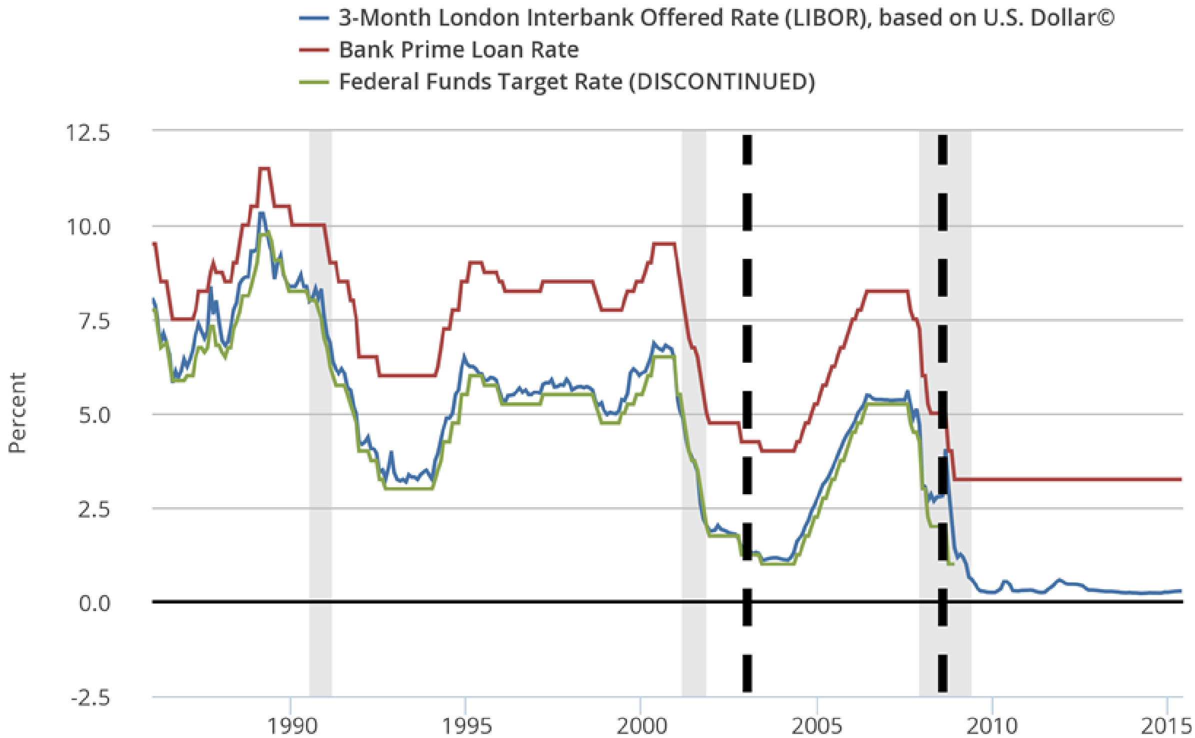


**Figure 1**

**The relation between the Federal Funds Target Rate and Floating-Rate Debt Reference Rates**

This figure displays the relation between two of the most common reference rates used in floating rate loans, the 3-Month London Interbank Offered Rate (LIBOR) and the Bank Prime Loan Rate, and the Federal Funds Target Rate, from January 1986 until January 2015. The data is from the Federal Reserve Bank of St. Louis FRED Economic Data.

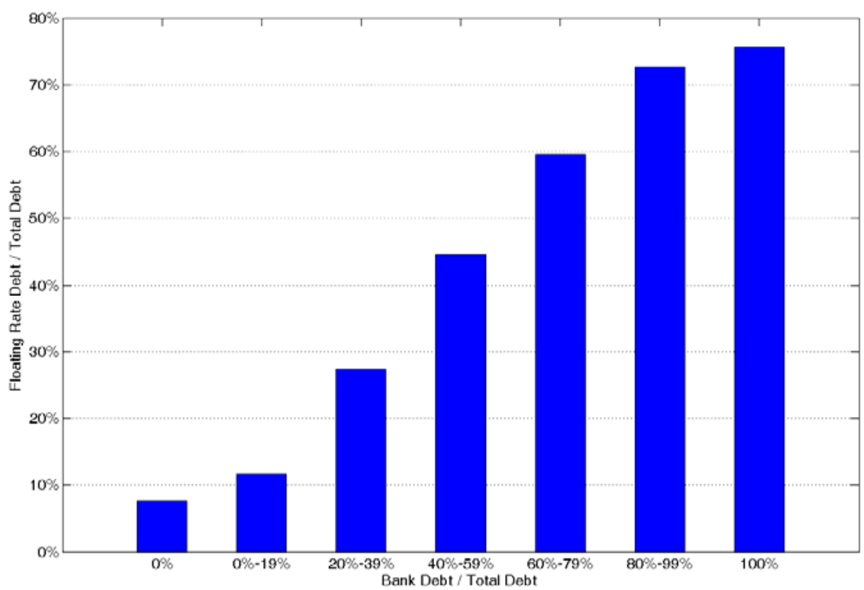


**Figure 2**

**The relation between bank debt and floating-rate debt**

This figure displays the relation between bank debt and floating-rate debt as a percentage of a firm's total debt. Firms are grouped in the horizontal axis according to bank debt as a percentage of total debt. The vertical axis shows the corresponding percentages of floating-rate debt as a percentage of total debt.

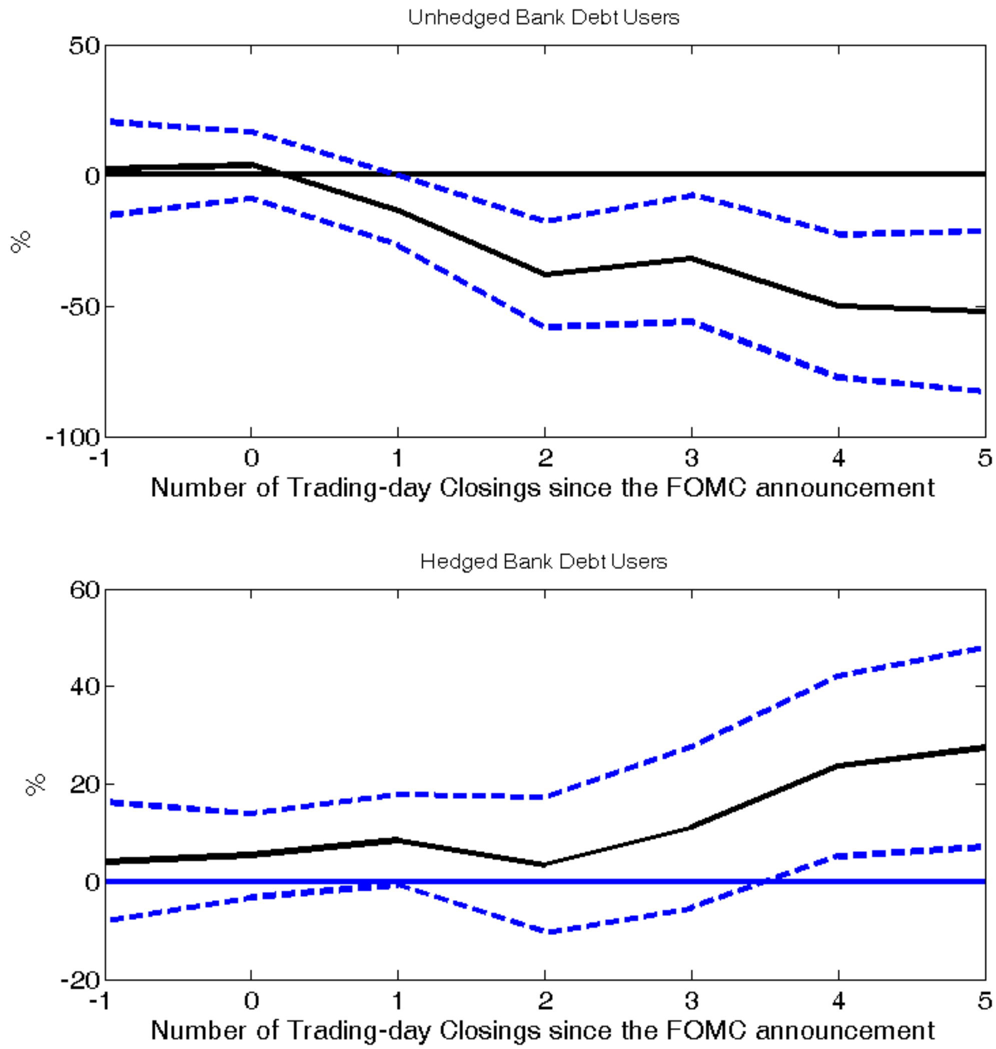


**Figure 3**

**Cumulative Reaction to monetary policy tightening associated with Bank Debt Usage: Hedgers vs Non-hedgers**

This figure displays the average additional effect of a 1 percentage point surprise increase in the Federal Funds target rate on the cumulative stock price return of a hypothetical firm that is financed exclusively with bank debt, relative to a firm with no bank debt. In the bottom (top) panel the sample consists of firms that hedge (do not hedge) interest rate risk. The estimates are a result of running regression (1) with the cumulative stock return over multiple trading days as the dependent variable. Dotted lines capture the 95% confidence interval around our estimates.

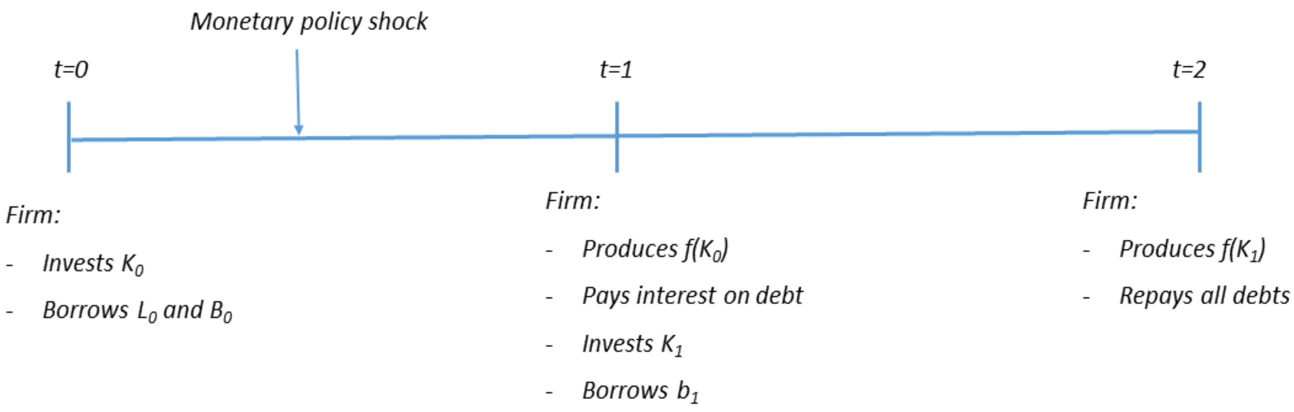


**Figure 4**
**Timeline of Events in the Simple Model**

**Table I**
**Dynamic Model Calibration – Parameter Value Choices**

| **Parameter** | **Symbol** | **Value** |
|---|---|---|
| Productivity factor | $A$ | 1 |
| Capital share | $\alpha$ | 0.4 |
| Upper bound of operating cost shock | $\overline{z}$ | 0.36 |
| Debt repayment rate | $\lambda$ | 0.035 |
| Cost of hedging interest rate risk | $\psi$ | 0.005 |
| Borrowing constraint | $\overline{b}$ | 4.3 |
| Dividend payout parameter | $\rho$ | 0.90 |
| Equity issuance cost | $\eta$ | 15 |

