Stock Market's Assessment of Monetary Policy Transmission: The Cash Flow Effect*

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Abstract

We show that firm liability structure and associated cash flows matter for firm behavior, and that financial market participants price stocks accordingly. Looking at firm level stock price changes around monetary policy announcements, we find that firms that have more cash flow exposure see their stock prices affected more. The stock price reaction depends on the maturity and type of debt issued by the firm, and the forward guidance provided by the Fed. This effect has remained intact during the ZLB period. Importantly, we show that this effect is not a rule of thumb behavior outcome and that the marginal stock market participant actually studies and reacts to the liability structure of firm balance sheets. The cash flow exposure at the time of monetary policy actions predicts future investment, assets, and net worth, verifying the stock pricing decision and also providing evidence of cash flow effects on firms' real behavior. The results hold for S&P500 firms that are usually thought of not being subject to tight financial constraints.

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1 Introduction

An influential branch of the macro-finance literature has focused on financial conditions to amend standard macroeconomic models to better fit the observed effects of monetary policy on real activity, which also helps explain why financial markets are so important and financial crises so destructive. These models, in which the Modigliani-Miller theorem fails, collectively require cash in the firm to be more valuable than cash outside it. The financial accelerator models are compelling, but the literature remains thinner on empirical evidence due to the difficulty of establishing identified effects. Similarly, our understanding of the effects of monetary policy on stock prices also remains incomplete. This is at least in part because individual stocks are heterogeneous in many dimensions and the interaction of monetary policy with firm heterogeneity, and how these are reflected in stock pricing is only a nascent literature. Monetary policy effects on stock prices are more often studied at the aggregate or industry level, as in the influential work of Bernanke and Kuttner (2005).

In this paper, we study stock market reaction to monetary policy at the level of individual firms' equity prices, reflecting the stock market participants' beliefs about monetary policy's effects on firm performances. Our object of interest is the liability difference caused by fixed versus floating rate obligations of otherwise similar firms. Fixed rate liabilities are, in a net present value sense, lowered by higher interest rates, and their future cash flows are *unchanged* by these. For floating rate liabilities, their net present values are either unchanged or mildly lowered, but future cash flow obligations *increase* with higher interest rates.

Given this difference, an increase in the policy rate, apart from its standard macroeconomic and discount rate impacts, creates two effects. The first one is mechanical: it causes a cash transfer from equity holders to bond (or loan) holders if debt is an unhedged floating rate one, and the effect is larger the longer the maturity of the debt and stronger the forward guidance. Whether this effect is priced in at high frequency, in response to monetary policy surprises, is an interesting question. We study this.

The second effect arises due to firms' cash flow exposures. Current and expected future cash flows change in response to monetary policy surprises based on the amount and maturity of floating rate liabilities on firms' balance sheets, and whether these liabilities are hedged. If financial accelerator channels are present in the data, as higher interest rates induce cash outflows, firms with more cash flow exposure should be more adversely affected by higher interest rates. This should again lower firm values for firms with high cash flow exposures and, importantly, also lead to changes in real outcomes for these firms. We study this as well.

The first effect, if present in the data, is a balance sheet effect that leads to a redistribution. But, if the Modigliani-Miller theorem holds, it will not have direct effects on firm behavior—a reshuffling of liabilities between loan and bond holders and residual claimants (stock holders) will have no real effects. The second possible effect, which leads to changes in real outcomes at the firm level due to cash flow exposure, is a direct channel of monetary policy transmission and a test of the Modigliani-Miller theorem. We find strong evidence for both effects.

Although we will discuss these in detail throughout the paper, the gist of the mechanism we have in mind that underlies our econometric tests boils down to comparing two firms that are otherwise identical but one having issued fixed and the other floating rate debt of the *same maturity*. Assume that this is either because lenders of the firm having agreed to lend at that maturity and form because of lender specific reasons, or the CFO of the firm having beliefs about the path of short rates that favored this liability structure. Supporting this interpretation, Kirti (2020) finds that banks that have more floating rate liabilities choose to lend more in floating rates and hold more floating rate securities and Barbosa and Özdağlı (2020) show that lender effects are present in the bond market as well. The key for us is the independence of this aspect of the firm liability structure from the actual policy surprise and the surprise not differentially affecting the firms through other channels.[1]

Note that focusing on the maturity dimension is important and will be one of our key contributions. One period fixed and floating rate (after the last reset date) debt are not different, they both will mature and either will be paid off or rolled over at the new (post policy) interest rates. But with longer maturities, fixed and floating rate debt of the same maturity have different properties. Loosely, one can think of long maturity floating rate debt as being rolled over every period at the new short rates, with rolling over guaranteed until maturity. Expected cash flow within maturity depends on expected short rates until then. On the other hand, fixed rate debt only gets rolled over infrequently, at maturity, and has the same fixed cash flow until maturity irrespective of the short rates. The longer the maturity of debt (our exposure measure) and larger the change in expected short rates (monetary policy path surprise), the more pronounced the difference between the two liability structures. The difference in cash flows created by fixed vs floating rate debt as a function of debt maturity and forward guidance surprises is therefore the object of our study.

If financial market participants price this information in, firm level stock price responses to

[1] Our identification clearly rests on the exogeneity of the fixed versus floating rate debt and maturity structure with respect to the monetary policy surprise, and the extensive list of covariates we control for and the robustness checks, including IV, we perform will be to achieve and document that.

monetary policy will depend on the balance sheet structure and monetary policy path surprises in a testable way, with more exposed firms' stock prices falling more in response to positive (contractionary) policy path surprises. And if financial market frictions are present for the S&P500 firms we are looking at–Modigliani-Miller fails–we should expect to see real effects of monetary policy at firm level, again more exposed firms' real outcomes being worse in response to positive policy path surprises.

To establish this mechanism, we proceed in two steps. Our first test is whether firms that have more cash flow exposure due to having issued more and longer maturity floating rate debt see their stock prices decline more in response to monetary policy surprises regarding forward guidance in high frequency. This is indeed the case. We show that the relevant measure of monetary policy is not the surprise in the current setting of interest rates but surprises about future path of rates, and that it is the interaction of this surprise with cash flow exposure, which depends not only on the amount but also on the maturity of floating rate obligations that predicts stock price reactions. We further show that, when measured this way, stock market reactions to monetary policy surprises as a function of cash flow exposure of firms have not changed during the Zero Lower Bound (ZLB) period: forward guidance has been as effective during the ZLB as it had been before it.

Before proceeding to real effects, we take a detour and ask what we find to be an interesting question: is it the case that the marginal stock market investor actually knows the balance sheet of the relevant firm, how much cash flow exposure it has, and prices in the interaction of cash flow exposure and monetary policy at high frequency, or is it that because cash flow exposure is quite persistent for most firms, stock market participants learn rules of thumb where certain firms fare worse in, say, tightening cycles? We devise tests to answer this question and find that what drives these stock price effects in high frequency is indeed knowledge of balance sheets and understanding of their interactions with monetary policy rather than rules of thumb. The marginal stock market investor is quite sophisticated.

Lastly, we show that firms that have more cash flow exposure fare worse in real outcomes in the quarters following surprise policy path increases. In particular, we show that following a monetary policy tightening their capital investment expenditures decline and total assets and net worth are lower, showing the real effects of a cash flow channel. These effects are based on balance sheet changes due to monetary policy actions external to the firm and constitute strong empirical evidence for real effects of cash flows. It is notable that we find these effects for S&P500 firms, which are often thought of as the least financially constrained corporations.[2]

Articulating our arguments and coming up with our econometric approach requires leaning on methods and ideas from the monetary policy event study literature, the firm valuation and stock pricing sub-strands of corporate finance and asset pricing literatures, and the literature on the role of financial frictions in monetary policy transmission.

There is an extensive literature studying the relationship between asset prices and monetary policy. Some examples are Thorbecke (1997) and Ehrmann and Fratzscher (2004) who study the relationship between monetary policy and stock returns, and Kuttner (2001) and Gürkaynak et al. (2005) who introduce the high frequency identification of monetary policy surprises and examine their impact on stock prices and bond yields, which Campbell et al. (2012) and Swanson (2021) extend to consider the effectiveness of unconventional monetary policy in recent years. Gorodnichenko and Weber's (2016) work is particularly pertinent to ours in that they provide evidence for stock market participants' awareness of different sectors' price stickinesses and how such information is priced following monetary policy announcements. We study a similar question in the context of firms' liability structures.

The literature on the interplay between monetary policy and financial frictions is rich, especially in theoretical work. Some examples in this vein include Gertler and Gilchrist (1994), Kiyotaki and Moore (1997, 2019), Bernanke et al. (1999), Gertler and Kiyotaki (2010), Adrian et al. (2012), Ciccarelli et al. (2013), and Gertler and Karadi (2015) whose works are mainly concerned with the credit channel of monetary policy. However, as Boivin et al. (2010) argue, the literature on unconventional or non-neoclassical transmission mechanisms is still thin, and this is mainly due to the lack of supporting empirical evidence.

There is also interest in the effects of monetary policy on firm liabilities. Kashyap et al. (1993) and Becker and Ivashina (2014), among others, have shown that firms try to substitute other forms of borrowing when bank loans decline, suggesting the existence of a bank lending channel. Three recent papers in this literature that are relevant for our work are English et al. (2018) who demonstrated how interest rate shocks transmit to bank equity valuations through interactions with the maturity mismatch between bank assets and liabilities; Greenwald (2019), who found that changes in interest rates also push firms closer to interest coverage covenants, which have real effects; and the important work of Ippolito et al. (2018) who showed that bank loan leverage, which is mostly floating rate, matters in stock price response to monetary

[2]S&P500 firms are by definition large and, with exceptions, older firms. Hadlock and Pierce (2010) find large and old firms do not face tight financial constraints. Looking at S&P500 directly, Brisker et al. (2013) show that the inclusion in the index relaxes financial constraints of firms and note that S&P500 firms should not be thought of being financially constrained. We will show that even for these firms cash flow matters.

policy surprises but that this relationship broke down during the ZLB episode. We build on the conceptual framework of the latter paper and show the importance of accounting for the maturity dimension both for the difference it makes in stock pricing and for tracking real effects. The theoretical model in that paper has implications for the relevance of debt maturity but it is here that we are able to offer empirical evidence for its salience. Doing so also shows that the effect in question has persisted at the ZLB as well. We deliberate on these further below.

The household finance side of this question was studied by Di Maggio et al. (2017), who showed that households with adjustable rate mortgages saw greater effects of low interest rates and had larger real reactions. Even more related to us, Garriga et al. (2017) found that it was the combination of long-duration adjustable rate mortgages and persistent monetary policy shocks that had large effects on household balance sheets and housing investment. We think of a firm balance sheet analogue of this mechanism, introducing controls so that firm liability structure can be treated as exogenous to policy here, similar to mortgages in that literature.

On the real side of monetary policy transmission, we inform the cash flow sensitivity of investment debate which goes back to Fazzari et al. (1988) and Kaplan and Zingales (1997). Our proposed measure of a firm's exposure to interest rate risks enables a structured and better identified analysis of the cash flow effect of monetary policy, which propagates through the firm's liability structure and ultimately impinges on its investment behavior. Investment is sensitive to cash flow.

Lastly and obviously, we contribute to the literature on stock price determination. This is a very large literature with important contributions in different dimensions including responses of stock prices to monetary policy such as Bernanke and Kuttner (2005), Ippolito et al. (2018), and Gorodnichenko and Weber (2016). We interpret our findings as evidence of investor sophistication, which is intimately tied to the issue of stock market efficiency. Some examples from this literature are Maloney and Mulherin (2003) who provide evidence in support of stock market sophistication by studying price discovery in the aftermath of the Challenger crash, and Chen et al. (2020) who document how hedge funds' information acquisition activities mitigate the impairment to information flows following exogenous reductions in analyst coverage due to the closures of brokerage firms. We contribute by showing that market participants know the current liability structure of S&P500 firms and quickly price in interactions of this with monetary policy forward guidance after FOMC announcements.

We present the main results, discussion, and brief robustness analysis in this paper and relegate details and a battery of tests that further establish robustness of results to an extensive online appendix.

2 Data and Summary Statistics

This section describes the data and provides summary statistics relevant for our analysis. Our sample begins in 2004, when detailed information on debt type and maturity becomes available, and ends in 2018. There were 127 FOMC announcements between January 2004 and December 2018. We employ our preferred measures of floating rate exposure while controlling for bank debt leverage to make sure that our results are not proxying for leverage, which as Ippolito et al. (2018) shows, matters.[3]

Whereas individual firms differ in many dimensions, our interest will be on their cash flows. In particular, we will be looking at changes in expected cash outlays of firms on days of monetary policy surprises due to unhedged floating rate obligations on their balance sheets, controlling for other firm characteristics.

We explain data sources and construction below and provide details in the appendix. Before going into specifics, it is useful to clarify the frequencies at which various components of our data are measured and how these work together.

The monetary policy surprise, measured in two components–policy setting (target) and forward guidance (path) surprises–is the main impulse in our analysis and is available intraday. The interest rate implications of monetary policy are immediately priced in fixed income markets and our intraday measures based on those minimize the measurement error in this key RHS variable.

We use equity prices of individual firms at daily frequency, the highest frequency at which the data is available to us. We study the equity price responses in one- and two-day windows. Finding the effects we document in these windows for this LHS variable shows that these are not initial jumps that are reversed within the day; the effects persist. If the effects are present at intraday frequency, our daily data adds noise to the system, lowering statistical significance. The results are nonetheless statistically very significant. Whether these cash flow effects are present in the intraday data, what the highest frequency data these effects can be found is, how fast the interaction of policy guidance and cash flow exposure gets prices in, are excellent questions that are left for future work. Our focus is on daily frequency stock price reactions to monetary policy surprises.

[3]We also use shorter sample of 2004-2008 to overlap with the baseline sample of Ippolito et al. (2018) so that the results can be compared.

The remainder of the data are based on firms' financial statements that are observed quarterly, some of which are filed annually but in different quarters for different firms. Controls such as firm size, leverage, and a long list of others, including whether the firm has interest rate hedges, are quarterly observations. The hand verified hedging indicator we constructed in the spirit of Ippolito et al. (2018) is the cleanest quarterly binary hedging indicator in the literature and is available to other researchers.

The cash flow exposure variable, incorporating debt type and maturity information, is observed as a clean measure annually and as a noisier and less available measure quarterly. We use the annual measure as baseline and show that the results are robust to using the quarterly measure when available.

To the extent that our quarterly observations of balance sheet variables overlap with the market participants' information sets (we lag the balance sheet variables, as explained below, to make sure that the information we condition on was available to market participants on the policy date), the regressions we run will correspond exactly to the mechanism we have in mind. If market participants have access to more frequent updates to balance sheet variables, including exposure, our variables will contain classical measurement error, attenuating the coefficients. Our coefficients of interest are statistically and economically significant nonetheless.

The variables we employ in assessing the real effects (assets, net worth, etc.) are also based on firm balance sheets and are similarly observed quarterly. In this case, changes we study also take place at quarterly frequency–unlike stock price changes that are daily–hence we aggregate the monetary policy surprises within the quarter to find a quarterly policy surprise measure.

2.1 Monetary Policy Data

In low frequencies, such as with quarterly observations, establishing causal links between stock prices and monetary policy is difficult hence the literature has moved towards high frequency event studies. This literature uses daily or higher frequency changes in prices of short-dated money market instruments or derivatives to measure monetary policy surprises on policy dates, and the reaction of stock prices to these. The standard is to use the scaled changes in spot-month Federal Funds Futures contracts, as pioneered by Kuttner (2001). Figure 1 shows the aggregate S&P500 reaction to these monetary policy surprises.

It is rather clear that there were very few policy surprises in the Kuttner surprise sense between 2004, when our data begins, and 2008, when the Global Financial Crisis hit and monetary policy in the US reached the ZLB, with no surprises in the policy setting for several years afterwards. This is not because monetary policy had no surprises in this period, but because policy surprises came from the statement, changing expectations about the future course of policy rates, rather than surprises in the immediate policy setting. In fact, this had been the case before the ZLB as well: the FOMC signaled its policy decision fairly transparently before the meetings took place, hence the surprise in the 21st century always came mainly from what is now called forward guidance.

We use Gürkaynak et al. (2005) measures of monetary policy surprises (GSS surprises henceforth) in our analysis. The GSS surprises are constructed under the identifying assumption that the FOMC announcement drives changes in asset prices in a thirty-minute window bracketing the announcement. Therefore, the asset price changes during this window of time can be attributed to a genuine monetary policy surprise which could not have been anticipated on the basis of what was known up until the announcement. The use of high frequency data makes this identifying assumption credible, which is also the identifying assumption underlying the Kuttner surprises that are daily.

GSS surprises, unlike Kuttner's measure of monetary policy surprises employed by Ippolito et al. (2018), are two-dimensional. The first dimension is exclusively related to the change in the current policy setting and the second dimension to the change in the market perceptions of future policy rates (e.g., forward guidance). Following Gürkaynak et al. (2005), we refer to them as "target factor" and "path factor" respectively. These are the first two principal components of the change in the yield curve up to one year maturity in a thirty-minute window bracketing an FOMC announcement, rotated such that one factor (path) is orthogonal to the Kuttner surprise. Hence, the path factor captures only the revisions to expectations of interest rates up to a year ahead that are not driven by the surprise in the current policy action (target), and the two rotated factors remain orthogonal to each other by construction. Campbell et al. (2016) and Swanson (2021) discuss the mechanics of the GSS surprises and extend these to help think about other questions. The temporal separation afforded by the GSS surprises is particularly useful in light of the fact that floating rate debt maturity, which relates firm liabilities to future expected interest rates, plays an important role in our analysis.

Figure 2 shows the S&P500 response to monetary policy, this time separately to the target and path surprises. The target factor is essentially the Kuttner surprise hence the top panel of the figure is about the same as Figure 1, in a longer sample. The bottom panel is striking and shows both that path surprise variance has been high in this period and that aggregate stock prices have responded strongly to these.[4]

[4]In their paper GSS do not find a significant effect of the path factor on stock prices in the 1990-2004 sample when path surprises and hence identifying variation were rarer. Monetary policy effects on stock index

While introducing the path surprises allows capturing much more of the monetary policy surprise variance and the resulting changes in aggregate stock returns, one can make little inference from these aggregate stock price responses that is useful in understanding the transmission of monetary policy. We therefore turn to individual stock prices, where we can use cross-sectional variations in firms' cash flow exposure to study a particular type of financial accelerator as well as testing market participants' understanding of firm balance sheets and monetary policy effects on these.

2.2 Firm-level Data

To analyze how the FOMC announcements affect the financial market's assessments of individual firms' exposures to floating rate debts and stock prices, we construct a panel data set whose cross-sectional dimension corresponds to firms in the S&P500 index and time (event) dimension to the FOMC announcement dates. Appendix A lists the data we utilize, their frequencies, and sources.

Our sample is the set of firms that were part of S&P500 at any point between 1957 (creation of the index) and 2018 (end of our sample) whose balance sheet data are also available in Capital IQ (CIQ) database. This gives us 975 firms in total.[5] The stock return we focus on is computed using the log-difference of the closing quotes of stock prices the day before and the day after an FOMC announcement, obtained from the Center for Research in Security Prices (CRSP) database.[6]

We relate the stock return to a measure of a firm's cash flow exposure, stemming from floating rate debts. These are financial obligations whose interest rates vary with benchmark rates, most often the London Interbank Offered Rate (LIBOR) over the course of their contract periods. To calculate cash flow exposure, we require detailed information about firms' debt structures beyond face values, such as debt categories (e.g., bank loans, bonds, etc.), interest rate types (fixed vs. floating rate), and maturity per category/type. These are available at annual frequency in 10-K forms of CIQ database that are filed at the end of each firm's fiscal year.[7] In robustness we also use information from mostly unaudited quarterly 10-Q forms.

aggregates are also confounded by possible time varying information effects, where surprises may also signal central banks' private information and exert different influences on aggregate indices based on the information perceived by market participants. Our identification, based on cross-sectional differences in firm liability structures, is independent of these effects.

[5] Our results are robust to using a much smaller sample of firms that have never left the index.

[6] Similarly, our results are robust to using a one-day window, from the close of the day before the FOMC meeting, to the close of the day of the announcement.

[7] Appendix B provides details and descriptive statistics.

Floating rate exposure of each firm in our sample is constructed as follows: First, floating rate debt items which are convertible, issued in currencies other than US Dollars, or are non-recourse as well as debt items which have already defaulted are removed. These are collectively a small fraction of all debt issuance and are removed as they understandably behave very differently from other debt. Second, for each item, its maturity is set to either the final payment date that is stipulated on the contract or the simple average of the lower and upper bound of the designated payment interval depending on which case is applicable. The maturity of a perpetuity (very rare in the sample) is set to 100 years. Finally, the maturity of each debt item from the previous step is multiplied by the corresponding leverage ratio (i.e., outstanding value of the debt item over total assets of the firm) and summed across the items to give the firm's floating rate exposure:

$$Exposure_i = \sum_j \frac{FRDA_{ij}}{TA_i} FRDM_{ij} \tag{1}$$

where subscript i indexes firm and subscript j debt item. Time subscript is omitted for simplicity. *FRDA* and *FRDM* are the amount and maturity of the floating rate debt item respectively, and *TA* stands for total assets. By construction, this measure captures both maturity and leverage of a firm's floating rate obligations, and is thus a measure of its future cash flow exposure. For this reason, we use the expressions "floating rate exposure" and "cash flow exposure" interchangeably when referring to it. Some of this debt are callable. As the firm will exercise the option only when it will benefit the shareholders, callability biases the results against finding the mechanism we are testing.

The standard balance sheet items, explained in detail in Appendix A, are obtained from the Compustat database. Based on these, we compute size, profitability, book leverage, market-to-book ratio, asset maturity, and other firm characteristics that are used as control variables in our analysis. These are available at quarterly frequency and their properties are discussed below. Our empirical work also employs financial slacks, retained earnings, dividend per share, and short-term debt as control variables. Size is deflated by CPI and recast in real terms. Floating rate exposure and leverage, profitability, market-to-book ratio, financial slacks, retained earnings, and short-term debt, which are scaled by total assets, need not be deflated.