**Table II**

**The Effect of Monetary Policy – Simulated Data**

Panel A of this table examines how monetary policy affects firms' stock returns and how this effect varies with floating rate debt usage and financing constraints. Not displayed in this table are some of the lower order combinations of the triple interaction variable (*Constrained*Surprise *Floating Rate/ Total Debt*), the constant term, and controls. Column 3 displays a regression in which the costs of distress are 33% lower than in the benchmark calibration. Panel B of this table examines how monetary policy affects firms' investment and how this effect varies with floating rate debt usage and financing constraints. Not displayed in this table are some of the lower order combinations of the triple interaction variable (*Constrained*Change *Floating Rate/ Total Debt*), the constant term, and Tobin's Q. *Surprise*, *Change*, *Stock Return* and *Net Investment/K* are expressed in basis points. The definitions of all the variables used are described in detail in Appendix B. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

**Panel A. Effect on Stock Returns**

| Dep variable: Stock Return$_t$ | (1) | (2) | (3) |
|---|---|---|---|
| Surprise | -19.55*** | -15.08*** | -15.04*** |
| | (-54.41) | (-46.17) | (-76.62) |
| Surprise *Floating Rate/ Total Debt | -21.58*** | -23.12*** | -15.99*** |
| | (-37.14) | (-44.21) | (-43.17) |
| Constrained*Surprise *Floating Rate/ Total Debt | -7.25*** | -4.23*** | -3.54*** |
| | (-6.83) | (-4.43) | (-5.22) |
| Controls | NO | YES | NO |
| Distress Costs | Benchmark | Benchmark | Low |
| R-squared | 0.19 | 0.24 | 0.24 |
| Observations | 38,000 | 38,000 | 38,000 |

**Panel B. Effect on Investment**

| Dep variable: Net Investment$_{t, t+x}$/K$_{t-1}$ | 4 Quarters Ahead | | 6 Quarters Ahead | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Change | -0.19*** | -0.47*** | -0.46*** | -0.64*** |
| | (-6.30) | (-14.72) | (-15.02) | (-20.07) |
| Change *Floating Rate/ Total Debt | 0.02 | -0.24*** | 0.19*** | 0.02 |
| | (0.47) | (-4.71) | (3.87) | (0.34) |
| Constrained*Change *Floating Rate/ Total Debt | -0.12 | -0.22** | -0.42*** | -0.49*** |
| | (-1.40) | (-2.46) | (-4.71) | (-5.42) |
| Controls | NO | YES | NO | YES |
| R-squared | 0.01 | 0.04 | 0.01 | 0.03 |
| Observations | 38,000 | 38,000 | 38,000 | 38,000 |

**Table III**

**The Effect of Monetary Policy on Financial Distress – Simulated Data**

This table examines how monetary policy affects firms' financial distress likelihood (column (1)), costs of financial distress (column (2)), and the interest rate coverage ratio (column (3)), and how these effects vary with floating rate debt usage and financing constraints. Not displayed in this table are some of the lower order combinations of the triple interaction variable (*Constrained*Surprise *Floating Rate/ Total Debt*), the constant term, and controls. All dependent variables and *Change* are expressed in basis points. The definitions of all the variables used are described in detail in Appendix B. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| Dep variable: | Covenant Violation Likelihood<br>(1) | Costs of Financial Distress<br>(2) | Interest Rate Coverage Ratio<br>(3) |
|---|---|---|---|
| Change | 1.48*** | 0.08 | 0.18 |
| | (5.18) | (1.55) | (0.72) |
| Change *Floating Rate/ Total Debt | 0.21 | 0.64*** | 13.36*** |
| | (0.674) | (6.39) | (29.79) |
| Constrained*Change *Floating Rate/ Total Debt | 2.38*** | 1.56*** | 2.62*** |
| | (2.58) | (8.48) | (3.19) |
| R-squared | 0.19 | 0.24 | 0.16 |
| Observations | 38,000 | 38,000 | 38,000 |

**Table IV**
**Descriptive Statistics**

This table provides summary statistics for the entire sample and for different subsamples. The entire sample consists of U.S. firms covered by Capital IQ, CRSP, and Compustat from 2003 to 2008 with December fiscal year-end, excluding utilities (SIC codes 4900-4949) and financials (SIC codes 6000-6999). We remove firm-year observations with negative revenues, missing information on total assets, or a value of total assets under 10 million. We also discard penny stocks, defined as those with a price of less than $5. After the above filters, the sample contains 9,746 firm-year observations comprising 2,368 unique firms. Complete variable definitions are given in the appendix. All variables are winsorized at the 1% level in both tails of the distribution, and total assets are expressed in terms of year-2000 dollars. See Table A1 for variable definitions.

| | (1) | | (2) | | (3) | | (4) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Leveraged Firms with Bank Debt | | | |
| | Entire Sample | | Leveraged Firms w/out Bank Debt | | Hedgers | | Nonhedgers | |
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Term Loans/At | 3.95% | 9.02% | 0.00% | 0.00% | 8.93% | 12.70% | 5.09% | 8.88% |
| Drawn Credit Lines/At | 3.09% | 6.55% | 0.00% | 0.00% | 6.12% | 8.51% | 5.06% | 7.36% |
| Bank Debt /At | 7.22% | 11.66% | 0.00% | 0.00% | 15.52% | 14.33% | 10.33% | 11.01% |
| Bank Debt / Total Debt | 37.51% | 40.07% | 0.00% | 0.00% | 50.35% | 36.26% | 58.89% | 37.97% |
| Floating-Rate Debt/At | 9.77% | 13.44% | 1.59% | 5.86% | 15.37% | 15.77% | 10.04% | 11.73% |
| Float-Rate Debt / Tot. Debt | 38.31% | 40.47% | 8.95% | 24.65% | 47.04% | 38.14% | 50.62% | 41.26% |
| Undrawn Credit Line/At | 9.85% | 10.56% | 8.19% | 9.89% | 12.99% | 9.61% | 11.11% | 10.95% |
| (Bank Debt + Und CL)/At | 17.14% | 16.64% | 8.19% | 9.89% | 28.51% | 16.89% | 21.43% | 15.36% |
| Short-Term Debt /At | 2.55% | 5.15% | 1.85% | 4.25% | 3.65% | 6.13% | 3.71% | 5.76% |
| | | | | | | | | |
| Profitability | 4.94% | 15.73% | 4.35% | 16.46% | 8.91% | 7.24% | 4.31% | 16.40% |
| Size (Total Assets, Million $) | 4,274.32 | 23990 | 5,404.67 | 20,292.93 | 5,071.905 | 23,784.68 | 4,677.73 | 32,800.7 |
| Book Leverage | 28.15% | 29.58% | 26.87% | 29.38% | 45.19% | 27.21% | 31.07% | 27.71% |
| Earnings-Interest Rate Sensitivity | -13.23% | 35.46% | -11.82% | 36.96% | -15.63% | 33.43% | -12.98% | 34.44% |
| Rated Dummy | 32.98% | 47.02% | 36.23% | 48.08% | 57% | 49.52% | 28.76% | 45.27% |
| Market-to-Book Assets | 1.98 | 1.57 | 2.13 | 1.61 | 1.42 | 0.92 | 1.79 | 1.38 |
| Cash/At | 22.35% | 24.26% | 27.19% | 23.31% | 7.44% | 9.83% | 17.44% | 22.07% |
| CAPM Beta (Monthly) | 1.32 | 1.20 | 1.37 | 1.23 | 1.11 | 0.93 | 1.35 | 1.24 |
| Cash Flow Volatility | 1.11% | 0.49% | 1.14% | 0.44% | 0.95% | 0.42% | 1.10% | 0.48% |
| Hadlock-Pierce Fin. Con. Measure | -2.85 | 0.59 | -2.89 | 0.61 | -3.12 | 0.49 | -2.82 | 0.57 |
| Age | 16.78 | 17.01 | 18.08 | 18.95 | 20.20 | 19.31 | 16.63 | 15.72 |
| | | | | | | | | |
| Hedging Dummy | 34.80% | 47.63% | 26.46% | 44.12% | 100.00% | 0.00% | 0.00% | 0.00% |
| Hedging*(Bank Debt /At) | 4.22% | 10.18% | 0.00% | 0.00% | 15.52% | 14.33% | 0.00% | 0.00% |
| Hedging*( Floating-Rate Debt/At) | 5.75% | 12.11% | 0.71% | 3.94% | 15.37% | 15.77% | 0.00% | 0.00% |
| | | | | | | | | |
| *Firm's lenders' characteristics:* | | | | | | | | |
| Bank Size (ln(assets)) | | | | | 19.80 | 1.92 | 19.65 | 2.05 |
| Tier 1 Capital Ratio | | | | | 8.39% | 0.65% | 8.46% | 0.82% |
| Deposit Ratio | | | | | 51.03% | 7.84% | 53.90% | 9.55% |
| Liquidity Ratio | | | | | 22.47% | 4.17% | 21.32% | 5.50% |
| | | | | | | | | |
| Observations (annual) | 9,746 | 9,746 | 2,509 | 2,509 | 2,463 | 2,463 | 2,647 | 2.647 |
| | | | | | | | | |
| ***Quarterly data*** | | | | | | | | |
| Interest Rate Coverage Ratio | 0.14 | 0.19 | 0.12 | 0.18 | 0.22 | 0.20 | 0.14 | 0.18 |
| Inventory (quarterly growth %) | 2.02% | 21.70% | 2.37% | 23.10% | 1.71% | 17.96% | 1.73% | 19.03% |
| Sales (quarterly growth %) | 2.16% | 21.1% | 2.40% | 21.19% | 1.51% | 17.48% | 2.04% | 21.67% |
| Prop. Pla. & Equip. (q. growth %) | 2.13% | 5.42% | 2.15% | 5.50% | 1.80% | 5.12% | 2.05% | 5.09% |
| | | | | | | | | |
| Observations (quarterly) | 45,694 | 45,694 | 11,932 | 11,932 | 10,117 | 10,117 | 11,645 | 11,645 |

**Table V**

**The Role of Bank Debt Usage and Interest Rate Risk Exposure in the Transmission of Monetary Policy**

This table examines how firms' bank and floating rate debt usage impacts the effect of monetary policy on stock prices, and how this impact varies with firms' hedging activity. Hedgers are defined on a yearly basis as those firms that report having swapped their interest rate from floating to fixed in their 10-K annual reports. Only firms with floating rate debt constituting more than 1% of total assets are included. Bank Debt/At is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). FloatingRateDebt /At is defined as floating rate debt over the book value of assets (At). All regressions also include an unreported constant term, as well as ln(assets), book leverage, profitability, market-to-book, interest rate sensitivity, and their interaction with surprise. All firm characteristics are lagged by one year and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for $p<0.01$, ** for $p<0.05$, * for $p<0.1$.

<table>
<tr><th>Panel A - Main Variables</th><th>ALL</th><th>(1)<br>Non-Hedgers</th><th>(2)<br>Hedgers</th><th>(3)<br>Non-Hedgers</th><th>(4)<br>Hedgers</th><th>ALL</th><th>(5)<br>Non-Hedgers</th><th>(6)<br>Hedgers</th><th>(7)<br>Non-Hedgers</th><th>(8)<br>Hedgers</th></tr>
<tr><td>Surprise</td><td>-6.04**<br>(-2.54)</td><td>-4.10***<br>(-4.07)</td><td>-8.62***<br>(-9.05)</td><td>-5.08*<br>(-1.91)</td><td>-6.83**<br>(-2.35)</td><td>-6.20***<br>(-2.63)</td><td>-4.59***<br>(-4.76)</td><td>-8.22***<br>(-8.96)</td><td>-5.76**<br>(-2.20)</td><td>-6.34**<br>(-2.16)</td></tr>
<tr><td>BankDebt/At</td><td>1.28**<br>(2.38)</td><td>0.35<br>(0.86)</td><td>0.26<br>(1.14)</td><td>0.13<br>(0.13)</td><td>1.94***<br>(3.12)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>FloatingRateDebt /At</td><td></td><td></td><td></td><td></td><td></td><td>1.03**<br>(2.06)</td><td>0.25<br>(0.65)</td><td>0.21<br>(0.96)</td><td>0.77<br>(0.84)</td><td>1.19**<br>(2.14)</td></tr>
<tr><td>Surprise *(BankDebt/At)</td><td>-13.50*<br>(-1.76)</td><td>-25.18***<br>(-3.04)</td><td>1.41<br>(0.26)</td><td>-38.02***<br>(-3.09)</td><td>3.45<br>(0.38)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Surprise *(FloatingRateDebt /At)</td><td></td><td></td><td></td><td></td><td></td><td>-14.70*<br>(-1.92)</td><td>-20.81***<br>(-2.60)</td><td>-2.72<br>(-0.53)</td><td>-30.79**<br>(-2.36)</td><td>-3.71<br>(-0.40)</td></tr>
<tr><td>Surprise*(BankDebt/At)*Hedging</td><td></td><td colspan="2">26.71***<br>(2.71)</td><td colspan="2">41.46***<br>(2.85)</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Surprise*(FloatingRateDebt /At)*Hedging</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">17.78*<br>(1.90)</td><td colspan="2">27.07*<br>(1.74)</td></tr>
</table>

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| Panel B - Surprise*Other variables | ALL | (1) Non-Hedgers | (2) Hedgers | (3) Non-Hedgers | (4) Hedgers | ALL | (5) Non-Hedgers | (6) Hedgers | (7) Non-Hedgers | (8) Hedgers |
|---|---|---|---|---|---|---|---|---|---|---|
| Surprise *log(Assets) | -1.32** | | | -1.95*** | -0.55 | -1.30** | | | -1.62** | -0.77 |
| | (-2.34) | | | (-2.69) | (-0.77) | (-2.35) | | | (-2.21) | (-1.11) |
| Surprise *Book Leverage | -0.32 | | | 5.85 | -6.20 | 0.64 | | | 5.73 | -4.14 |
| | (-0.09) | | | (1.18) | (-1.36) | (0.18) | | | (1.13) | (-0.91) |
| Surprise *Market-to-Book | 0.81 | | | -0.22 | 2.18 | 0.85 | | | -0.12 | 2.19 |
| | (0.80) | | | (-0.17) | (1.60) | (0.83) | | | (-0.10) | (1.61) |
| Surprise *Profitability | -18.28 | | | -16.22 | -22.98 | -18.04 | | | -16.65 | -23.07 |
| | (-1.63) | | | (-1.34) | (-1.06) | (-1.62) | | | (-1.39) | (-1.06) |
| Surprise *Int. Rate Sensitivity | -7.63 | | | -9.21 | -5.61 | -7.76 | | | -9.77* | -5.84 |
| | (-1.50) | | | (-1.58) | (-0.89) | (-1.54) | | | (-1.69) | (-0.92) |
| Test for the coefficients of Surprise*(Other variables)*Hedging are jointly zero (p-value) | | | | | 0.19 | | | | | 0.39 |
| Firm Controls | YES | NO | NO | YES | YES | YES | NO | NO | YES | YES |
| Firm FE | YES | NO | NO | YES | YES | YES | NO | NO | YES | YES |
| Surprise*Firm Controls | YES | NO | NO | YES | YES | YES | NO | NO | YES | YES |
| Cluster (Fed event*IndustryFF48) | YES | NO | NO | YES | YES | YES | NO | NO | YES | YES |
| Observations | 24,123 | 11,796 | 12,335 | 11,788 | 12,335 | 24,123 | 11,796 | 12,335 | 11,788 | 12,335 |

**Table VI**
**The Role of Interest Rate Risk Exposure in the Transmission of Monetary Policy: Instrumental Variables Analysis**

All variables are as defined in Table IV. Column (1) is the fixed effects regression for the sample of firms that have data on lagged hedging dummy and column (3) is the fixed effects regression for the sample of firms that have data on tax convexity, our instrument for hedging from Graham and Smith (1999) and Campello, Lin, Ma, Zou (2011). Column (2) uses lagged hedging dummy as instrument for hedging. Column (4) uses the variables underlying the convexity measure, excluding *Vol*, whereas column (5) uses all variables as instruments. Column (6) uses the tax convexity measure directly, as given in the text. Column (7) uses both the lagged hedging dummy and the tax convexity measure. Only firms with floating rate debt constituting more than 1% of total assets are included. A constant, non-interacted terms, and the policy surprise interacted with firm size, book leverage, profitability and the market-to-book ratio are included but not reported. All firm characteristics are lagged by one year and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1. The coefficient of Surprise in columns (4) to (6) are not negative because the linear first stage regression does not restrict hedging between zero and one.

Panel A: Bank Debt

| | (1)<br>OLS<br>L.hedging | (2)<br>IV<br>L.hedging | (3)<br>OLS<br>Convexity | (4)<br>IV1<br>Convexity | (5)<br>IV2<br>Convexity | (6)<br>IV3<br>Convexity | (7)<br>IV<br>Both |
|---|---|---|---|---|---|---|---|
| Surprise | -5.13*** | -3.99*** | -5.78*** | 1.83 | 1.21 | 64.25 | -5.40*** |
| | (-4.62) | (-3.19) | (-3.33) | (0.25) | (0.21) | (1.07) | (-2.60) |
| Surprise*(BankDebt/At) | -38.17*** | -30.19** | -49.43*** | -102.30** | -121.91*** | -153.31 | -46.47*** |
| | (-3.90) | (-2.47) | (-3.73) | (-2.33) | (-2.95) | (-0.33) | (-2.66) |
| Surprise*(BankDebt/At)*Hedging | 43.50*** | 34.95** | 59.00*** | 173.15*** | 183.41*** | 501.27 | 59.60** |
| | (3.54) | (2.13) | (3.53) | (2.65) | (3.02) | (0.82) | (2.56) |
| | | | | | | | |
| Hausman test (p-value) | | 0.934 | | 0.786 | 0.925 | 0.998 | 1.000 |
| Firm FE | YES | YES | YES | YES | YES | YES | YES |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES | YES | YES | YES |
| Observations | 23,413 | 23,413 | 12,009 | 12,009 | 12,009 | 12,009 | 11,665 |

Panel B: Floating Rate Debt

| | (1)<br>OLS<br>L.hedging | (2)<br>IV<br>L.hedging | (3)<br>OLS<br>Convexity | (4)<br>IV1<br>Convexity | (5)<br>IV2<br>Convexity | (6)<br>IV3<br>Convexity | (7)<br>IV<br>Both |
|---|---|---|---|---|---|---|---|
| Surprise | -5.82*** | -4.47*** | -6.74*** | 2.13 | 0.88 | 41.97 | -6.17*** |
| | (-5.38) | (-3.66) | (-3.93) | (0.31) | (0.15) | (0.87) | (-3.02) |
| Surprise*(FloatingRateDebt/At) | -28.79*** | -25.17** | -25.45* | -74.93* | -88.14** | -243.60 | -30.58* |
| | (-2.96) | (-2.06) | (-1.95) | (-1.74) | (-2.22) | (-1.55) | (-1.83) |
| Surprise*(FloatingRateDebt/At)*Hedging | 26.36** | 24.32 | 22.45 | 136.09** | 128.79** | 422.53 | 33.77 |
| | (2.18) | (1.50) | (1.37) | (2.03) | (2.16) | (0.78) | (1.52) |
| | | | | | | | |
| Hausman test (p-value) | | 0.882 | | 0.812 | 0.984 | 0.956 | 0.999 |
| Firm FE | YES | YES | YES | YES | YES | YES | YES |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES | YES | YES | YES |
| Observations | 23,413 | 23,413 | 12,009 | 12,009 | 12,009 | 12,009 | 11,665 |

**Table VII**

**Interest Rate Risk Exposure and the Transmission of Monetary Policy: The Role of Financing Constraints**

Hedgers are defined on a yearly basis as those firms that report having hedged their interest rate risk from floating to fixed, in their 10-K annual reports. Financial constraints are proxied by the firm's age and the Hadlock and Pierce (2010) measure given by HP = -0.548*Size+0.025*Size2-0.031*Age. Firm size is defined to be the log of assets (inflation-adjusted to 2004). Age is defined as the current year minus the first year that the firm has a non-missing stock price in CRSP. Firm size and age are at the 1% tails on the low end, and at the $4.5 billion and 37- year points on the high end. The financial constraint measure takes the value of 1 if the firm's age is below the median or if the firm's HP statistic is above the median in a given year. Only firms with floating rate debt constituting more than 1% of total assets are included. Bank Debt/At is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). All regressions also include an unreported constant term, as well as ln(assets), book leverage, profitability, market-to-book value, both interacted with surprise and un-interacted. All firm and lender characteristics are lagged by one year and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote p values: *** for p<0.01, ** for p<0.05, and * for p<0.1.

| VARIABLES | (1) Non-Hedgers OLD | (2) Non-Hedgers YOUNG | (3) Hedgers OLD | (4) Hedgers YOUNG | (5) Non-Hedgers LOW HP | (6) Non-Hedgers HIGH HP | (7) Hedgers LOW HP | (8) Hedgers HIGH HP |
|---|---|---|---|---|---|---|---|---|
| Surprise | -6.23*** | -3.05 | -6.33** | -7.03*** | -1.18 | -6.31** | -5.90** | -9.46*** |
| | (-3.73) | (-1.48) | (-2.52) | (-2.74) | (-0.52) | (-2.40) | (-2.29) | (-3.05) |
| Surprise*(BankDebt/At) | -20.30 | -56.73*** | 3.81 | 3.20 | -29.19** | -46.11*** | 4.05 | 7.01 |
| | (-1.49) | (-3.49) | (0.37) | (0.29) | (-1.96) | (-3.06) | (0.46) | (0.51) |
| Surprise*(BankDebt/At)*Constrained | -36.43* | | -0.61 | | -16.92 | | 2.96 | |
| | (-1.74) | | (-0.04) | | (-0.79) | | (0.19) | |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 6,713 | 5,075 | 7,303 | 5,032 | 5,785 | 6,003 | 8,561 | 3,774 |
| R-squared | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.02 | 0.02 |
| Number of gvkey | 432 | 409 | 407 | 337 | 354 | 486 | 469 | 288 |

**Table VIII**
**The Effect of Monetary Policy on the Interest Coverage Ratio**

This table examines how monetary policy affects firms' interest coverage ratio and how this effect varies with bank debt usage and interest rate risk hedging. The quarterly coverage ratio is equal to interest expenses (XINTQ) divided by the sum of interest expenses and cash flow. Cash flow is equal to earnings before extraordinary items (IBQ) plus depreciation (DPQ). The dependent variable is computed as the difference between the coverage ratio x quarters after the monetary policy shock and the coverage ratio during the quarter before the monetary policy shock, where x={4,6}. *Change* is the sum of all changes in the federal funds rate that occur during a quarter. *Hedgers* are defined as those firms that report having hedged their interest rate risk from floating to fixed in their 10K annual reports. Only firms with floating rate debt constituting more than 1% of total assets are included. *Bank Debt/At* is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). All regressions also include an unreported constant term. Unreported controls include ln(assets), book leverage, market-to-book, profitability and interest rate sensitivity of operating income. All firm controls are lagged by one quarter and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| Dep variable: $CoverageRatio_{t+x}$ - $CoverageRatio_{t-1}$ | (1) x=1 quarter ahead | (2) x=2 quarters ahead | (3) x=3 quarters ahead | (4) x=4 quarters ahead | (5) x=5 quarters ahead | (6) x=6 quarters ahead |
|---|---|---|---|---|---|---|
| <u>*Non-hedgers*</u> | | | | | | |
| (Sum) Change* BankDebt/At | -0.11 | 3.56 | 6.04* | 4.69 | 8.72** | 7.88 |
| | (-0.04) | (1.00) | (1.71) | (1.46) | (2.28) | (1.14) |
| <u>*Hedgers*</u> | -3.05 | -0.18 | 1.82 | -1.06 | -0.33 | -3.89 |
| (Sum) Change* BankDebt/At | (-0.71) | (-0.08) | (0.54) | (-0.29) | (-0.15) | (-1.15) |
| *Hedger*(Sum) Change* BankDebt/At* | -2.93 | -3.74 | -4.21 | -5.74 | -9.05** | -11.77** |
| | (-0.72) | (-0.87) | (-0.76) | (-1.01) | (-1.98) | (-2.08) |
| Firm Controls | YES | YES | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES | YES | YES |
| Change*Firm Controls | YES | YES | YES | YES | YES | YES |
| Year-quarter dummies | YES | YES | YES | YES | YES | YES |
| Industry-Quarter Clustering | YES | YES | YES | YES | YES | YES |
| Observations (non-hedgers regressions) | 7,669 | 7,511 | 7,332 | 7,193 | 7,076 | 6,963 |
| Observations (hedgers regressions) | 7,445 | 7,351 | 7,238 | 7,134 | 7,036 | 6,941 |