We employ two measures of floating rate leverage, (as opposed to exposure), which were studied by Ippolito et al. (2018). First is bank debt leverage as a fraction of total assets that assumes bank debts are the floating component of firm liabilities. We also consider floating rate debt leverage, which is total floating rate debts (all obligations, including bank debt, indicated to have variable interest rates) over total assets. Both measures are calculated using CIQ and Compustat and are included in our analysis to distinguish leverage from exposure.

Figure 3, which plots floating rate debt leverage against bank debt leverage, shows that the two measures are closely related. Figure 4, however, reveals that our preferred measure of cash flow exposure contains variations that are differentially informative over and above those contained in the leverage measures. These figures visually suggest that maturity matters, independently of leverage. Our econometric work will formalize that argument. Similarly, Figure 5 provides the simple average of the exposure measure in each decile of bank debt leverage. It confirms the positive relationship between the two as shown in Figure 4, but also indicates that the relationship is neither linear nor monotonic.

We address firms' interest rate risk hedging behavior in a way that keeps our measure close to that of Ippolito et al. (2018), in spirit but we increase the frequency from annual to quarterly. We first construct a dummy variable for hedging by using as inputs the 10-K reports from the Securities and Exchange Commission (SEC) database (which are the original source of 10-K forms in CIQ). The reports, which every firm regulated by the SEC is required to file at the end of its fiscal year, provide textual information about the firm's hedging decisions related to interest rate risks. We set the dummy variable for hedging to 1 if the following phrases are found on the report: "hedge interest rate," "hedge against interest rate," "interest rate swap," or their variants.[8] As will be seen later, the positive interaction effect among the path surprise, the cash flow exposure, and the hedging dummy provides further evidence for the cash flow channel of monetary policy.

To control for the possibility that interest rate derivatives are purchased for speculative purposes rather than hedging motives, the firms which invest in interest rate derivatives even though their floating rate leverage ratios (i.e., total floating rate debts over total assets) are below 1% are dropped from the sample. This decreases the number of firms to 873 in the baseline sample (from January 2004 to December 2008) and 935 in the extended sample (from January 2004 to December 2018). Lastly, we drop financial firms as these are very different from other firms in many dimensions and have the final sample sizes of 720 and 773 respectively.[9] We conduct our empirical analysis on these samples, for which summary statistics are presented

[8]We also check for false positives such as "not hedge interest rate," "not use interest rate swap," etc. This hedging indicator is also checked by hand and improves the state of the art in binary hedging measures. Bretscher et al. (2018) propose a continuous hedging measure that we do not use in the paper because the data required to construct it is available for only a fraction of our sample. As an aside, hedging is a persistent variable with a median hedging autocorrelation of 0.6 in the quarterly data we have compiled.

[9]Although we drop financial firms for comparability to earlier literature, our results are insensitive to whether financial and/or utility firms are in the sample.

in Table 1.

We merge the event window stock returns and the GSS factors with the firm-level variables described above, taking into account the fact that the end of fiscal year differs across firms. This allows matching the latest available balance sheet information in CIQ (available at annual frequency in our baseline) to the FOMC announcements at quarterly frequency rather than using calendar years, which sacrifices resolution. Because the SEC requires 10-K forms to be released to public within 90 days following the end of a firm's fiscal year, we assume that both Compustat and CIQ variables are observed with one quarter delay.[10]

3 Cash Flow Channel of Monetary Policy

This section tests the joint hypothesis that monetary policy affects cash flows of firms based on their unhedged floating rate debt exposures and that market participants reflect this in stock prices at high frequency. We indeed find strong evidence in favor of this conjecture. Based on our event study of the FOMC announcements, we further find that floating rate exposure, rather than floating rate leverage, is an important determinant of stock market reactions to monetary policy surprises, and that the cash flow channel of monetary policy operates through the innovation to the expected path of future policy rates, rather than to the target for the current policy rate. The cash flow channel manifests itself in the negative interaction effect between the cash flow exposure and the monetary policy path (forward guidance) surprise. The interaction of hedging and these variables has a positive effect, showing that interest rate hedging is indeed perceived by stock market participants as protecting against this floating rate effect.

We also find that the monetary policy channel discussed above was not changed at the ZLB, which confirms the view that forward guidance was a dominant source of monetary policy surprises, operating symmetrically in and out of the ZLB. This is consistent with the recent work of Debortoli et al. (2020) and Swanson (2018) who, looking at different metrics of policy effectiveness, also argue that monetary policy transmission was not different at the ZLB.

Figure 6 illustrates the motivation behind our event study and highlights the importance

[10]In our sample, 98% of firms file their 10-K forms within 90 days. Our results continue to hold with more noise under a more conservative data matching scheme which assumes that firm balance sheet variables are observed with a 180-day delay, as in Fama and French (1992), or with a one year delay as in Ippolito et al. (2018), who use annual data.

of focusing on exposure rather than leverage.[11] The top panel provides partial regression plots between stock returns and both floating rate exposure (triangles) and floating rate leverage (squares) for the FOMC announcement on March 28, 2006. This event was associated with a (contractionary) path surprise of about 18 basis points. On this day, the firm level stock return and exposure correlation is -0.25, consistent with a cash flow channel working through exposure. On the other hand, the correlation between stock returns and leverage is about 0.14, which does not indicate a cash flow effect. The figure shows that the range of exposure is much wider than that of leverage, as maturity variance is also present in exposure. Based on the evidence for that day, it is visually clear that the maturity of debt matters in understanding the interaction between monetary policy surprises and stock price reactions.

The bottom panel presents similar partial regression plots for the FOMC announcement on August 8, 2006, which was associated with a path surprise of about -3 basis points. In contrast to the top panel, now the correlation between stock return and the exposure measure is about 0.22, which reflects the expansionary nature of the surprise. Again, this supports our proposition regarding the cash flow channel where stock prices of firms with higher exposure to floating rates fare better in response to easing surprises in high frequency. The correlation between stock return and the leverage measure, on the other hand, is -0.04 which is practically zero but whose sign nonetheless goes against the mechanics of a cash flow channel. The figure and the associated correlations on these dates suggest that floating rate exposure, not floating rate leverage, is the appropriate measure for studying the cash flow effect of monetary policy.[12] In what follows, our event study will investigate this systematically, taking full advantage of the panel structure of our data set.

3.1 Empirical Design

As discussed by Gürkaynak and Wright (2013), the event study methodology based on high-frequency data allows researchers to circumvent endogeneity issues related to omitted variable bias and reverse causality. This is especially useful in the current context because there is evidence that at low frequencies the FOMC decisions are influenced by stock market movements (Rigobon and Sack, 2004; D'Amico and Farka, 2011).

[11] To make the figure clear and informative, for both event dates we plot only the observations whose exposure levels are above the bottom third in the whole sample. The figure is harder to decipher but the implications are qualitatively the same without this filter.

[12] Note that these are partial regression plots for exposure conditional on leverage (and other controls) and vice versa which are consistent with the panel data analysis that will be presented below. This is the pattern of correlations for the vast majority of events in our sample irrespective of the size of monetary policy surprises.

Identification of the policy surprise is established by conditioning on the timing of FOMC releases and high-frequency responses to the surprise components of these. By definition of the surprise, the target and path factors are independent over time, therefore analysis can be done via OLS. The panel structure of our data lends itself naturally to fixed effects estimation, where we include firm and/or time fixed effects and cluster standard errors at the event (time) level.

The model we estimate is

$$\triangle p_{it} = \beta_0 + \beta_1 target_t + \beta_2 path_t + \beta_3 exposure_{it-1}$$

$$\beta_4 target_t * exposure_{it-1} + \beta_5 hedge_{it-1} * target_t * exposure_{it-1}$$

$$+\beta_6 path_t * exposure_{it-1} + \beta_7 hedge_{it-1} * path_t * exposure_{it-1}$$

$$+\beta_8 leverage_{it-1} + \beta_9 target_t * leverage_{it-1} + \beta_{10} hedge_{it-1} * target_t * leverage_{it-1}$$

$$+\beta_{11} path_t * leverage_{it-1} + \beta_{12} hedge_{it-1} * path_t * leverage_{it-1}$$

$$+ \lambda(remaining\ controls\ and\ interaction\ terms) + \varepsilon_{it} \quad (2)$$

where i is the firm subscript, t is the FOMC announcement subscript, $\triangle p_{it}$ is the stock return bracketing an FOMC announcement, $target_t$ is the monetary policy target (Kuttner) surprise, $path_t$ is the monetary policy forward guidance surprise, $hedge_{it-1}$ is the hedging dummy whose value is equal to one if firm i hedges against interest rate risks, $leverage_{it-1}$ is the floating rate leverage measure, and $exposure_{it-1}$ is the floating rate exposure measure. Regressions include firm and/or time fixed effects and controls including size, profitability, book leverage ratio, market-to-book ratio, asset maturity, and more variables, with interactions, listed in table notes. For the record, of these controls the most consequential ones are size and asset maturity. All variables in the regression other than the monetary policy surprise and the stock price change are lagged by a quarter (or more, in robustness) to make sure that the relevant variables are in the market participants' information sets.

The intraday monetary policy surprise measure and the long list of covariates and interactions included, which are shown in the Appendix, and extended in robustness checks (Section 3.3), are used to identify the effect of monetary policy surprises on stock prices through cash flow exposure. The covariates and interactions control for other mechanisms (that may be correlated with cash flow exposure) through which monetary policy surprises affect firms. For example, if larger firms have more exposure, and size affects the stock price reaction directly, controlling for size makes sure that this effect does not appear through exposure. Importantly, any firm specific, time invariant unobservable will be captured by the fixed effects. Here, it is also useful to note that lagging the exposure measure to make sure that it is in market participants' information set further helps in identification as the lagged exposure measure will not reflect contemporaneous unobservable firm level behavior that is correlated with current exposure, which may be transmitting policy surprises directly to stock prices (although it is not easy to think what such behavior may be). We use this insight as the basis of an IV robustness exercise in Section 3.3 as well.

3.2 Results

We first analyze the pre-ZLB period in the US (January 2004 to December 2008), which helps us show that the mechanism works through the interaction of cash flow *exposure* and the monetary policy *path* surprise. We then use this finding to reinterpret the ZLB period (January 2009 to December 2015). The full sample (January 2004 to December 2018) also includes the post-ZLB period which allows us to further our argument that the cash flow channel of monetary policy was intact throughout the first two decades of the 21st century.

3.2.1 Pre-ZLB Results

Table 2 shows the baseline findings of our paper. The first column is analogous to Ippolito et al. (2018) with our data, and shows that when there is a surprise in the policy action (target) firms that have more floating rate leverage see their stock prices more affected; however, having hedged against interest rate risk mitigates this effect.[13] Thus, in this regard our data has the same properties as those used in earlier work.