**Table IX**
**The Effect of Monetary Policy on Cash Holdings**

This table examines how monetary policy affects firm cash holdings and how this effect varies with bank debt usage and interest rate risk hedging. Cash holdings are calculated as cash and short-term investments divided by total assets. *Change in Cash Holdings*$_{t-1,t+x}$ is computed as the difference (in basis points) between the cash holdings *x* quarters ahead, and cash holdings at the end of the quarter before the monetary policy change occurs, scaled by total assets at the end of the quarter before the monetary policy change occurs. *Change* is the sum of all changes in the federal funds rate that occur during a quarter. *Hedgers* are defined as those firms that report having hedged their interest rate risk from floating to fixed in their 10K annual reports. Only firms with floating rate debt constituting more than 1% of total assets are included. *Bank Debt/At* is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). All regressions also include an unreported constant term. Unreported controls include ln(assets), book leverage, market-to-book, profitability and interest rate sensitivity of operating income. All firm controls are lagged by one quarter and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| Dependent variable (in basis points): 10,000*((Cash$_{t+x}$- Cash$_{t-1}$)/Assets$_{t-1}$) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | x=4 quarters ahead | | | | x=6 quarters ahead | | | |
| | Non-hedgers | | Hedgers | | Non-hedgers | | Hedgers | |
| | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) |
| BankDebt/At | 700.68 | 140.01 | 152.40 | 221.87 | 420.47 | 496.87 | 358.07* | 241.59 |
| | (1.56) | (0.38) | (0.82) | (1.39) | (0.81) | (1.36) | (1.74) | (1.48) |
| (Sum) Change *BankDebt/At | -3.22 | 0.99 | -0.53 | -0.20 | -7.06** | 2.39 | -1.00 | 1.00 |
| | (-1.43) | (0.86) | (-0.67) | (-0.22) | (-2.37) | (1.54) | (-0.57) | (1.06) |
| *(Sum) Change* BankDebt/At*Constrained* | -4.21* | | -0.33 | | -9.45*** | | -1.99 | |
| | (-1.74) | | (-0.33) | | (-3.15) | | (-1.08) | |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Change*Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Year-quarter dummies | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry-Quarter Clustering | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 3,812 | 3,764 | 2,032 | 5,204 | 3,663 | 3,667 | 1,934 | 5,075 |

**Table X**

**The Effect of Monetary Policy on Inventory Investment**

This table examines how monetary policy affects firm inventory investment and how this effect varies with bank debt usage and interest rate risk hedging. Inventories are calculated as Total Inventories (INVTQ), and *Change in Inventories*$_{t-1,t+x}$ is computed as the difference (in basis points) between the log of inventories *x* quarters ahead and the log of inventories at the end of the quarter before the monetary policy change occurs. *Change* is the sum of all changes in the federal funds rate that occur during a quarter. *Hedgers* are defined as those firms that report having hedged their interest rate risk from floating to fixed in their 10K annual reports. Only firms with floating rate debt constituting more than 1% of total assets are included. *Bank Debt/At* is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). All regressions also include an unreported constant term. Controls include the inventory to sales ratio, the change in cumulative sales over the *x* quarters following the monetary policy change and the *x* quarters before, and cash holdings over assets, and also (unreported): ln(assets), book leverage, market-to-book, profitability and interest rate sensitivity of operating income. All firm controls are lagged by one quarter and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| Dependent variable (in basis points): 10,000*(ln(Inventory$_{t+x}$) - ln(Inventory$_{t-1}$)) | x=4 quarters ahead | | | | x=6 quarters ahead | | | |
|---|---|---|---|---|---|---|---|---|
| | Non-hedgers | | Hedgers | | Non-hedgers | | Hedgers | |
| | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) |
| BankDebt/At | -55.43 | -1,082.20 | 672.17 | 1,547.13 | 1,204.72 | -2,817.44 | -473.70 | 1,068.42 |
| | (-0.03) | (-0.69) | (0.61) | (1.40) | (0.60) | (-1.60) | (-0.38) | (0.84) |
| (Sum) Change *BankDebt/At | -16.81** | 7.59 | 7.78 | -6.06 | -21.20*** | 0.99 | 5.31 | -2.44 |
| | (-2.05) | (0.57) | (1.64) | (-1.62) | (-2.83) | (0.09) | (1.07) | (-0.49) |
| *(Sum) Change* BankDebt/At*Constrained* | -24.39** | | 13.83** | | -22.18* | | 7.74 | |
| | (-2.21) | | (2.35) | | (-1.72) | | (1.39) | |
| ln(Inventory$_{t-1}$/ Sales$_{t-1}$) | -3,144.56*** | -3,824.72*** | -4,857.47*** | -602.85 | -3,626.21*** | -4,301.13*** | -6,462.38*** | -1,388.76 |
| | (-9.75) | (-7.95) | (-7.24) | (-0.80) | (-10.78) | (-7.70) | (-9.68) | (-1.53) |
| ln(Sales$_{t-1,t+x}$) | 0.51*** | 0.52*** | 0.65*** | 0.65*** | 0.54*** | 0.60*** | 0.87*** | 0.82*** |
| | (10.04) | (9.41) | (5.45) | (7.34) | (11.63) | (12.14) | (10.30) | (15.00) |
| Cash$_{t-1}$/At$_{t-1}$ | 6,150.26*** | 6,864.56*** | 18,180.29*** | 7,091.18*** | 6,494.47*** | 7,590.74*** | 15,304.41*** | 7,736.34*** |
| | (4.48) | (5.51) | (6.06) | (3.92) | (4.78) | (5.36) | (4.85) | (3.79) |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Change*Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Year-quarter dummies | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry-Quarter Clustering | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 2,964 | 3,171 | 1,448 | 4,243 | 2,863 | 3,082 | 1,371 | 4,130 |

**Table XI**
**The Effect of Monetary Policy on Sales**

This table examines how monetary policy affects firm sales and how this effect varies with bank debt usage and interest rate risk hedging. *Change in Sales*$_{t-x-1,t+x}$ is calculated as the difference between the ln of the accumulated quarterly sales over x quarters starting in the quarter (t) in which the monetary policy action occurs, and the ln of the accumulated quarterly sales in the x quarters preceding the monetary policy action. *Change* is the sum of all changes in the federal funds rate that occur during a quarter. *Hedgers* are defined as those firms that report having hedged their interest rate risk from floating to fixed in their 10K annual reports. Only firms with floating rate debt constituting more than 1% of total assets are included. *Bank Debt/At* is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). All regressions also include an unreported constant term. Unreported controls include ln(assets), book leverage, market-to-book, profitability and interest rate sensitivity of operating income. All firm controls are lagged by one quarter and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

Dependent variable (in basis points): 10,000*(ln(Sales$_{t, t+x}$) - ln(Sales$_{t-x-1, t-1}$))

| | x=4 quarters ahead | | | | x=6 quarters ahead | | | |
|---|---|---|---|---|---|---|---|---|
| | Non-hedgers | | Hedgers | | Non-hedgers | | Hedgers | |
| | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) |
| BankDebt/At | -2,353.22*** | -1,066.41 | 319.36 | -395.46 | -2,671.31*** | -392.00 | 938.17** | -516.16 |
| | (-2.86) | (-1.32) | (0.77) | (-0.77) | (-2.95) | (-0.43) | (2.03) | (-0.95) |
| (Sum) Change *BankDebt/At | -6.43 | 12.71* | -5.12** | 4.83** | -6.29 | 16.89** | -5.51*** | 6.31** |
| | (-1.59) | (1.79) | (-2.47) | (2.14) | (-1.60) | (2.23) | (-2.87) | (2.39) |
| *(Sum) Change* BankDebt/At*Constrained* | -19.13*** | | -9.95*** | | -23.18*** | | -11.82*** | |
| | (-3.71) | | (-3.27) | | (-3.59) | | (-3.84) | |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Change*Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Year-quarter dummies | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry-Quarter Clustering | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 3,813 | 3,770 | 2,037 | 5,207 | 3,664 | 3,671 | 1,940 | 5,078 |

**Table XII**

**The Effect of Monetary Policy on Fixed Investment**

This table examines how monetary policy affects firm fixed investment and how this effect varies with bank debt usage and interest rate risk hedging. Inventories are calculated as Total Inventories (INVTQ), and *Fixed Investment* $_{t-1,t+x}$ is computed as the difference (in basis points) between the log of property, plant and equipment (PPEGTQ) *x* quarters ahead and the log of PPEGTQ at the end of the quarter before the monetary policy change occurs. *Change* is the sum of all changes in the federal funds rate that occur during a quarter. *Hedgers* are defined as those firms that report having hedged their interest rate risk from floating to fixed in their 10K annual reports. Only firms with floating rate debt constituting more than 1% of total assets are included. *Bank Debt/At* is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). All regressions also include an unreported constant term. Controls include the lagged investment to capital ratio, the lagged cash holdings to capital ratio, and the market to book ratio, and also (unreported): ln(assets), book leverage, market-to-book, profitability and interest rate sensitivity of operating income. All firm controls are lagged by one quarter and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for $p<0.01$, ** for $p<0.05$, * for $p<0.1$.

| Dependent variable (in basis points): $10{,}000*(\ln(PPE_{t+x}) - \ln(PPE_{t-1}))$ | x=4 quarters ahead | | | | x=6 quarters ahead | | | |
|---|---|---|---|---|---|---|---|---|
| | Non-hedgers | | Hedgers | | Non-hedgers | | Hedgers | |
| | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) |
| BankDebt/At | -2,007.41 | -1,002.06 | 1,031.09 | -119.24 | -717.06 | -483.32 | 831.46 | -245.13 |
| | (-1.20) | (-1.02) | (1.27) | (-0.29) | (-0.34) | (-0.49) | (0.97) | (-0.56) |
| (Sum) Change *BankDebt/At | 4.14 | 9.65* | 3.27* | -1.15 | -1.39 | 14.44*** | 1.52 | 1.30 |
| | (0.51) | (1.67) | (1.74) | (-0.58) | (-0.20) | (2.84) | (0.74) | (0.62) |
| *(Sum) Change* BankDebt/At*Constrained* | -5.50 | | 4.41 | | -15.82** | | 0.21 | |
| | (-0.79) | | (1.59) | | (-2.03) | | (0.07) | |
| Market-to-Book | 281.38** | 476.11*** | -88.34 | 773.48*** | 330.31* | 481.26*** | -26.30 | 866.56*** |
| | (2.21) | (5.23) | (-0.54) | (7.14) | (1.93) | (5.27) | (-0.13) | (7.30) |
| CashFlow/Capital | 5,652.95** | 3,212.44 | 6,407.42** | 2,888.91** | 11,226.57*** | 5,846.00*** | 3,430.26 | 5,405.10*** |
| | (2.09) | (1.19) | (2.21) | (2.34) | (2.93) | (2.91) | (1.33) | (3.26) |
| Lagged Investment/Capital | 16,219.03*** | 13,070.66*** | 9,663.72*** | 12,616.35*** | 17,210.22*** | 13,567.38*** | 9,220.25*** | 12,262.66*** |
| | (5.45) | (8.12) | (4.60) | (9.04) | (5.06) | (8.17) | (4.53) | (6.72) |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Change*Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Year-quarter dummies | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry-Quarter Clustering | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 3,813 | 3,770 | 2,037 | 5,207 | 3,664 | 3,671 | 1,940 | 5,078 |

**Table XIII**
**Bank Debt Specialness in the Unconventional Period**

All regressions include firm fixed effects. Hedgers are defined on a yearly basis as those firms that report having hedged their interest rate risk from floating to fixed in their 10-K annual reports. Calculation of other variables is presented in Tables III. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| VARIABLES | (1) ALL | (2) ALL | (3) ALL | (4) Hedgers | (5) Non-Hedgers |
|---|---|---|---|---|---|
| Surprise | -0.33*** | -0.35*** | -0.31*** | -0.24*** | -0.24*** |
| | (-11.67) | (-12.19) | (-10.63) | (-3.36) | (-5.42) |
| Surprise*(BankDebt/At) | | 0.43** | 0.00 | -0.23 | 0.15 |
| | | (1.98) | (0.00) | (-0.61) | (0.28) |
| Surprise*LnAssets | | | -0.11*** | -0.12*** | -0.08*** |
| | | | (-5.27) | (-3.46) | (-2.89) |
| Surprise*Book Leverage | | | 0.24* | 0.65*** | 0.14 |
| | | | (1.92) | (3.03) | (0.74) |
| Surprise*Profitability | | | -0.15 | -0.87 | -0.05 |
| | | | (-0.69) | (-1.40) | (-0.18) |
| Surprise*M/B | | | -0.12*** | -0.19*** | -0.09*** |
| | | | (-5.05) | (-2.89) | (-2.97) |
| Observations | 38,097 | 36,736 | 36,568 | 10,918 | 15,256 |
| R-squared | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 |
| Number of gvkey | 1,903 | 1,792 | 1,779 | 679 | 1,030 |

# APPENDIX

**Table A1**
**Description of Firm Level Variables**

Item codes are from Compustat. CIQ items come from Capital IQ. All data used in regressions is deflated to year 2000 dollars.

| Variable | Construction |
|---|---|
| Bank Debt/At 1 | [Drawn Credit Lines (CIQ) + Term Loans (CIQ)] / Assets (AT) |
| Bank Debt/At 2 | [Drawn Credit Lines (CIQ) + Term Loans (CIQ) + Undrawn Credit Lines (CIQ)]/ Assets (AT) |
| Book Leverage | (Total Debt (DLC+DLTT)) / (Total Debt + Book Value of Equity) |
| Book Value of Equity | Common/Ordinary Equity – Total (CEQ) |
| Cash/At | Cash and Short-Term Investments (CHE)/Total Assets (AT) |
| Cash Flow | Quarterly level measure: earnings before extraordinary items (IBQ) + depreciation (DPQ). |
| Cash Flow Volatility | Standard Deviation of Operating Income Before Depreciation (OIBDP) over Previous 12 Quarters Scaled by Total Assets (AT) |
| CAPM Beta | Monthly CAPM Beta using last 60 months. |
| Floating Interest Rate Debt | Debt with floating interest rate (CIQ) |
| Hadlock-Pierce (HP) measure | HP = $-0.548*Size+0.025*Size^2-0.031*Age$. Size is log of assets (inflation adjusted to 2004). Age is the current year minus the first year that the firm has a non-missing stock price in CRSP. Size (Age) is winsorized at 1% on the low end, and at the $4.5 billion (37 years) on the high end. |
| Hedging Dummy | A dummy variable that takes the value 1 if a firms reports floating-to-fixed interest-rate hedging activities in its 10-K |
| Interest Rate Coverage Ratio | Quarterly level measure: interest expenses (XINTQ) / (interest expenses (XINTQ) + cash flow) |
| Int. Rate Sensitivity of Earnings | Correlation between quarterly firm EBITDA and three-month average LIBOR rates |
| Inventory Investment | Quarterly level measure: logarithm of Inventories (INVTQ) in quarter 't' - logarithm of Inventories in quarter 't-1' (Inventory is deflated to base year 2000) |
| Investment in Capital | Quarterly level measure: logarithm of Property, Plant and Equipment (PPEGTQ) in quarter 't' - logarithm of Property, Plant and Equipment in quarter 't-1' (Property, Plant and Equipment is deflated to base year 2000) |
| Market-to-Book Assets | [Market Value of Equity + Total Debt + Preferred Stock Liquidating Value (PSTKL)] / Total Assets (AT) |
| Market Value of Equity | Stock Price (PRCC_F) × Common Shares Used to Calculate EPS (CSHO) |
| Profitability | Operating Income before Depreciation (OIBDP) / Total Assets (AT) |
| Rated | A dummy variable that takes the value of one if the firm has a long term credit rating from S&P, and zero otherwise |
| Sales Growth | Logarithm of total sales (SALEQ) during quarters 't' to 't+s' – logarithm of total sales during quarters "t-s-1" to "t-1" (sales are deflated to base year 2000) |
| Short-Term Debt | Debt in current liabilities (DLC) and is equal to the total amount of short-term notes and the current portion of long-term debt that is due in one year. |
| Size (At) | Logarithm of Book Value of Total Assets (AT) , deflated to base year 2000 |
| Tangibility | (Inventories (INVT) + Net Plant, Property, Equipment (PPENT))/Total Assets (AT) |
| Total Debt | Long-Term Debt (DLTT) + Debt in Current Liabilities (DLC) |

**Table A2**

**Which Firms Use Bank, Floating-Rate and Short-Term Debt, and Interest Rate Hedging**

This table examines the use of bank debt, floating-rate debt, short-term debt and interest rate hedging, using firm-year data. A constant is included but not reported. All firm characteristics are winsorized at the 1% level. Standard errors are clustered at the firm level. Columns 1-4 use an OLS specification, as in Lemmon, Roberts and Zender (2008), while columns 5 and 6 use a Probit specification. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Bank/At | Bank/At | Floating-Rate Debt/At | Short-Term Debt/At | Hedging | Hedging |
| LnAssets | 0.01*** | | 0.00** | -0.00*** | 0.21*** | |
| | (16.24) | | (2.55) | (-10.13) | (40.54) | |
| Profitability | -0.03*** | -0.02*** | 0.01*** | -0.01*** | 1.42*** | 1.43*** |
| | (-10.08) | (-7.45) | (4.69) | (-4.67) | (19.78) | (20.10) |
| Market to Book | -0.00*** | -0.00*** | -0.00*** | -0.00 | -0.14*** | -0.14*** |
| | (-3.86) | (-7.22) | (-3.11) | (-1.27) | (-22.25) | (-22.98) |
| Book Leverage | 0.18*** | 0.18*** | 0.04*** | 0.05*** | 0.38*** | 0.40*** |
| | (113.33) | (114.16) | (34.31) | (44.82) | (14.27) | (14.99) |
| Unrated | 0.03*** | 0.03*** | 0.00 | 0.00*** | -0.37*** | -0.58*** |
| | (20.13) | (17.13) | (1.31) | (3.35) | (-21.33) | (-37.48) |
| Interest Rate Sensitivity | 0.01 | 0.00 | 0.00 | -0.00 | -0.01 | -0.05*** |
| | (1.56) | (0.83) | (0.05) | (-0.12) | (-0.73) | (-2.68) |
| Cash Flow Volatility | -0.50 | -0.70 | 0.33 | -0.52** | -12.79*** | -13.74*** |
| | (-1.04) | (-1.46) | (1.10) | (-2.33) | (-6.31) | (-6.82) |
| Tangibility | 0.03*** | 0.03*** | 0.01*** | 0.01*** | 0.25*** | 0.28*** |
| | (6.66) | (7.16) | (2.94) | (3.71) | (6.73) | (7.58) |
| Age | -0.00*** | | -0.00*** | 0.00*** | 0.00*** | |
| | (-5.35) | | (-6.44) | (6.14) | (3.18) | |
| HP Index | | -0.01*** | | | | -0.48*** |
| | | (-4.78) | | | | (-34.32) |
| Bank/At | | | 0.76*** | 0.09*** | 3.04*** | 2.92*** |
| | | | (268.07) | (41.96) | (48.57) | (47.29) |
| Year FE | YES | YES | YES | YES | YES | YES |
| Industry FF48 FE | YES | YES | YES | YES | YES | YES |
| Observations | 69,179 | 69,179 | 67,127 | 69,179 | 64,654 | 64,654 |
| Number of gvkey | 2,564 | 2,564 | 2,503 | 2,564 | | |

**Table A3**

**Response of Equity Prices to Federal Funds Rate Changes: Comparison across Samples**

The table reports the results from regressions of equity returns on the surprise and expected components of the change in the federal funds rate, all expressed in percentage terms. Outliers are excluded following the analysis of Bernanke and Kuttner (2005) based on a Cook's D statistic greater than 0.1. As in Bernanke and Kuttner (2005), for the period 1994-2002 outliers include October 15, 1998, January 3, 2001, March 20, 2001, April 18, 2001, and September 17, 2001 which are discussed in their paper. For the period 2003-2008, outlier dates are January 22, 2008, and March 18, 2008. Both of which are characterized by very large rate cuts. On January 21, 2008, in response to deteriorating market conditions, the Federal Open Market Committee (FOMC) held an unscheduled meeting (conference call) despite the national holiday (Martin Luther King day). They decided on a rate cut of 75 basis points (bp), which they announced shortly before the opening of U.S. markets. Although the rate cut was almost entirely unexpected, with an unprecedented surprise of -74bp, stock prices declined by almost 100bp compared to their closing price before the holidays. Shortly after, on March 18, 2008, the FOMC announced another unusually large cut in the federal funds rate (-75bp) in response to turmoil in the markets and the collapse of Bear Stearns. Stocks rallied in response, although the federal funds futures data suggested that some market participants had expected an even larger rate cut (about 100bp).

Column 1 contains returns for a value-weighted equity index. Columns 2-5 report returns for individual firm-date observations over different sample periods. Column 5 includes only observations for which data on bank debt is available. The firm level regressions contain random effects. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| | (1)<br>Daily Value-weighted Index<br>1994-2008 | (2)<br>Daily Returns<br>All Firms<br>1994-2008 | (3)<br>Daily Returns<br>All Firms<br>1994-2002 | (4)<br>Daily Returns<br>All Firms<br>2003-2008 | (5)<br>Two-day Returns<br>Our Sample<br>2003-2008 |
|---|---|---|---|---|---|
| Expected | 0.421 | 0.209*** | 0.193*** | 0.133*** | -0.641*** |
| | (1.00) | (8.40) | (5.73) | (3.90) | (8.13) |
| Surprise | -3.359** | -2.704*** | -2.424*** | -4.665*** | -4.451*** |
| | (-2.05) | (-32.46) | (-25.67) | (-25.64) | (11.60) |
| # Observations | 115 | 536,357 | 363,290 | 173,067 | 66,200 |

**Table A4**

**The Role of Bank Debt Usage and Interest Rate Risk Exposure in the Transmission of Monetary Policy**

This table examines how the reaction of firm equity prices to surprise changes in the federal funds rate varies with their level of bank dependence. The sample consists of U.S. firms covered by Capital IQ, CRSP and Compustat from 2003 to 2008, excluding utilities (SIC 4900-4949) and financials (SIC 6000-6999). We focus on firms with December fiscal year end to avoid asynchronous balance sheet items and use 2-day returns in order to allow the effect of bank-debt to be fully incorporated in stock prices. We remove firm-year observations with negative revenues, missing information on total assets, or a value of total assets under 10 million. We also discard penny stocks, defined as those with a price of less than $5. The sample comprises 43 monetary policy events from 2003 to 2008. Firm characteristics are demeaned and are lagged by one year and winsorized at the 1% level. The regression specification is as in equation (1). Unreported terms include a constant and non-interacted coefficients. In specification (6) we add undrawn credit lines to bank debt and normalize the resulting ratio to have the same standard deviation as the original BankDebt/At. Standard errors are clustered at the date level in specifications (1)-(2) and two-way clustered at the date and industry levels in specifications (4)-(7). Industries are Fama-French 48 industries. Square brackets around the estimates of the coefficient of surprise in columns (4)-(7) are introduced to indicate that, due to the interaction of surprise with industry fixed effects, these estimates cannot be interpreted as the estimate applicable to the average firm. Parentheses contain t-statistics. The asterisks denote *** for $p<0.01$, ** for $p<0.05$, * for $p<0.1$. Hadlock and Pierce (2010) measure given by HP = $-0.548*Size+0.025*Size^2-0.031*Age$.