Our contribution begins with the second column which shows that when we use our exposure measure and allow both target and path surprises as well as both leverage and exposure, the relevant variable turns out to be exposure's interaction with path. Once again, having hedged against interest rate risk lessens the impact of the cash flow exposure on stock prices of the firms. Note that the R^2 more than doubles as we move from target and leverage to path and exposure, showing the importance of the additional information on maturity embedded in the exposure measure in understanding stock price reactions to monetary policy. One might

[13] Here we use bank debt to measure floating rate leverage rather than debt that is explicitly identified as floating rate. This is different from our exposure measure, which uses all debt that is declared to be on floating rate. Appendix B-6 shows that using the analogous floating rate leverage measure rather than bank debt in this and other regressions does not affect our results.

expect the target and exposure interaction to also matter, to the extent that surprises to the current setting of policy also change expectations of the policy stance going forward. While the idea is correct, the target surprise does not exert a statistically significant effect on year-ahead expected rates (as measured by the change in the fourth eurodollar futures contract, not shown for brevity) and explains a trivial share of their variance. The path surprise alone captures changes in the expected future path of the short rate and therefore path alone triggers the channel through cash flow exposure that we are studying.

The third column of the table shows that when all covariates are included in the regression, the information in the exposure measure encompasses that of leverage, as expected from its design, and only the interaction of exposure with path exerts a statistically significant effect on firm level stock prices. Note that including the leverage and its interactions does not help in an R^2 sense either, further suggesting that it is the exposure measure that matters, and leverage works in regressions excluding exposure because it partially proxies for the more informative measure. And note again that hedging against interest rate risks counteracts the negative effect on stock prices.

Finally, the last two columns of the table employ Fama-French adjusted stock returns (i.e., the difference between raw stock return and expected stock return based on the Fama-French three-factor model, Fama and French (1992, 1993, 1995)) over the event window as an alternative dependent variable.[14] R^2 increases substantially in this case, indicating that our floating rate exposure measure accounts for a substantial proportion of firm level variations in policy day stock returns that are not attributed to the standard Fama-French factors.

These results suggest that market participants pay attention to firms' balance sheets, in particular to their liability structures, and factor in the transfer between debt and stock holders that arise when expectations of future interest rates change (path surprise) in pricing stocks. This is a high level of sophistication, an issue we return to in Section 4. It should be clear that Table 2 by itself is silent on whether monetary policy's impact through floating rate exposure has real effects. The transfer between debt and stock holders alone will qualitatively generate Table 2, even if the Modigliani-Miller theorem holds and this balance sheet effect has no real repercussions. We study the monetary policy transmission effects in Section 5.

[14]The Fama-French adjustment is along the lines of Gorodnichenko and Weber (2016) where factor loadings are full sample coefficients of the returns on the factors and the predicted returns based on these are deducted from the raw returns to obtain adjusted (abnormal) returns.

3.2.2 Did Monetary Policy Work Differently at the ZLB?

A nascent literature argues that monetary policy at the ZLB worked just like unconstrained monetary policy, through the use of forward guidance and quantitative easing (Debortoli et al. (2020); Swanson (2018)). An important exception is Ippolito et al. (2018), who find that the floating rate channel only worked before the ZLB and ceased to exist when the constraint was binding.

Table B-7 shows that the floating rate channel remained intact during the ZLB.[15] We test for a change in the relationship at the ZLB by including a binary variable for this period (from January 2009 to December 2015) and interacting it with the cash flow channel variables. None of those interactions are statistically significant, showing that the binding constraint on immediate policy actions did not materially affect the cash flow channel, which depends on the interaction of path and cash flow exposure.[16] Thus, when measured using our exposure measure, the cash flow channel effects at the ZLB are also consistent with the notion that the ZLB did not pose a major impediment to monetary policy effectiveness during the Great Recession.[17]

What this result shows, other than the fact that monetary policy transmission to financial markets was unchanged during the ZLB in this dimension as well, is that fully measuring the cash flow exposure of firms–inclusive of debt maturity–and the monetary policy component this interacts with–forward guidance–are important constituent parts of answers to substantive questions. This point is worth emphasizing: although for simplicity we often model interest rates and debt to be of one period, for some questions their maturities are of paramount importance. The balance sheet and monetary policy surprise measures we make use of, which are theoretically coherent, demonstrate that factoring these in makes a difference in empirical applications.

[15] Table B-7 in Appendix B provides the regression coefficients for all regressors.

[16] The marginal effects of a 100 basis point path surprise for a non-hedged firm at the ZLB are -6.57% at the 90th percentile, -7.81% at the 95th percentile, and -10.12% at the 99th percentile. All of these are statistically significant at the 1% or 5% level, indicating statistical and economic significance.

[17] Ippolito et al. (2018) follow Wright (2012) and use an unconventional monetary policy surprise that is closely related to the change in the 10-year yield as the policy surprise during the ZLB. We have verified that the difference between our results stem from our inclusion of maturity information in the exposure measure, not from the using path versus change in a longer term interest rate. Gürkaynak et al. (2005) show that change in the 10-year yield around policy announcements is driven by path, hence this is not surprising.

3.3 Robustness

The results presented above are very robust. We tried different samples, variable definitions, additional controls, and econometric approaches, as well as a falsification test. The effect we find comes across clearly in the data. Below we discuss some of the tests we have carried out and report their results in Appendix B.

Tables B-8, B-9, B-10, B-11, B-12, and B-13 in Appendix B demonstrate that our findings in the period before and including the ZLB are robust. Our results do not change when we employ an instrumental variable analysis where the terms involving (already lagged) exposure are instrumented by those involving (further) four quarter lagged exposure, which controls for current firm specific information driving floating rate exposure. (Ippolito et al. (2018) present a nice argument for the use of a similar IV method in controlling for possible floating rate endogeneity.) We also show robustness to using a narrower one-day window for stock returns, alternative measures of floating rate exposure and leverage,[18] monetary policy surprises,[19] and with additional control variables.[20] Further, including average liability maturity as a separate variable and in interactions similar to those of exposure and leverage does not change our results either. It is not leverage or maturity alone, but the exposure measure we propose that matters and drives the results.

The results are also robust to considering only scheduled FOMC meetings and this, together with the partial regression evidence earlier in the section, alleviates the concern that our findings are driven by a handful of influential events such as unscheduled FOMC meetings during the Great Recession. Our findings also go through using the quarterly exposure and leverage measures when available. These trade off the advantage of being more up to date with the disadvantage of being potentially less accurate because 10-Q forms, which are the source of the additional observations, are mostly unaudited. The results also pass falsification tests where we look at two-day stock returns one week before FOMC announcements and find no relationship. That is, it is not that high exposure firms always behave differently for some reason that is unrelated to monetary policy. It is the increased forward guidance variance created by the policy announcement that drives the result. The robustness tests are extensive; monetary policy affects firms' stock prices differentially, as a function of their cash

[18] For instance, the cash flow exposure measure based on floating rate debt items with outstanding maturities less than five years, or based on only bank debt items.

[19] The GSS monetary policy surprises based on the change in the yield curve up to two years in maturity rather than one.

[20] For instance, the S&P credit rating which proxies for access to credit and the fixed rate exposure measure which is obtained by applying the expression in equation (1) to fixed rate debt items.

flow exposures.

4 Sophistication or Rules of Thumb?

We interpreted the results above as evidence of a good understanding of firm liability structures and their interaction with monetary policy surprises by stock market participants. An interesting question is whether financial market participants indeed study the balance sheets of the firms and, understanding the effect of monetary policy path surprises, price stocks accordingly or, given the persistence of exposure, learn rules of thumb such that certain firms fare better or worse as interest rates begin to increase or decrease. In this section we show that the marginal stock market investor is quite sophisticated in that the repricing of stocks in high frequency is not based on rules of thumb but on knowledge of current balance sheet conditions.

We devise three tests of stock market participants' sophistication in studying and interpreting firm liability structures and their interaction with monetary policy. These tests are designed to differentiate between investors' following current firm liability structures versus using rules of thumb to react to monetary policy surprises. Our weakest test is to separately look at firms that have recently had IPOs. These firms would not have stock market histories to allow for rules of thumb and hence should not show the effect due to exposure that we find if market participants do not study their balance sheets. We therefore interact a dummy for firms that have had IPOs in the past 8 quarters with our variables of interest.

The first column of Table 4 shows that IPO interaction effects are not statistically significant, suggesting that these firms' stock price reactions, as a function of their cash flow exposures and the path surprise, are not different from other firms'. Since rules of thumb based on past stock price performance under different monetary conditions are by definition not present for these firms, these results suggest that investors are indeed paying attention to current balance sheets.

While verifying our conjecture, this is a relatively weak test due to two reasons. The first is, the firms that have IPOs and then enter our sample very soon after are small in number (even though firms that are in the S&P500 index during any time in its history are in the sample). Hence, standard errors of variables interacted with the dummy are quite wide. The second reason is that, firms that have had recent IPOs do not have stock price histories but do have balance sheet histories. If market participants follow rules of thumb or look at past profits, etc., it is not clear what the implications for a firm with a recent IPO are. If they use some form of heuristic (derived from past performance) for all firms that also applies to newly traded firms, we would again find no recent IPO effect.

While these concerns make this test a relatively weak one, they inform our next test. Our second test separates the firms that have seen the largest positive and negative changes in their floating rate exposure in the sample. We provide separate dummies for the largest 20 percent[21] of firm-quarters based on the distribution of positive and negative *changes* (separately) of exposure between two filings of 10-K forms. Here, the number of observations for which the large positive change (more exposure) and large negative change (less exposure) dummy variables are 1 constitute 20 percent of observations each, by construction.

Further, the implications under the null and the alternative are clear. If market participants are sophisticated and follow current balance sheets and assess their interactions with monetary policy, these categories are irrelevant and dummy interactions will be insignificant. If, on the other hand, they base pricing on rules of thumb based on past performance, firms that have increased (decreased) their exposure will be treated like lower (higher) exposure firms and the dummy interaction will be positive (negative). Hence, this is a much less ambiguous and statistically stronger test.

The second column of Table 4 shows that neither of these dummies, in their interactions with our variables of interest, has statistically significant effects on firms' stock price reactions to monetary policy. This is strong evidence that market participants pay attention to current liability structures of firms, understand effects of floating rate exposure, and reprice when future expected interest rates change.

Our final test is in similar vein but is based on an even stricter sophistication criterion. If market participants behave based on rules of thumb derived from past performance in terms of our variables of interest, which are related to past exposure that is slow moving, then including past exposure in the analysis will be more helpful than having current exposure. When both past and current exposure are included in the analysis, under the rules of thumb interpretation past exposure should matter and under the sophistication interpretation current exposure should matter for stock price reactions.

The last column of Table 4 shows that when we employ this test, *only* current exposure matters. This is a very strong test to identify whether stock market investors pay attention to the ebbs and flows of firms' balance sheets. They do.

[21] We check robustness using a variety of alternative threshold levels and find similar results.

5 Real Effects of Cash Flow Exposure

So far we looked only at the stock price reactions to monetary policy surprises at firm level, which transmit through cash flow exposures of these firms. We found a statistically and economically significant relationship and showed that market participants pay attention to current balance sheets of firms.

Floating rate exposure changes cash flows of firms as interest rates change. This is part of a mechanism that underlies all financial accelerator mechanisms, which collectively require cash in the firm to be more valuable than cash outside it. While our results so far are consistent with these models, the stock market reaction by itself does not settle the question as the transfer between debt and stock holders of the firm as a result of interest rate changes will produce these findings even if the Modigliani-Miller theorem holds. Hence, we directly look at future real outcomes of firms with different cash flow exposures when interest rates change, to study whether there is a transmission mechanism to real outcomes that works through cash flows.