| | (1) | (2a) | (2b) | (2c) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | No Controls | Mkt. Return Control | CAPM Control | Fama-French Control | Other Controls | Industry FE & Event-Industry Clustering | Inc. Undrawn Credit Lines | Other Controls | Firm Fixed Effects | Instrumental Variable | Floating Rate Debt |
| Surprise | -4.97*** | 2.93*** | 1.28*** | -0.09 | -8.02*** | [-7.44] | [-8.07] | [-9.83] | -8.04*** | -8.07*** | -8.81*** |
| | (-13.03) | (8.22) | (3.66) | (-0.25) | (-17.72) | (-0.83) | (-0.90) | (-1.10) | (-3.33) | (-17.12) | (-3.63) |
| Surprise*(BankDebt/At) | -14.10*** | -12.31*** | -10.52*** | -8.09*** | -16.34*** | -16.77*** | -14.62*** | -15.22*** | -16.37*** | -14.50 | -13.79** |
| | (-4.35) | (-4.15) | (-3.54) | (-2.63) | (-4.17) | (-3.82) | (-3.10) | (-3.30) | (-2.69) | (-0.58) | (-2.48) |
| Surprise*LnAssets | | | | | -0.95*** | -1.12*** | -1.06*** | -0.07 | -0.94*** | -1.00** | -1.01** |
| | | | | | (-3.67) | (-4.19) | (-3.99) | (-0.15) | (-2.64) | (-2.06) | (-2.53) |
| Surprise*Book Leverage | | | | | 3.28** | 3.83* | 2.59 | 4.24** | 3.15 | 2.44 | 4.49* |
| | | | | | (1.96) | (1.85) | (1.32) | (1.98) | (1.28) | (0.40) | (1.71) |
| Surprise*Profitability | | | | | -16.10*** | -11.49** | -11.08** | -8.16 | -15.36** | -15.68*** | -16.54 |
| | | | | | (-6.10) | (-2.19) | (-2.13) | (-1.33) | (-2.08) | (-4.06) | (-1.45) |
| Surprise*M/B | | | | | -0.02 | -0.41 | -0.41 | -0.71 | 0.01 | 0.10 | 0.43 |
| | | | | | (-0.08) | (-0.77) | (-0.78) | (-1.31) | (0.01) | (0.25) | (0.42) |
| Surprise*Int Rate Sensitivity | | | | | | | | -7.05** | | | |
| | | | | | | | | (-2.24) | | | |
| Surprise*Cash-Flow Volatility | | | | | | | | -77.57 | | | |
| | | | | | | | | (-0.55) | | | |
| Surprise*Beta | | | | | | | | 1.47** | | | |
| | | | | | | | | (2.16) | | | |
| Surprise*Cash Holdings | | | | | | | | 3.37 | | | |
| | | | | | | | | (0.96) | | | |
| Surprise*HP | | | | | | | | 4.22*** | | | |
| | | | | | | | | (3.42) | | | |
| Firm FE | NO | NO | NO | NO | NO | NO | NO | NO | YES | YES | YES |
| FF48 Industry FE | NO | NO | NO | NO | NO | YES | YES | YES | NO | NO | NO |
| Year FE | NO | NO | NO | NO | YES | YES | YES | YES | YES | YES | YES |
| Surprise*FF48 Industry FE | NO | NO | NO | NO | NO | YES | YES | YES | NO | NO | NO |
| Cluster (Fed event*IndustryFF48) | NO | NO | NO | NO | NO | YES | YES | YES | YES | NO | YES |
| Observations | 64,682 | 64,682 | 64,557 | 64,549 | 64,428 | 62,871 | 62,746 | 55,506 | 64,428 | 63,626 | 41,710 |

**Table A5**

**The Role of Bank Debt Usage and Interest Rate Risk Exposure in the Transmission of Monetary Policy: Excluding Positive Rate Changes**

This table repeats Table II after discarding those FOMC announcements with positive rate changes. Hedgers are defined on a yearly basis as those firms that report having hedged their interest rate risk from floating to fixed in their 10-K annual reports. Only firms with floating rate debt constituting more than 1% of total assets are included. Bank Debt/At is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). FloatingRateDebt /At is defined as floating rate debt over the book value of assets (At). All regressions also include an unreported constant term, as well as ln(assets), book leverage, profitability, market-to-book, interest rate sensitivity, and their interaction with surprise. All firm characteristics are lagged by one year and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| Main Variables | (1) Non-Hedgers | (2) Hedgers | (3) Non-Hedgers | (4) Hedgers | (5) Non-Hedgers | (6) Hedgers | (7) Non-Hedgers | (8) Hedgers |
|---|---|---|---|---|---|---|---|---|
| Surprise | -3.44*** | -7.84*** | -4.42 | -5.96* | -3.94*** | -7.41*** | -5.14* | -5.41* |
| | (-3.28) | (-7.71) | (-1.62) | (-1.94) | (-3.92) | (-7.56) | (-1.91) | (-1.74) |
| Surprise *(BankDebt/At) | -25.20*** | 0.59 | -38.68*** | 1.96 | | | | |
| | (-2.91) | (0.10) | (-3.13) | (0.20) | | | | |
| Surprise *(FloatingRateDebt /At) | | | | | -20.64** | -3.98 | -29.97** | -6.35 |
| | | | | | (-2.47) | (-0.73) | (-2.26) | (-0.64) |
| Difference (1)–(2), (3)–(4), (5)–(6), (7)–(8) | 25.61** | | 40.64*** | | 16.32* | | 23.62 | |
| | (2.48) | | (2.75) | | (1.66) | | (1.43) | |
| Surprise *log(Assets) | | | -2.02*** | -0.70 | | | -1.65** | -0.98 |
| | | | (-2.82) | (-0.97) | | | (-2.26) | (-1.37) |
| Surprise *Book Leverage | | | 6.43 | -6.13 | | | 6.02 | -3.62 |
| | | | (1.29) | (-1.32) | | | (1.16) | (-0.78) |
| Surprise *Market-to-Book | | | -0.25 | 2.34* | | | -0.16 | 2.35* |
| | | | (-0.19) | (1.66) | | | (-0.12) | (1.67) |
| Surprise *Profitability | | | -13.14 | -24.14 | | | -13.79 | -24.12 |
| | | | (-1.07) | (-1.07) | | | (-1.13) | (-1.06) |
| Surprise *Int. Rate Sensitivity | | | -9.80* | -5.33 | | | -10.38* | -5.57 |
| | | | (-1.67) | (-0.80) | | | (-1.79) | (-0.84) |
| Firm Controls | NO | NO | YES | YES | NO | NO | YES | YES |
| Firm FE | NO | NO | YES | YES | NO | NO | YES | YES |
| Surprise*Firm Controls | NO | NO | YES | YES | NO | NO | YES | YES |
| Cluster (Fed event*IndustryFF48) | NO | NO | YES | YES | NO | NO | YES | YES |
| Observations | 7,067 | 7,585 | 7,067 | 7,585 | 7,067 | 7,585 | 7,067 | 7,585 |

**Table A6**
**The Role of Bank Debt Usage and Interest Rate Risk Exposure in the Transmission of Monetary Policy**
**Cumulative Returns in two Days before the FOMC announcement**

This table provides a placebo experiment by repeating Table II after replacing the dependent variable with the cumulative returns over the two days before the FOMC announcement. Hedgers are defined on a yearly basis as those firms that report having hedged their interest rate risk from floating to fixed in their 10-K annual reports. Only firms with floating rate debt constituting more than 1% of total assets are included. Bank Debt/At is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). FloatingRateDebt /At is defined as floating rate debt over the book value of assets (At). All regressions also include an unreported constant term, as well as ln(assets), book leverage, profitability, market-to-book, interest rate sensitivity, and their interaction with surprise. All firm characteristics are lagged by one year and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| Main Variables | (1)<br>Non-Hedgers | (2)<br>Hedgers | (3)<br>Non-Hedgers | (4)<br>Hedgers |
|---|---|---|---|---|
| Surprise | -1.98 | -2.82 | -2.30 | -2.53 |
| | (-1.00) | (-1.08) | (-1.19) | (-0.97) |
| Surprise *(BankDebt/At) | 2.45 | 4.10 | | |
| | (0.26) | (0.59) | | |
| Surprise *(FloatingRateDebt /At) | | | 23.77** | 0.61 |
| | | | (2.36) | (0.09) |
| Surprise *log(Assets) | -0.89 | -0.81 | -0.50 | -0.93 |
| | (-1.29) | (-1.13) | (-0.74) | (-1.32) |
| Surprise *Book Leverage | -0.26 | -3.30 | -5.33 | -2.40 |
| | (-0.07) | (-0.73) | (-1.29) | (-0.53) |
| Surprise *Market-to-Book | 2.28** | -0.34 | 2.35** | -0.34 |
| | (2.36) | (-0.22) | (2.41) | (-0.22) |
| Surprise *Profitability | 2.71 | 23.97 | 0.09 | 23.88 |
| | (0.38) | (1.46) | (0.01) | (1.45) |
| Surprise *Int. Rate Sensitivity | -0.65 | -0.48 | -0.56 | -0.59 |
| | (-0.14) | (-0.10) | (-0.12) | (-0.12) |
| Firm Controls | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES |
| Cluster (Fed event*IndustryFF48) | YES | YES | YES | YES |
| Observations | 11,788 | 12,334 | 11,788 | 12,334 |

**Table A7**
**The Role of Interest Rate Risk Exposure in the Transmission of Monetary Policy:**
**First Stage Regressions of Instrumental Variables Analysis**

Following Graham and Smith (1999) and Campello, Lin, Ma, Zou (2011), Vol is the volatility of taxable income, Corr is the serial correlation of taxable income, DITC is a dummy for investment tax credits, DNOL is a dummy for net operating losses, and DSmallNeg (DSmallPos) is a dummy for small negative (positive) taxable income. We calculate the volatility of taxable income and the serial correlation of taxable income on a rolling basis, using historical annual data up to the year of interest, starting in 1989. Column (1) uses lagged hedging dummy as instrument for hedging. Column (2) uses the variables underlying the convexity measure, excluding *Vol*, whereas column (3) uses all variables. Column (4) uses the tax convexity measure, Convexity, directly, as given in the text. Column (5) uses both the lagged hedging dummy and the tax convexity measure. Only firms with floating rate debt constituting more than 1% of total assets are included. A constant, non-interacted terms, and the policy surprise interacted with firm size, book leverage, profitability and the market-to-book ratio are included but not reported for brevity. All firm characteristics are lagged by one year and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

Panel A: Bank Debt

| VARIABLES<br>Surprise*(BankDebt/At)* | (1)<br>IV<br>L.hedging | (2)<br>IV1<br>Convexity | (3)<br>IV2<br>Convexity | (4)<br>IV3<br>Convexity | (5)<br>IV<br>Both |
|---|---|---|---|---|---|
| L.hedgingdummy | 0.69*** | | | | 0.67*** |
| | (116.06) | | | | (73.74) |
| Corr | | -0.01 | -0.00 | | |
| | | (-0.71) | (-0.31) | | |
| DITC | | -0.23*** | -0.23*** | | |
| | | (-12.08) | (-11.74) | | |
| DSmallNeg | | -0.87 | -0.74 | | |
| | | (-0.42) | (-0.36) | | |
| DNOL | | 0.16*** | 0.16*** | | |
| | | (11.48) | (11.58) | | |
| DNOL*DSmallNeg | | 2.17 | 1.77 | | |
| | | (0.67) | (0.55) | | |
| DSmallPos | | 1.41 | 1.59 | | |
| | | (0.03) | (0.04) | | |
| DNOL*DSmallPos | | -2.00 | -2.28 | | |
| | | (-0.05) | (-0.05) | | |
| Vol | | | -0.00 | | |
| | | | (-0.40) | | |
| Convexity | | | | 0.02*** | -0.00 |
| | | | | (9.75) | (-1.62) |
| Observations | 23,413 | 12,009 | 12,009 | 12,009 | 11,665 |
| R-squared | 0.86 | 0.75 | 0.75 | 0.74 | 0.87 |
| Firm FE | YES | YES | YES | YES | YES |
| Firm Controls | YES | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES | YES |
| F-stat | 6012 | 441.5 | 385.0 | 1390 | 2024 |

Panel B: Floating Rate Debt

| VARIABLES<br>Surprise*(FloatingRateDebt/At)* | (1)<br>IV<br>L.hedging | (2)<br>IV1<br>Convexity | (3)<br>IV2<br>Convexity | (4)<br>IV3<br>Convexity | (5)<br>IV<br>Both |
|---|---|---|---|---|---|
| L.hedgingdummy | 0.70*** | | | | 0.68*** |
| | (120.40) | | | | (77.82) |
| Corr | | -0.18*** | -0.17*** | | |
| | | (-12.35) | (-11.99) | | |
| DITC | | -0.16*** | -0.15*** | | |
| | | (-8.30) | (-7.88) | | |
| DSmallNeg | | 3.25 | 2.00 | | |
| | | (0.49) | (0.30) | | |
| DNOL | | 0.15*** | 0.15*** | | |
| | | (10.89) | (10.86) | | |
| DNOL*DSmallNeg | | -2.78 | -1.62 | | |
| | | (-0.44) | (-0.25) | | |
| DSmallPos | | 8.68 | 8.31 | | |
| | | (0.04) | (0.04) | | |
| DNOL*DSmallPos | | -9.37 | -9.20 | | |
| | | (-0.05) | (-0.05) | | |
| Vol | | | 0.00 | | |
| | | | (0.57) | | |
| Convexity | | | | 0.04*** | 0.01*** |
| | | | | (20.86) | (8.36) |
| Observations | 23,413 | 12,009 | 12,009 | 12,009 | 11,665 |
| R-squared | 0.87 | 0.77 | 0.77 | 0.76 | 0.88 |
| Firm FE | YES | YES | YES | YES | YES |
| Firm Controls | YES | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES | YES |
| F-stat | 6564 | 477.1 | 415.8 | 1553 | 2346 |

**Table A8**
**Interest Rate Risk Exposure and the Transmission of Monetary Policy: The Role of Financing Constraints**
**Whited-Wu and Kaplan_Zingales Measures**

Hedgers are defined on a yearly basis as those firms that report having hedged their interest rate risk from floating to fixed in their 10-K annual reports. Financial constraints are proxied with Whited-Wu (WW) quarterly measure as reported in Whited and Wu (2006) and Kaplan-Zingales (KZ) measure, as reported in Lamont, Polk, Saa-Requejo (2001). Accordingly, KZ = –1.001909[(IB+DP)/lagged PPENT] + 0.2826389[ (AT + PRCC_F×CSHO - CEQ - TXDB)/AT] + 3.139193[(DLTT + DLC)/(DLTT + DLC + SEQ)] – 39.3678[(DVC + DVP)/lagged PPENT] – 1.314759[CHE/lagged PPENT] and WW = –0.091 [(IB + DP)/AT] – 0.062[indicator set to one if DVC + DVP is positive, and zero otherwise] + 0.021[DLTT/AT] – 0.044[log(AT)] + 0.102[average SIC 3-digit industry sales growth each year] – 0.035[sales growth]. All capitalized mnemonics refer to Compustat data items. The financial constraint measure takes value 1 if the corresponding measure is above the median in a given year. Only firms with floating rate debt constituting more than 1% of total assets are included. Bank Debt/At is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). All regressions also include an unreported constant term, as well as ln(assets), book leverage, profitability, market-to-book, interacted with surprise and uninteracted. All firm and lender characteristics are lagged by one year and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | LOW WW | HIGH WW | LOW WW | HIGH WW | LOW KZ | HIGH KZ | LOW KZ | HIGH KZ |
| VARIABLES | NONHEDGER | NONHEDGER | HEDGER | HEDGER | NONHEDGER | NONHEDGER | HEDGER | HEDGER |
| Surprise | -2.59 | -6.66** | -6.11** | -11.56*** | -6.86*** | -3.51** | -3.24 | -7.86*** |
| | (-1.08) | (-2.54) | (-2.31) | (-3.40) | (-3.24) | (-2.04) | (-0.89) | (-3.68) |
| Surprise*BankDebt/At | -18.82 | -51.93*** | 0.59 | 6.95 | -45.70* | -45.79*** | -26.92* | 7.91 |
| | (-1.24) | (-3.36) | (0.07) | (0.47) | (-1.84) | (-3.76) | (-1.72) | (0.91) |
| Surpr.*(BankDebt/At)* | -33.11 (columns 1–2) | | 6.36 (columns 3–4) | | -0.0834 (columns 5–6) | | 34.83* (columns 7–8) | |
| Constrained | (1.50) | | (0.39) | | (0.00) | | (1.84) | |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 5,291 | 5,996 | 7,893 | 3,795 | 3,879 | 6,909 | 2,703 | 8,436 |
| R-squared | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 |
| Number of gvkey | 363 | 489 | 450 | 285 | 344 | 510 | 189 | 516 |

**Table A9**

**Interest Rate Risk Exposure and the Transmission of Monetary Policy: The Role of Liquidity Constraints**

**Current Ratio and Interest Coverage Ratio**

Hedgers are defined on a yearly basis as those firms that report having hedged their interest rate risk from floating to fixed in their 10-K annual reports. Liquidity constrained firms are those with current ratio (Current Assets/Current Liabilities) below the median or interest coverage ratio above the median in a given year. The interest coverage ratio is equal to interest expenses (XINT) divided by the sum of cash flow and interest expenses. Cash flow is equal to earnings before extraordinary items (IB) plus depreciation (DP). All capitalized mnemonics refer to Compustat data items. Only firms with floating rate debt constituting more than 1% of total assets are included. Bank Debt/At is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). All regressions also include an unreported constant term, as well as ln(assets), book leverage, profitability, market-to-book, interacted with surprise and uninteracted. All firm and lender characteristics are lagged by one year and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| VARIABLES | (1) CURRENT RATIO UNCONSTR. NONHEDGER | (2) CURRENT RATIO CONSTR. NONHEDGER | (3) CURRENT RATIO UNCONSTR. HEDGER | (4) CURRENT RATIO CONSTR. HEDGER | (5) COVERAGE RATIO UNCONSTR. NONHEDGER | (6) COVERAGE RATIO CONSTR. NONHEDGER | (7) COVERAGE RATIO UNCONSTR. HEDGER | (8) COVERAGE RATIO CONSTR. HEDGER |
|---|---|---|---|---|---|---|---|---|
| Surprise | -7.30*** | -3.18* | -7.92*** | -8.33*** | -4.51** | -6.94*** | -2.83 | -11.63*** |
| | (-3.73) | (-1.80) | (-2.84) | (-3.59) | (-2.35) | (-2.70) | (-0.93) | (-4.94) |
| Surprise*BankDebt/At | -17.48 | -49.19*** | 8.79 | -1.06 | -30.07* | -41.00*** | 3.20 | 7.46 |
| | (-0.93) | (-3.84) | (0.52) | (-0.13) | (-1.65) | (-3.02) | (0.18) | (0.93) |
| Surpr.*(BankDebt/At)* Constrained | -31.71 | | -9.857 | | -10.93 | | 4.258 | |
| | (1.41) | | (0.55) | | (0.47) | | (0.21) | |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 4,978 | 6,450 | 3,320 | 8,351 | 5,963 | 5,457 | 4,262 | 7,975 |
| R-squared | 0.01 | 0.01 | 0.03 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 |
| Number of gvkey | 417 | 496 | 257 | 532 | 459 | 470 | 331 | 517 |

**Table A10**

**The Effect of Monetary Policy on Fixed Investment – Analysis using Monetary Policy Surprises**

This table examines how monetary policy affects firm fixed investment and how this effect varies with bank debt usage and interest rate risk hedging. Inventories are calculated as Total Inventories (INVTQ), and *Fixed Investment* $_{t-1,t+x}$ is computed as the difference (in basis points) between the log of property, plant and equipment (PPEGTQ) *x* quarters ahead and the log of PPEGTQ at the end of the quarter before the monetary policy surprise occurs. *Surprise* is the sum of all surprises in the federal funds rate that occur during a quarter. *Hedgers* are defined as those firms that report having hedged their interest rate risk from floating to fixed in their 10K annual reports. Only firms with floating rate debt constituting more than 1% of total assets are included. *Bank Debt/At* is defined as bank debt (term loans plus drawn revolving credit) over the book value of assets (At). All regressions also include an unreported constant term. Controls include the lagged investment to capital ratio, the lagged cash holdings to capital ratio, and the market to book ratio, and also (unreported): ln(assets), book leverage, market-to-book, profitability and interest rate sensitivity of operating income. All firm controls are lagged by one quarter and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| Dependent variable: $\ln(PPE_{t+x}) - \ln(PPE_{t-1})$ | x=4 quarters ahead | | | | x=6 quarters ahead | | | |
|---|---|---|---|---|---|---|---|---|
| | Non-hedgers | | Hedgers | | Non-hedgers | | Hedgers | |
| | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) | Constrained (high HP) | Unconstrained (low HP) |
| (Sum) Surprise (<u>*omitted*</u>) | | | | | | | | |
| BankDebt/At | -1,764.02 | -828.41 | 989.51 | -93.86 | -618.15 | -312.49 | 841.93 | -258.83 |
| | (-1.07) | (-0.84) | (1.21) | (-0.23) | (-0.30) | (-0.31) | (0.97) | (-0.59) |
| (Sum) Surprise | 15.27 | 42.02*** | 2.28 | -3.08 | -18.73 | 48.24*** | 1.99 | -1.03 |
| *BankDebt/At | (0.64) | (2.75) | (0.51) | (-0.54) | (-1.05) | (3.27) | (0.39) | (-0.17) |
| *(Sum) Surprise** | -26.74 | | 5.36 | | -66.97** | | 3.01 | |
| *BankDebt/At*Constrained* | (-1.65) | | (0.74) | | (-4.19) | | (0.40) | |
| Market-to-Book | 283.36** | 467.50*** | -106.77 | 769.00*** | 337.19** | 475.44*** | -40.56 | 863.15*** |
| | (2.20) | (5.13) | (-0.67) | (7.15) | (1.98) | (5.18) | (-0.21) | (7.30) |
| CashFlow/Capital | 5,746.04** | 3,162.56 | 6,435.81** | 2,858.27** | 11,257.96*** | 5,782.55*** | 3,500.91 | 5,374.71*** |
| | (2.11) | (1.16) | (2.23) | (2.31) | (2.94) | (2.87) | (1.36) | (3.24) |
| | 16,215.94*** | 13,209.57*** | 9,745.25*** | 12,662.08*** | 17,325.72*** | 13,773.10*** | 9,317.81*** | 12,314.08*** |
| Lagged Investment/Capital | (5.44) | (8.18) | (4.67) | (9.06) | (5.08) | (8.26) | (4.59) | (6.73) |
| Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm FE | YES | YES | YES | YES | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES | YES | YES | YES | YES |
| Year-quarter dummies | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry-Quarter Clustering | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 3,813 | 3,770 | 2,037 | 5,207 | 3,664 | 3,671 | 1,940 | 5,078 |