Note the clear establishment of causality here. We are not looking at the effect of a change in interest rates on firm behavior, as average firm behavior will be cyclical and endogenous to monetary policy. Rather, our focus is on the effect of changes in interest rates, *through changes in cash flows based on firm balance sheets*, on firm behavior. Individual firms' balance sheets are exogenous to monetary policy changes (having controlled for the extensive list of covariates and fixed effects we employ) and our identification comes from the cross sectional variation in cash flow exposure. Ippolito et al. (2018), using similar methodology with leverage as the floating rate measure, find mixed effects, and that only when studying strongly financially constrained firms which excludes most of our sample that comprises S&P500 firms. We will show that, unambiguously, differences in firms' balance sheets lead to differences in real outcomes when the liability structure and monetary policy surprises are measured as we propose, and that this effect is present even for S&P500 firms.

Our balance sheet regressions take the form

$$bsv_{it+x} = \beta_0 + \beta_1 exposure_{it-1} + \beta_2 path_t * exposure_{it-1} + \beta_3 hedge_{it-1} * path_t * exposure_{it-1}$$

$$+\beta_4 zlb_t * path_t * exposure_{it-1} + \beta_5 hedge_{it-1} * zlb_t * path_t * exposure_{it-1}$$

$$+ \lambda(remaining\ controls\ and\ interaction\ terms) + \varepsilon_{it+x} \quad (3)$$

for $x = 1, 2, ..., 8$ where t is the reference quarter. bsv_{it+x} is one of the balance sheet variables that are defined below and $path_t$ is the aggregated path surprises within the reference quarter.

The control variables include the firm balance sheet variables in Table 1 with appropriate lags, as well as the list of covariates used in previous regressions.[22] The regressions also feature both year-quarter fixed effects and firm-level fixed effects.[23]

We first look at the cash flow effect on capital investment which has remained an important debate in the corporate finance literature since the influential work of Fazzari et al. (1988) and Gilchrist and Himmelberg (1995). To measure capital investment, we consider the cumulative change in capital stock in $t + x$ relative to the value in $t - 1$ as a fraction of total assets in $t - 1$. This appears as the first panel in Table 5. A contractionary monetary policy surprise interacts with cash flow exposure of a firm to generate a persistent negative effect on capital investment. However, the firms that hedge against the interest rate risk of their floating rate obligations are well-protected, as indicated by the positive coefficient on the interaction term involving the hedging indicator, aggregated path surprises, and floating rate exposure. Overall, these results provide strong evidence for cash flow sensitivity of investment.[24] Furthermore, there is no evidence that this relationship was different at the ZLB, which is indicated by the non-significant coefficient on the interaction term involving the ZLB indicator, aggregated path surprises, and floating rate exposure. This verifies our findings based on stock market responses in Section 3.2.2 that the ZLB did not disrupt the cash flow channel of monetary policy.

Next, we turn to net worth which is a key variable for all financial accelerator mechanisms. As was the case for capital investment, we measure this as the cumulative change relative to the initial (i.e., time period $t-1$) total assets. The results are provided in the the second panel of Table 5. Our findings, which are consistent with those for capital investment above, again demonstrate the cash flow channel in action. The effect, which is persistent and statistically significant, empirically validates a mechanism that exists in a wide class of financial accelerator models where having less cash in the firm leads to persistently lower net worth. Moreover, the results indicate that the stock market reactions documented in Section 3 are also justified by realized future firm outcomes. Again, there is no evidence that the ZLB altered the working

[22] The results are robust to conditioning on the hedging indicator and the balance sheet variables as of the reference quarter t instead, as well as being robust to also controlling for bank debt or floating rate leverage.

[23] We show abridged versions of regression output for readability. Tables B-14 to B-21 in Appendix B present more comprehensive tables.

[24] The marginal effects of a path surprise are negative and highly statistically significant for relatively highly exposed firms, from one quarter ahead up until eight quarters ahead. For instance, subject to a 100 basis point surprise, a non-hedged firm at the 95th percentile of exposure distribution sees its capital investment declining by -16.76% in $t+1$, -20.69% in $t+4$, -20.66% in $t+5$ and -22.32% in $t+8$ relative to the initial total assets which are statistically significant at the 1% or 5% level. But a hedged firm sees its capital investment declining by less at -11.03%, -8.22%, -4.17%, and -8.35% respectively, which are statistically significant at the conventional levels only in t+1.

of the cash flow channel.

The decline in net worth documented above can take place through either a change in total assets or total liabilities, or both. This break down of the cash flow effect on net worth, which is interesting in itself as it provides stylized facts that the theory of business cycles should be mindful of, is what we now take on.[25] These are again measured as the cumulative change relative to the initial total assets (for total assets, it is therefore also the cumulative percentage change relative to the initial time period $t-1$). The third and fourth panels of Table 5 present results for these variables respectively. We see that both total assets and liabilities decrease, with the former decreasing by more. So, the decline in net worth takes place despite the fall in total liabilities due to the even larger fall in total assets, which is consistent with the large decline in capital investment documented above. The coefficients on the interaction term involving path surprises and cash flow exposure in these panels line up with the same coefficient in the panel for net worth. In the last two panels of Table 5, we also provide the results for inventory investment and cash holdings, which are also consistent with the working of the cash flow effect. The analysis of cash holdings has ambiguous theoretical underpinnings as firms often liquidate other assets to keep cash in hand and we had already seen that total assets decline in response to an adverse policy surprise for firms with high cash flow exposure. The results for cash holding are presented for completeness and show that cash holdings also decline after a few quarters.

Our findings indicate real effects of monetary policy, whose transmission is through the cash flow exposure of firms and the ensuing actual changes in cash flows due to changes in interest rates. Significantly, we find these effects for S&P500 firms, which are older, larger, and are thought to be less financially constrained than other firms (Hadlock and Pierce (2010)). Cash flow sensitivity is an important concern for even these firms and their behavior responds to monetary policy in part through interest rate effects on their balance sheets.

Explicitly testing the presence of financial frictions driving these real effects requires bringing in a measure of financial constraint and showing that more constrained firms are more affected by their cash flow exposure in response to monetary policy shocks. This is what we now turn to. The measure we employ is that of Schauer et al. (2019), which is a weighted average of size, interest coverage, ROA, and cash holdings (with Schauer et al. showing this measure outperforms others and can be applied to listed US firms). We include the financial

[25] Net worth, studied above, was constructed as total assets less total liabilities. Total assets clearly respond to cash flow. Total liabilities are noisier and due to the practice of accrual accounting and the structure of the data set employed in our study, the cash flow effect we are looking for is better captured by a liability measure constructed by summing "other current liabilities" and "long-term debt."

constraint alone and in interactions, reporting the main results in Table 6 and relegating the details to Appendix Tables B-20 and B-21.

Table 6 clearly shows that financial constraints matter and that more constrained firms show larger sensitivity to cash flows triggered by monetary policy shocks.[26] This, then, is very clear evidence supporting the presence of financial frictions and their relevance in amplifying and propagating monetary policy transmission, as in financial accelerator models.

6 Central Bank Information Effects

A recent set of papers have argued that monetary policy surprises measured as employed here may be forecastable (Miranda-Agrippino and Ricco, 2021; Karnaukh, 2020) and may capture information transmitted from the Fed to the public via monetary policy actions and announcements (Jarociński and Karadi, 2020; Andrade and Ferroni, 2021).[27] Bauer and Swanson (2020) nicely show that when the public knows the state of the economy but not the exact monetary policy rule, the surprises we measure will be unforecastable in real time but forecastable ex-post. In this case high frequency regressions of stock prices on monetary policy surprises and their interpretations are unaffected. The lower frequency analysis presented in section (5) has the interpretation we offer under the assumption that the monetary policy surprises are "clean," and may still have the same interpretation under some asymmetric information structures but may admit other interpretations if policy surprises convey Fed's private information (perhaps about its preferences) and such information directly affects firm level real outcomes in a way that is correlated with cash flow exposures.

Model-based analyses of such information effects are difficult and face serious identification problems (Gürkaynak et al., 2021; Lee, 2020)[28] but empirically asking whether something helps

[26]The marginal effects for capital investment are as follows. At the 95th percentile of exposure distribution and the median of financial constraint distribution, the marginal effects of a 100 basis point path surprise for a non-hedged firm are -24.76% in t+1, -26.68% in t+4, -27.28% in t+5, and -17.66% in t+8 relative to the initial assets which are statistically significant at the 1% or 5% level. But a hedged firm sees weaker effects at -14.13%, -8.13%, -3.89%, and 4.36% respectively which are statistically significant at the conventional levels only in t+1. At the 10th percentile of financial constraint (less constrained), the effect is weaker and not statistically significant at the conventional levels for both hedged and non-hedged firms. However, at the 90th percentile of financial constraint (more constrained), the effect is stronger and statistically significant for the non-hedged firm (-30.30%, -35.05%, -36.63%, and -26.55% respectively, all at the 1% level) but weaker and statistically significant at the conventional levels only in t+1 (-16.58%, -8.03%, -0.31%, and 8.79% respectively) for the hedged firm.

[27]We thank Nina Karnaukh, Silvia Miranda-Agrippino and Giovanni Ricco for sharing some or all of their data and for answering our questions.

[28]Whereas Lee (2020) focuses on central bank information transmission to the public through a short-term policy rate in a closed economy setting subject to an occasionally binding ZLB constraint, Gürkaynak et al. (2021) discuss the issue in an open economy context, concentrating on information structure indeterminacy related to exchange rate behavior. Both examine shock identification issues using (otherwise standard) New

forecast the monetary policy surprise and if so, whether removing that component makes a difference is possible. We will show in this section that doing so does not affect our findings hence will present those results without taking a stance on whether the analysis is theoretically justified or not.

This exercise is based on that of Miranda-Agrippino and Ricco (2021) who run a first stage regression of the policy surprise on the changes in the Fed staff's internal forecast since the last meeting, the Greenbook forecast. We take averages of the variables as in Karnaukh (2020) (although following Miranda-Aggripino and Ricco exactly makes no difference). Running that regression for target and path surprises separately, we do find some coefficients that are statistically significant, which follows the findings of the papers cited above. These first stage regressions are reported in Table 7 below. Note that the R^2 of these regressions are very low, indicating that any information effects that may be present constitute a small fraction of the surprises.

We next run our core stock price and real effects regressions with the residuals from the first stage, using the extended specification in our sample period.[29] Under the Fed information effect interpretation, these residuals are cleansed and capture the pure monetary policy surprise. (Under the central bank preferences being time varying and unknown to the public interpretation, the first stage captures information about Fed preferences and is still about monetary policy.) Tables 8 and 9 show that with this measure of policy surprises the main results are unchanged, path surprises' interaction with firm exposures to cash flow predict both stock price responses and future real outcomes for the firms in our sample.

7 Conclusions

Cash flow matters. Stock market participants know that firms that have higher unhedged floating rate obligations will fare worse in an increasing interest rate environment, and better in a decreasing one. And they are right, both because of the mechanical effect of higher interest rates redistributing firm income from dividends to interest payments, and because as future cash flow obligations increase, firm investment and net worth also decreases. That is, for these firms, higher interest payments lead to higher cash outflows, and firms cannot costlessly substitute external financing for internal funds. There is a clear financial accelerator channel

Keynesian models under asymmetric information.

[29] We present the longer sample results for the first stage, going back to 1994, as a memo item showing that our sample period is not special in this regard.

that is intimately linked to monetary policy as the rates on firms' new fixed rate debts, as well as the payments of their previously issued floating debts depend on current interest rates.

We find that looking at the maturity structure of debt obligations is important in understanding the interaction between monetary policy decisions and the cash flow channel. Bank debt and floating rate debt leverage do not sufficiently capture the cash flow obligations and how these change in response to monetary policy surprises, as these measures are based on the principal value rather than the commitments for future payments, which depend on maturity as well as the principal value. We empirically see the relevance of debt maturity information.

In answering related questions, the choice of monetary policy surprise measure also matters. The path, or forward guidance, component of monetary policy is the surprise about future path of interest rates. It is natural that this is the component that has a sizable bearing on future cash flow obligations, and is therefore the component that stock market participants pay attention to when updating their beliefs about firms' cash flows and reassessing stock prices according to new information. We show that this distinction is important for firms' stock price changes before, during, and after the zero lower bound.

Studying whether in high frequency stock prices respond to monetary policy surprises depending on firms' balance sheets requires jointly testing the existence of such an effect and market participants' ability to incorporate it in prices shortly after a policy announcement. Finding the effect naturally leads to the question of whether market participants actually pay attention to firm balance sheets and understand how they interact with monetary policy, or follow rules of thumb as cash flow exposure is quite persistent. We show that market participants indeed pay attention to balance sheets and differentiate firms by their current liabilities when repricing stocks due to monetary policy surprises. This is of independent interest.

Lastly, we show that cash flow exposure has real effects. More exposed firms–those that have more unhedged long maturity floating rate obligations–see their investment, assets, and net worth change more in quarters following monetary policy changes. This is very strong evidence in favor of a financial friction where cash in the firm is more valuable than cash outside it. There is indeed an external finance premium, and unhedged cash flow exposure triggers it. We also find that the ZLB has not changed this relationship, further suggesting that transmission of monetary policy was unhindered by this constraint.

We leave for future work the study of aggregate effects of this channel and questions related to further differences in balance sheets, such as callability of debt, existence of untapped lines of credit and the like; as well as studying the effects of QE and possible asymmetries of positive and negative surprises or surprises taking place in high and low interest rate environments. Also left for future work is how monetary policy should be carried out in light of this mechanism that changes our understanding of real effects of forward guidance.

8 References

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9 Tables and Figures

Table 1: Summary Statistics for Balance Sheet Variables

	Hedge=0		Hedge=1		Entire Sample	
	Mean	SD	Mean	SD	Mean	SD
Exposure	0.61	0.63	0.75	0.71	0.68	0.67
Bank Debt Leverage	0.14	0.12	0.16	0.14	0.15	0.13
Floating Rate Debt Leverage	0.14	0.12	0.16	0.14	0.15	0.13
Size	4.42	1.18	4.63	1.15	4.52	1.17
Profitability	0.04	0.02	0.03	0.02	0.04	0.02
Book Leverage	0.42	0.27	0.51	0.26	0.46	0.27
Market-to-book Ratio	1.57	1.04	1.42	0.87	1.50	0.96
Asset Maturity	0.52	0.52	0.54	0.48	0.53	0.50
Short-term Debt	0.03	0.04	0.03	0.05	0.03	0.05
Observations	23,465					

This table is based on the full sample used for the regressions in Table 3. The dummy variable Hedge = 1 for firms which engage in hedging activities against interest rate risks of their floating rate obligations. Exposure is the sum of maturity weighted floating rate debts as a fraction of total assets. Bank Debt Leverage is the ratio of total bank debts to total assets. Floating Rate Debt Leverage is the ratio of total floating rate debts to total assets. Size is the logarithm of the book value of total assets (deflated by CPI), Profitability is the ratio of operating income before depreciation to total assets, Book Leverage is the ratio of total debts to the sum of total debts and the book value of equity, Market-to-book Ratio is the ratio of the sum of the market value of equity and total debts to total assets, Asset Maturity is the weighted average of imputed short-term and long-term asset maturities with the weights being the ratios of the asset values to total assets, and Short-term Debt is the ratio of short-term debt to total assets. The summary statistics based on different samples (for instance, the full sample before controlling for speculative investment in interest rate derivatives and dropping financial firms; see Section 2.2) are similar to those above.

Table 2: Pre-ZLB

VARIABLES	(1) Stock Return	(2) Stock Return	(3) Stock Return	(4) Stock Return	(5) Stock Return	(6) Stock Return	(7) Stock Return
target	-11.70**	-19.26***	-20.47***			-2.66	-0.83
	(5.03)	(6.68)	(7.26)			(2.71)	(7.64)
path		-10.14***	-10.19***			1.23	6.52
		(3.41)	(3.79)			(1.16)	(4.29)
exposure		0.07	0.18	0.27*	0.30	-0.04	0.40*
		(0.20)	(0.25)	(0.14)	(0.22)	(0.22)	(0.21)
target*exposure		0.13	-2.16	-3.23*	-2.37	-1.79	-3.01**
		(1.60)	(1.93)	(1.70)	(1.72)	(1.33)	(1.49)
hedge*target*exposure		-1.58	-0.35	1.85	0.08	0.55	3.86
		(2.03)	(3.96)	(3.23)	(3.21)	(1.88)	(2.83)
path*exposure		-2.74***	-3.19***	-1.97***	-2.40***	-1.36***	-2.04***
		(0.74)	(0.69)	(0.68)	(0.60)	(0.39)	(0.62)
hedge*path*exposure		2.86***	4.25***	3.09***	3.20***	2.78***	3.20***
		(0.99)	(1.09)	(1.08)	(0.99)	(0.77)	(0.75)
leverage	2.35		-0.53	-1.21	-1.01	0.44	-0.50
	(1.79)		(1.46)	(0.82)	(1.34)	(1.58)	(1.43)
target*leverage	-18.03**		15.74	17.11	14.37	17.87	14.53
	(8.82)		(13.20)	(11.27)	(13.00)	(10.66)	(14.63)
hedge*target*leverage	27.90***		-5.62	-8.31	-4.68	-23.74	-8.61
	(9.20)		(24.91)	(20.94)	(22.68)	(18.67)	(23.12)
path*leverage			3.58	0.56	2.09	3.07	1.25
			(4.43)	(3.40)	(4.06)	(2.53)	(4.59)
hedge*path*leverage			-9.35	-4.94	-5.10	-9.86*	-4.80
			(5.59)	(4.07)	(4.75)	(5.35)	(6.02)
Observations	9,922	7,027	5,877	5,877	5,877	9,712	5,877
R-squared	0.06	0.16	0.17	0.33	0.37	0.68	0.81
Firm FE	YES	YES	YES	NO	YES	YES	YES
Time FE	NO	NO	NO	YES	YES	NO	NO
Firm controls/contr*surp*hedge	YES	YES	YES	YES	YES	NO	YES

The dependent variable is the two-day stock return bracketing an FOMC announcement. The sample covers 47 FOMC announcements between January 2004 and December 2008. The dummy variable hedge = 1 if a firm enters into interest rate swaps to protect against interest rate risks of its floating rate obligations. Firm-level control variables are size, profitability, book leverage, market-to-book ratio, asset maturity, financial slacks, retaining earnings, dividend per share, and their interactions with target and path surprises and hedging indicator. The variable "leverage" in the table refers to bank debt leverage. All regressions are run with firm-level fixed effects unless otherwise noted. (1) replicates Ippolito et al. (2018) using our data. (2) replaces their bank debt leverage measure with our floating rate exposure, and includes both target and path surprises. (3) adds bank debt leverage as a separate regressor. (4) and (5) are versions of (3) with only time fixed effects and both firm and time fixed effects, respectively. (6) replaces raw stock return with Fama-French adjusted stock return as the dependent variable. (7) adds controls and their interaction terms to (6). The regression coefficients of control variables are not shown here for brevity. The numbers in the parentheses are standard errors which are clustered at the event-level. Only the firms whose floating rate debts constitute more than one percent of total assets are included to control for potentially speculative interest rate derivative investments. We also drop financial firms. 720 firms remain in the sample after these procedures. All RHS variables are trimmed at the bottom and top 1 percent (the results are robust to using winsorization instead). * stands for $0.05 < p \leq 0.1$, ** for $0.01 < p \leq 0.05$, and *** for $p \leq 0.01$.

Table 3: Full Sample Including ZLB

VARIABLES	(1) Stock Return	(2) Stock Return	(3) Stock Return
target	-19.21**		
	(8.31)		
path	-10.78***		
	(3.52)		
exposure	-0.01	0.11	0.05
	(0.13)	(0.10)	(0.12)
target*exposure	-2.88	-3.27*	-2.83
	(1.78)	(1.89)	(1.89)
hedge*target*exposure	2.29	1.86	0.81
	(3.91)	(3.29)	(3.43)
zlb*target*exposure	3.30	-3.37	-2.70
	(9.51)	(4.67)	(5.19)
hedge*zlb*target*exposure	-7.30	6.11	7.50
	(12.97)	(8.20)	(8.69)
path*exposure	-2.40***	-1.56**	-1.66**
	(0.63)	(0.67)	(0.65)
hedge*path*exposure	3.38***	2.62**	2.73***
	(1.03)	(1.03)	(1.04)
zlb*path*exposure	0.18	-0.10	0.01
	(1.85)	(1.38)	(1.35)
hedge*zlb*path*exposure	-2.18	-1.48	-1.57
	(2.72)	(2.29)	(2.21)
leverage	0.00	-0.55	-0.19
	(0.71)	(0.54)	(0.64)
target*leverage	13.46	15.62	14.10
	(11.97)	(11.65)	(11.56)
hedge*target*leverage	-9.46	-4.31	-2.70
	(22.37)	(21.29)	(20.86)
zlb*target*leverage	-41.97	-1.42	-3.11
	(63.70)	(36.74)	(42.02)
hedge*zlb*target*leverage	89.12	-2.86	-13.88
	(104.41)	(48.99)	(58.68)
path*leverage	1.40	-0.37	0.06
	(3.69)	(3.00)	(3.39)
hedge*path*leverage	-4.81	-3.10	-2.93
	(4.82)	(3.87)	(4.02)
zlb*path*leverage	9.31	7.79	6.81
	(9.67)	(6.54)	(6.90)
hedge*zlb*path*leverage	4.05	-1.53	-1.53
	(11.53)	(6.98)	(6.93)
Observations	23,465	23,465	23,465
R-squared	0.09	0.30	0.32
Firm FE	YES	NO	YES
Time FE	NO	YES	YES
Firm controls/contr*surp*hedge*zlb	YES	YES	YES

The dependent variable is the two-day stock return bracketing an FOMC announcement. The sample covers 127 FOMC announcements between January 2004 and December 2018, which includes the zero lower bound period. This is incorporated into the regression model using a dummy variable (denoted by "zlb" in the table, where zlb = 1 from January 2009 to December 2015). (1) augments (3) in Table 2 using this dummy variable. (2) is a version of (1) with only time fixed effects and (3) with both firm and time fixed effects. All other conventions are identical to those in Table 2. The variable "leverage" in the table refers to bank debt leverage. 773 firms remain in the sample after controlling for potentially speculative derivative investments and dropping financial firms.