**Table A11**
**Short-Term Debt and the Response of Equity Prices to Federal Funds Rate Changes**

This table examines how the reaction of firm equity prices to surprise changes in the target federal funds rate varies with their usage of short-term debt. Short-Term Debt/At is defined as debt in current liabilities (item 34) over the book value of assets. Columns 2 and 4 include (unreported) log(assets), profitability, book leverage, the market-to-book ratio, and their interaction with policy surprise. All firm characteristics are lagged by one year, demeaned, and winsorized at 1%. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Surprise | -5.04*** | -8.11*** | -4.97*** | -8.02*** |
| | (-13.32) | (-18.07) | (-13.03) | (-17.73) |
| Surprise*(ShortTermDebt/At) | -10.30 | -8.30 | -4.36 | -5.26 |
| | (-1.38) | (-1.06) | (-0.56) | (-0.66) |
| Surprise*(BankDebt/At) | | | -13.64*** | -15.99*** |
| | | | (-4.09) | (-4.05) |
| Firm Controls | NO | YES | NO | YES |
| Surprise*Firm Controls | NO | YES | NO | YES |
| Year FE | NO | YES | NO | YES |
| Observations | 65,893 | 65,649 | 64,658 | 64,428 |

**Table A12**

**Is Bank Debt Special for the Transmission of Monetary Policy? Normalizing Bank Debt with Total Debt**

This table examines how the reaction of firm equity prices to changes in the federal funds rate varies with their level of bank dependence. The sample consists of U.S. firms covered by Capital IQ, CRSP and Compustat from 2003 to 2008, excluding utilities (SIC 4900-4949) and financials (SIC 6000-6999). We focus on firms with December fiscal year end to avoid asynchronous balance sheet items and use 2-day returns in order to allow the effect of bank-debt to be fully incorporated in stock prices. We remove firm-year observations with negative revenues, missing information on total assets, or a value of total assets under 10 million. We also discard penny stocks, defined as those with a price of less than $5. The sample comprises 43 monetary policy events from 2003 to 2008. Firm characteristics are demeaned and are lagged by one year and winsorized at the 1% level. The regression specification is as in equation (1). Unreported terms include a constant and non-interacted coefficients. In specification (5) we add undrawn credit lines to bank debt and normalize the resulting ratio to have the same standard deviation as the original BankDebt/At. Standard errors are clustered at the date level in specifications (1)-(2) and two-way clustered at the date and industry levels in specifications (4)-(7). Industries are Fama-French 48 industries. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| | (1) No Controls | (2) With Controls | (3) Event-indust. Clustering | (4) Including Credit Lines | (5) Other Controls | (6) Firm Fixed Effects | (7) Instrumental Variable | (8) Floating Rate Debt |
|---|---|---|---|---|---|---|---|---|
| Surprise | -5.60*** | -8.20*** | [-8.27] | [-8.58] | [-10.51] | -8.19*** | -8.22*** | -8.57*** |
| | (-13.65) | (-16.33) | (-0.92) | (-0.96) | (-1.17) | (-3.51) | (-14.32) | (-3.51) |
| Surprise*(BankDebt/Debt) | -2.18** | -3.04*** | -3.06*** | -1.61 | -3.14*** | -2.85** | -3.20 | -1.53 |
| | (-2.12) | (-2.73) | (-2.87) | (-1.58) | (-2.75) | (-2.18) | (-0.35) | (-0.95) |
| Surprise*LnAssets | | -0.77*** | -1.05*** | -0.79*** | -0.15 | -0.73* | -0.79 | -0.85** |
| | | (-2.76) | (-3.74) | (-2.83) | (-0.32) | (-1.90) | (-0.86) | (-2.16) |
| Surprise*Book Leverage | | 0.38 | 0.52 | -0.05 | 0.80 | 0.30 | 0.52 | 1.32 |
| | | (0.25) | (0.28) | (-0.02) | (0.40) | (0.13) | (0.32) | (0.50) |
| Surprise*Profitability | | -21.36*** | -14.62** | -15.21** | -12.29 | -21.73** | -22.41*** | -17.99 |
| | | (-6.93) | (-2.26) | (-2.35) | (-1.53) | (-2.40) | (-4.53) | (-1.58) |
| Surprise*M/B | | 0.40 | -0.16 | -0.02 | -0.23 | 0.45 | 0.40 | 0.55 |
| | | (1.20) | (-0.25) | (-0.04) | (-0.33) | (0.57) | (0.75) | (0.55) |
| Surprise*Int Rate Sensitivity | | | | | -7.42** | | | |
| | | | | | (-2.44) | | | |
| Surprise*Cash-Flow Volatility | | | | | -91.93 | | | |
| | | | | | (-0.62) | | | |
| Surprise*Beta | | | | | 1.83** | | | |
| | | | | | (2.44) | | | |
| Surprise*Cash Holdings | | | | | 1.19 | | | |
| | | | | | (0.32) | | | |
| Surprise*HP | | | | | 3.94*** | | | |
| | | | | | (3.13) | | | |
| Firm FE | NO | NO | NO | NO | NO | YES | YES | YES |
| FF48 Industry FE | NO | NO | YES | YES | YES | NO | NO | NO |
| Year FE | NO | YES | YES | YES | YES | YES | YES | YES |
| Interacted FF48 Industry FE | NO | NO | YES | YES | YES | NO | NO | NO |
| Cluster (Fed event*IndustryFF48) | NO | NO | YES | YES | YES | YES | NO | YES |
| Observations | 53,054 | 53,028 | 51,963 | 51,963 | 45,972 | 53,028 | 52,398 | 41,665 |

**Table A13**

**Bank Debt Specialness and Firm Financing Constraints**

This table examines how the effect of monetary policy on firm stock prices varies with their exposure to bank debt and their level of financial constraints. Financial constraints are proxied with the firm's age and the Hadlock and Pierce (2010) measure given by HP = -0.548*Size+0.025*Size$^2$-0.031*Age. Firm size is defined to be the log of assets (inflation adjusted to 2004). Age is defined as the current year minus the first year that the firm has a non-missing stock price in CRSP. Firm size and age are at the 1% tails on the low end, and at the $4.5 billion and thirty-seven year points on the high end. The financial constraint measure takes value 1 if the firm's age is below the median or firm's HP statistic is above the median in a given year. Only firms with floating rate debt constituting more than 1% of total assets are included. A constant, non-interacted terms, and the policy surprise interacted with firm size book leverage, profitability and the market-to-book ratio are included but not reported. All firm characteristics are lagged by one year and winsorized at the 1% level. Industries are defined according to the Fama French 48 sector grouping. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| VARIABLES | AGE | HP | AGE | HP |
| Surprise | -4.92*** | -2.31 | -5.47*** | -2.80 |
| | (-3.25) | (-1.18) | (-3.69) | (-1.47) |
| Surprise*Financial Constraint Measure | 0.67 | -3.85 | 0.56 | -4.28* |
| | (0.36) | (-1.57) | (0.31) | (-1.79) |
| Surprise*Hedging | -1.95 | | -0.83 | -1.29 |
| | (-0.95) | | (-0.42) | (-0.63) |
| Surprise*(BankDebt/At) | -28.00** | -29.20** | | |
| | (-2.50) | (-2.46) | | |
| Surprise*(BankDebt/At)*Financial Constraint Measure | -16.79 | -12.50 | | |
| | (-1.43) | (-1.04) | | |
| Surprise*(BankDebt/At)*Hedging | 41.25*** | 40.41*** | | |
| | (3.36) | (3.27) | | |
| Surprise*(FloatingRateDebt /At) | | | -19.31* | -25.18** |
| | | | (-1.73) | (-2.21) |
| Surprise*(FloatingRateDebt /At)*Financial Constraint Measure | | | -17.02 | -5.33 |
| | | | (-1.48) | (-0.45) |
| Surprise*(FloatingRateDebt /At)*Hedging | | | 24.55** | 26.06** |
| | | | (2.04) | (2.16) |
| Firm FE | YES | YES | YES | YES |
| Firm Controls | YES | YES | YES | YES |
| Surprise*Firm Controls | YES | YES | YES | YES |
| Observations | 24,123 | 24,123 | 24,123 | 24,123 |
| R-squared | 0.01 | 0.01 | 0.01 | 0.01 |
| Number of gvkey | 1,283 | 1,283 | 1,283 | 1,283 |

**Table A14 – Dynamic Model Simulated Regressions: Variable Definitions**

| Variable | Definition |
|---|---|
| Investment Rate | $\frac{i_t}{k_t} = \frac{k_{t+1}(k_t,b_t,\theta_t,z_t,r_t)-k_t}{k_t}$ |
| Stock Return | $r_t^S = \frac{V(k_t,b_t,\theta_t,z_t,r_t)+(1+r_{t+1})d_t-V(k_{t-1},b_{t-1},\theta_{t-1},z_{t-1},r_{t-1})}{V(k_{t-1},b_{t-1},\theta_{t-1},z_{t-1},r_{t-1})}$ |
| Leverage | $\frac{b_t}{k_t}$ |
| Tobin's Q | $Q_t = \frac{V(k_t,b_t,\theta_t,z_t,r_t)+b_t}{k_t}$ |
| Bank Debt Usage | $\theta_t$ |
| Surprise Monetary Policy Shock | $s_t = r_t - E_{t-1}(r_t)$ |
| Monetary Policy Change | $\Delta r_t = r_t - r_{t-1}$ |
| Firm Size | $n_t$ |
| Interest Rate Surprise Change | $s_t = r_t - E_{t-1}[r_t]$ |
| Interest Rate Change | $\Delta r_t = r_t - r_{t-1}$ |
| Instance of a Covenant Violation | $\mathbf{1}_{\{n_t<0\}} = 1$ |
| Costs of Financial Distress | $\frac{\eta \mathbf{1}_{\{n_t<0\}}\rho n_t}{V(k_t,b_t,\theta_t,z_t,r_t)+\bar{b}}$ |
| Interest Rate Coverage Ratio | $\frac{c_t b_t}{\pi_t}$ |

**Table A15**

**The Effect of Monetary Policy using Simulated Data – Robustness using Bank Debt over Assets**

This table displays regression results using simulated data from our dynamic model in Section 2.2 in which we use floating rate debt over total assets as our proxy for exposure to floating rate debt. It provides robustness for all the results on Tables II and II. Δrate refers to *Surprise* in stock return regressions, and *Change* in all other regressions. The definitions of all the variables used are described in detail in Appendix B. Parentheses contain t-statistics. The asterisks denote *** for p<0.01, ** for p<0.05, * for p<0.1.

| Dep variable: | Stock Returns | Stock Returns | Investment/K (4Q Ahead) | Investment/K (6Q Ahead) | Covenant Violation Likelihood | Costs of Financial Distress | Interest Rate Coverage Ratio |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Δrate | -14.52*** | -11.60*** | -1.81*** | -0.99*** | -0.21 | -0.53*** | -1.24*** |
| | (-49.05) | (-54.70) | (-48.09) | (-25.52) | (-0.88) | (-9.38) | (-4.53) |
| Δrate *(BankDebt/At) | -1.46*** | -1.38*** | -0.09*** | -0.06*** | 0.02 | 0.09*** | 0.79*** |
| | (-60.03) | (-79.83) | (-31.87) | (-21.18) | (1.01) | (19.58) | (35.15) |
| Constrained* Δrate *(BankDebt/At) | -0.25*** | -0.22*** | -0.02** | -0.01 | -0.02 | 0.21*** | 0.52*** |
| | (-3.95) | (-4.93) | (-2.32) | (-0.35) | (-0.40) | (17.76) | (8.99) |
| Controls | YES | YES | YES | YES | YES | YES | YES |
| R-squared | 0.72 | 0.24 | 0.19 | 0.07 | 0.56 | 0.55 | 0.48 |
| Observations | 38,000 | 38,000 | 38,000 | 38,000 | 38,000 | 38,000 | 38,000 |