Table 4: Stock Market Sophistication

VARIABLES	(1) (Dummy for Initial 8 Quarters after IPO) Stock Return	(2) (Dummy Large Changes) Stock Return	(3) (Current and Lagged Exposure) Stock Return
exposure	0.05	0.10	-0.04
	(0.12)	(0.12)	(0.12)
path*exposure	-1.68**	-1.99***	-2.13***
	(0.65)	(0.63)	(0.70)
hedge*path*exposure	2.68***	3.12***	2.64**
	(0.96)	(1.02)	(1.07)
IPO dummy	-0.83		
	(0.82)		
IPO dummy*path	-4.12		
	(3.24)		
IPO dummy*path*exposure	6.34		
	(4.06)		
IPO dummy*hedge*path*exposure	-4.25		
	(4.80)		
positive dummy		-0.17	
		(0.92)	
positive dummy*path		-3.28	
		(3.79)	
positive dummy*exposure		-0.14	
		(0.66)	
positive dummy*path*exposure		2.62	
		(2.11)	
positive dummy*hedge*path*exposure		-1.02	
		(2.49)	
negative dummy		0.83	
		(0.73)	
negative dummy*path		-0.64	
		(2.16)	
negative dummy*exposure		-0.17	
		(0.50)	
negative dummy*path*exposure		2.52	
		(1.79)	
negative dummy*hedge*path*exposure		-2.66	
		(2.04)	
lagged exposure			-0.05
			(0.10)
path*lagged exposure			0.81
			(0.69)
hedge*path*lagged exposure			-1.50
			(0.98)
Constant	-2.71	-2.58	2.90**
	(1.74)	(1.72)	(1.17)
Observations	23,465	23,465	19,255
R-squared	0.32	0.32	0.33

The sample period ranges from January 2004 and December 2018. The dependent variable is the two-day stock return bracketing an FOMC announcement. “IPO dummy” indicates that firms are within the first two years of IPO. “positive dummy” corresponds to the observations that belong to top 20 percent of positive changes in exposure in the sample. Similarly, “negative dummy” stands for the observations that belong to top 20 percent of (absolute values of) negative changes in exposure. (1) and (2) use these dummy variables, respectively. For (1), similar results follow when firms within the first two years of IPO are more finely categorized (e.g., within the first quarter of IPO, within the second quarter of IPO, so on). (3) includes both current and lagged exposure and their interaction terms. All regressions include firm and time fixed effects. Other conventions are identical to those in the tables above.

Table 5: Balance Sheet Regressions

Capital Investment (Cum. Change in Capital Stock over Assets)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)
path*exposure	-5.32***	-5.61***	-4.55***	-6.37***	-7.31***	-7.40***	-6.90***	-8.98***
	(1.36)	(1.52)	(1.56)	(1.92)	(2.22)	(2.05)	(1.94)	(2.51)
hedge*path*exposure	2.31	1.91	2.62	5.03**	6.65**	5.78**	4.28**	5.63**
	(2.15)	(1.70)	(1.68)	(1.93)	(2.66)	(2.48)	(2.06)	(2.39)
zlb*path*exposure	-0.30	-0.42	0.30	3.24	4.17	9.72*	5.40	8.62
	(1.63)	(2.07)	(2.19)	(2.68)	(4.27)	(5.64)	(5.10)	(6.69)
hedge*zlb*path*exposure	8.10***	8.88**	7.19*	3.59	1.17	-4.06	1.29	-1.58
	(2.77)	(3.50)	(4.10)	(4.18)	(6.43)	(7.77)	(9.19)	(10.70)
Net Worth (Cum. Change in Net Worth over Assets)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)
path*exposure	-4.82***	-4.31***	-3.84***	-3.98***	-3.89***	-4.02***	-3.57***	-3.01**
	(1.06)	(1.03)	(1.04)	(1.09)	(1.13)	(1.14)	(1.12)	(1.37)
hedge*path*exposure	-0.73	-0.99	-1.04	-1.45	-0.44	-1.26	-0.44	-2.60
	(1.88)	(1.78)	(1.55)	(1.71)	(1.97)	(2.12)	(2.09)	(2.17)
zlb*path*exposure	2.29	1.08	2.29	2.69	2.33	0.02	1.92	1.94
	(1.70)	(2.80)	(2.57)	(2.55)	(2.18)	(2.70)	(3.63)	(3.80)
hedge*zlb*path*exposure	7.43***	8.97**	5.61	4.69	0.80	2.40	-3.05	0.75
	(2.73)	(3.63)	(3.56)	(3.70)	(3.20)	(3.20)	(5.24)	(5.52)
Total Assets (Cum. Perc. Change)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)
path*exposure	-7.10***	-6.73***	-5.91***	-6.36***	-8.15***	-7.70***	-7.15***	-7.36**
	(1.66)	(1.80)	(1.84)	(1.93)	(2.56)	(2.53)	(2.40)	(2.81)
hedge*path*exposure	-4.06	-4.29	-2.09	-4.22	-2.44	-4.62	-2.59	-6.84*
	(3.80)	(3.30)	(3.35)	(3.50)	(3.78)	(3.79)	(3.86)	(3.99)
zlb*path*exposure	1.36	-0.80	3.59	2.30	0.02	-9.21	-5.78	-6.10
	(2.45)	(5.15)	(5.27)	(5.93)	(5.16)	(6.05)	(9.08)	(9.49)
hedge*zlb*path*exposure	18.47***	20.74**	12.52	15.46	17.04*	25.13***	18.51	24.77
	(4.93)	(7.92)	(9.04)	(9.57)	(8.97)	(9.05)	(13.68)	(14.91)
Total Liabilities (Cum. Change in Liabilities over Assets)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)
path*exposure	-2.52***	-2.84***	-2.69***	-2.54***	-3.74***	-3.37**	-3.33**	-4.22**
	(0.84)	(0.78)	(0.89)	(0.90)	(1.34)	(1.41)	(1.56)	(1.68)
hedge*path*exposure	-1.94	-1.47	-0.03	-3.75**	-2.94	-3.26	-0.14	-0.96
	(1.44)	(1.22)	(1.63)	(1.64)	(1.78)	(2.08)	(2.33)	(2.57)
zlb*path*exposure	0.04	-1.62	0.31	-0.88	-1.89	-6.49**	-5.42	-7.62*
	(1.05)	(1.37)	(1.65)	(2.06)	(2.30)	(2.63)	(3.98)	(4.23)
hedge*zlb*path*exposure	9.62***	11.13**	5.22	10.52**	15.14***	18.95***	15.70**	19.43**
	(3.52)	(4.50)	(4.82)	(4.97)	(5.07)	(5.95)	(7.72)	(8.13)
Inventory Investment (Cum. Change in Inventories over Assets)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)
path*exposure	-0.38***	-0.40**	-0.31**	-0.22	-0.45***	-0.17	-0.24	-0.32
	(0.11)	(0.16)	(0.14)	(0.14)	(0.16)	(0.24)	(0.22)	(0.24)
hedge*path*exposure	0.07	0.04	-0.09	-0.28*	-0.15	-0.51**	-0.27	-0.33
	(0.11)	(0.11)	(0.12)	(0.16)	(0.17)	(0.24)	(0.22)	(0.24)
zlb*path*exposure	0.17	-0.30	0.01	-0.34	-0.04	-0.41	-0.30	0.10
	(0.21)	(0.30)	(0.45)	(0.49)	(0.44)	(0.53)	(0.80)	(0.97)
hedge*zlb*path*exposure	0.06	0.63*	0.24	0.77	0.55	1.11	0.78	0.49
	(0.31)	(0.32)	(0.63)	(0.74)	(0.72)	(0.73)	(1.11)	(1.35)
Cash Holding (Cum. Change in Cash Holding over Assets)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)
path*exposure	-0.06	-0.07	-0.37	-0.81*	-1.00*	-1.03*	-1.22***	-0.41
	(0.25)	(0.36)	(0.39)	(0.44)	(0.53)	(0.51)	(0.44)	(0.49)
hedge*path*exposure	-0.13	0.33	0.61	0.35	0.75	0.71	1.36*	0.96
	(0.47)	(0.81)	(0.68)	(1.01)	(0.72)	(0.85)	(0.77)	(0.59)
zlb*path*exposure	-0.33	-0.30	0.25	0.47	0.70	-2.02**	-0.25	0.03
	(0.36)	(0.60)	(0.82)	(0.69)	(0.88)	(0.99)	(1.24)	(1.91)
hedge*zlb*path*exposure	1.34	0.24	-0.07	-0.41	-0.03	1.31	-0.02	-2.50
	(0.87)	(1.28)	(1.32)	(1.41)	(1.96)	(1.61)	(1.70)	(2.58)
Firm and time FEs	YES	YES	YES	YES	YES	YES	YES	YES
Firm controls interacted with surprises	YES	YES	YES	YES	YES	YES	YES	YES

This table analyzes how monetary policy, through interactions with firms' exposure to floating rate liabilities, affects their balance sheet conditions and decisions. We consider capital stock, net worth, total assets, total liabilities, inventories, and cash holding. We use the cumulative changes over the initial total assets, $(Y_{i,t+x} - Y_{i,t-1})/Assets_{i,t-1}$ for all variables which is also the cumulative percentage change with respect to the initial value, $(Y_{i,t+x} - Y_{i,t-1})/Y_{i,t-1}$ for total assets. They are multiplied by 100 to facilitate interpretation. The sample period is from January 2004 to December 2018 and the ZLB enters the models using the binary indicator "zlb" (zlb = 1 from January 2009 to December 2015). "path" is the aggregated path surprises within the reference quarter t. We control for size, profitability, book leverage, market-to-book ratio, asset maturity, financial slacks (not included in the cash holding regression because it would in effect include the lagged dependent variable), retained earnings, dividend per share, and short-term debt which are also interacted with the aggregated monetary policy surprises. We also include firm and year-quarter fixed effects, and cluster standard errors at the quarter level (the results are robust to using quarter-industry clustering instead). The numbers in the parentheses are standard errors. * stands for $0.05 < p \leq 0.1$, ** for $0.01 < p \leq 0.05$, and *** for $p \leq 0.01$.

Table 6: Balance Sheet Regressions with Financial Constraints

Capital Investment (Cum. Change in Capital Stock over Assets)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)
path*exposure	-19.79***	-20.83***	-16.08***	-27.26***	-30.79***	-31.31***	-24.62***	-30.72**
	(5.30)	(5.80)	(4.03)	(8.42)	(9.73)	(10.42)	(5.86)	(11.75)
hedge*path*exposure	14.20	17.11**	19.95***	32.93***	43.16***	43.60***	32.04***	41.58**
	(8.95)	(7.48)	(5.78)	(11.27)	(12.96)	(14.04)	(10.18)	(17.04)
zlb*path*exposure	2.77	5.15	1.04	13.40	15.53	10.91	0.51	11.45
	(6.64)	(8.27)	(6.55)	(12.35)	(15.46)	(23.47)	(18.02)	(22.74)
hedge*zlb*path*exposure	34.51	23.94	40.21**	19.94	12.74	20.35	30.67	1.62
	(21.44)	(24.77)	(19.87)	(23.72)	(27.99)	(34.08)	(33.09)	(37.87)
fincon*path*exposure	-7.17**	-7.49**	-4.66**	-11.03**	-12.29**	-13.10**	-8.27**	-11.77*
	(3.19)	(3.45)	(2.05)	(4.80)	(5.47)	(5.95)	(3.13)	(7.01)
hedge*fincon*path*exposure	6.24	8.51*	9.43**	16.09**	21.86***	22.49**	16.10**	21.99*
	(5.38)	(4.92)	(3.96)	(7.16)	(7.99)	(8.78)	(6.75)	(11.77)
zlb*fincon*path*exposure	0.84	2.38	-0.52	5.86	6.67	-2.34	-6.27	-1.73
	(4.20)	(5.13)	(3.50)	(7.27)	(8.68)	(12.18)	(8.86)	(11.56)
hedge*zlb*fincon*path*exposure	17.17	9.74	20.49*	9.92	5.09	16.70	19.23	2.23
	(12.92)	(14.41)	(11.17)	(13.63)	(15.23)	(18.34)	(16.29)	(19.12)
Net Worth (Cum. Change in Net Worth over Assets)	**(t+1)**	**(t+2)**	**(t+3)**	**(t+4)**	**(t+5)**	**(t+6)**	**(t+7)**	**(t+8)**
path*exposure	-12.89***	-12.66***	-10.84***	-11.31***	-12.11***	-11.77***	-13.05***	-11.18***
	(3.53)	(3.66)	(3.07)	(3.11)	(2.84)	(2.93)	(3.08)	(3.92)
hedge*path*exposure	4.79	7.87	7.10	7.06	7.51	4.99	15.90**	16.69**
	(7.57)	(6.70)	(5.94)	(6.30)	(6.38)	(6.60)	(6.34)	(6.57)
zlb*path*exposure	-0.98	-2.38	0.93	4.94	-1.21	0.25	7.07	7.41
	(5.38)	(5.67)	(5.55)	(6.06)	(7.25)	(6.49)	(6.25)	(7.22)
hedge*zlb*path*exposure	28.16*	28.46*	9.32	2.61	0.48	4.86	-13.16	-23.63
	(15.97)	(15.33)	(15.86)	(16.10)	(14.88)	(14.42)	(19.44)	(20.70)
fincon*path*exposure	-3.60	-4.04*	-3.20	-3.70*	-4.35**	-4.58**	-6.13***	-5.55**
	(2.18)	(2.17)	(2.08)	(2.17)	(1.95)	(2.04)	(2.01)	(2.51)
hedge*fincon*path*exposure	0.94	4.28	2.84	3.24	2.64	1.96	10.50**	12.54**
	(4.07)	(3.91)	(4.20)	(4.18)	(4.26)	(4.86)	(5.16)	(5.29)
zlb*fincon*path*exposure	-3.16	-3.27	-2.17	0.43	-3.28	-0.23	3.31	3.03
	(3.33)	(3.08)	(3.39)	(3.72)	(4.75)	(4.44)	(3.83)	(4.34)
hedge*zlb*fincon*path*exposure	15.04	13.73	5.38	1.76	2.81	3.25	-5.34	-12.95
	(9.59)	(8.71)	(8.79)	(8.92)	(9.40)	(9.32)	(10.33)	(10.70)
Firm and time FEs	YES	YES	YES	YES	YES	YES	YES	YES
Firm controls interacted with surprises	YES	YES	YES	YES	YES	YES	YES	YES

This table studies the effect of financial constraints on balance sheet conditions and decisions. We adopt the financial constraint index of Schauer et al. (2019) which takes the form $FCP_{i,t}$ = - 0.123*$size_{i,t-1}$ - 0.024*$interestcoverage_{i,t-1}$ - 4.404*$ROA_{i,t-1}$ - 1.716*$cashholdings_{i,t-1}$ (see Appendix A for the definitions). The larger (less negative) the value, the more financially constrained the firm is. We take the simple average of this in the previous four quarters to obtain a measure of a firm's financial condition over the past year. This appears as "fincon" above. It is interacted with monetary policy surprises and floating rate exposure measure to test the financial accelerator mechanism. Other conventions are identical to those in Table 5.

Table 7: First Stage Regressions with Greenbook Forecasts

	1994-2013				2004-2013			
	Baseline Spec.		Extended Spec.		Baseline Spec.		Extended Spec.	
VARIABLES	Target	Path	Target	Path	Target	Path	Target	Path
real GDP	1.67	7.39**	1.95	6.21	1.36	8.46*	0.81	6.07
	(1.17)	(3.60)	(1.29)	(4.20)	(1.22)	(4.33)	(1.34)	(3.96)
inflation			0.11	18.36*			4.51	20.58*
			(3.55)	(9.36)			(5.06)	(12.21)
unemployment			1.51	-8.39			-2.22	-9.51
			(3.17)	(11.08)			(3.28)	(10.69)
constant	0.00	0.01	0.00	0.01	0.01*	0.02	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Observations	172	172	172	172	87	87	87	87
R-squared	0.01	0.04	0.01	0.07	0.02	0.10	0.04	0.15

This table provides first stage regressions where GSS target and path surprises are the dependent variables. The independent variables are average forecast revisions in real GDP, inflation, and unemployment for the current and the next three quarters from the Fed's Greenbook dataset.

Table 8: Stock Market Regressions with Target and Path Residuals

VARIABLES	(1) Stock Return	(2) Stock Return
targetres	-13.46	
	(10.59)	
pathres	-3.78	
	(4.91)	
exposure	0.20	0.22
	(0.25)	(0.19)
targetres*exposure	-2.88	-2.46
	(2.59)	(2.34)
hedge*targetres*exposure	-0.18	0.22
	(5.44)	(3.88)
zlb*targetres*exposure	-5.11	3.71
	(9.52)	(8.24)
hedge*zlb*targetres*exposure	21.17	20.00
	(19.75)	(18.32)
pathres*exposure	-2.88**	-2.04**
	(1.23)	(1.01)
hedge*pathres*exposure	3.89**	3.00*
	(1.86)	(1.51)
zlb*pathres*exposure	-0.89	-0.66
	(1.75)	(1.73)
hedge*zlb*pathres*exposure	-0.32	0.35
	(2.59)	(2.18)
leverage	0.50	-0.26
	(1.01)	(0.95)
targetres*leverage	14.79	12.72
	(13.13)	(13.30)
hedge*targetres*leverage	0.72	-0.41
	(24.96)	(21.71)
zlb*targetres*leverage	7.16	-45.82
	(63.70)	(47.98)
hedge*zlb*targetres*leverage	42.37	61.02
	(63.75)	(52.79)
pathres*leverage	0.84	-0.20
	(5.48)	(5.24)
hedge*pathres*leverage	-4.20	-1.14
	(6.24)	(6.09)
zlb*pathres*leverage	17.07**	11.06
	(7.71)	(7.65)
hedge*zlb*pathres*leverage	1.53	-8.22
	(12.28)	(9.15)
Observations	14,118	14,118
R-squared	0.09	0.36
Firm FE	YES	YES
Time FE	NO	YES
Firm controls/contr*surp*hedge*zlb	YES	YES

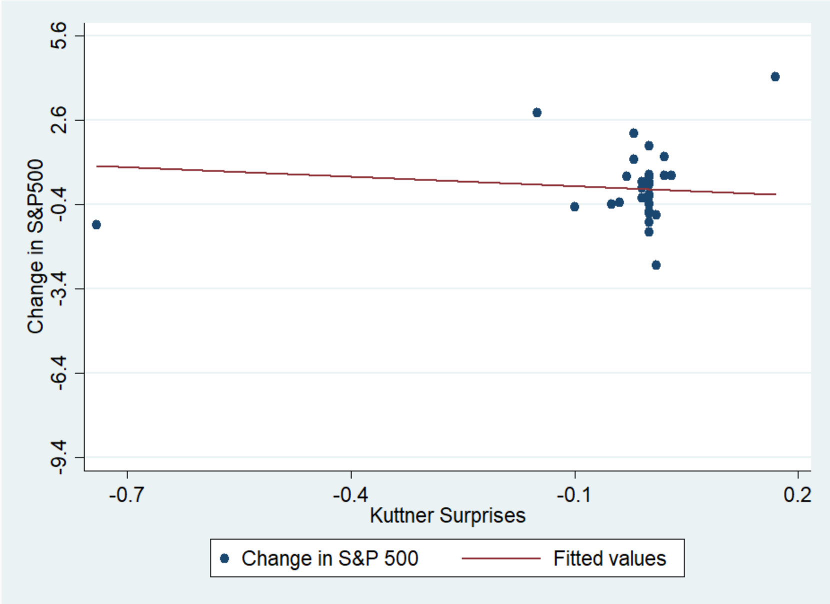
This table runs our stock return regressions in Table 3 with the residuals obtained from the first stage regressions in Table 7, using our extended specifications under the last two columns. "targetres" is the residual from the first stage regression for target surprises and "pathres" is that for path surprises. We consider specifications with only firm fixed effects and both firm and time fixed effects. Other conventions are identical to those in Table 3.

Table 9: Balance Sheet Regressions with Target and Path Residuals

Capital Investment (Cum. Change in Capital Stock over Assets)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)
pathres*exposure	-5.59**	-5.95***	-3.61*	-5.01**	-5.47*	-5.36*	-5.35**	-7.31**
	(2.08)	(2.19)	(2.07)	(2.25)	(2.75)	(2.79)	(2.41)	(2.96)
hedge*pathres*exposure	2.36	-0.17	0.13	2.87	5.04	3.80	1.71	2.80
	(2.69)	(3.39)	(3.31)	(3.11)	(3.81)	(3.54)	(3.55)	(2.91)
zlb*pathres*exposure	-0.70	-0.97	-1.16	-1.31	-2.14	1.43	3.98	4.37
	(1.70)	(1.83)	(2.21)	(2.26)	(2.60)	(4.02)	(3.39)	(4.24)
hedge*zlb*pathres*exposure	10.45**	12.04**	10.77**	7.84*	5.77	5.46	5.30	4.87
	(4.23)	(4.97)	(5.25)	(4.46)	(5.00)	(5.42)	(6.45)	(6.23)
Net Worth (Cum. Change in Net Worth over Assets)	(t+1)	(t+2)	(t+3)	(t+4)	(t+5)	(t+6)	(t+7)	(t+8)
pathres*exposure	-5.49***	-4.56***	-3.59**	-3.09**	-3.53***	-3.20***	-3.05**	-2.88**
	(1.59)	(1.48)	(1.46)	(1.31)	(1.23)	(1.13)	(1.13)	(1.22)
hedge*pathres*exposure	-1.63	-2.66	-3.43	-4.37	-1.43	-3.16	-2.84	-3.69
	(2.77)	(3.55)	(3.65)	(3.88)	(4.34)	(4.53)	(4.24)	(4.65)
zlb*pathres*exposure	0.42	-4.19**	-2.17	-1.87	0.27	-0.22	2.82	1.83
	(1.79)	(1.69)	(2.12)	(1.96)	(1.11)	(1.87)	(4.21)	(4.48)
hedge*zlb*pathres*exposure	12.37***	17.61***	12.42**	12.33**	5.06	7.19	3.44	4.94
	(4.34)	(4.61)	(4.84)	(5.04)	(5.16)	(5.50)	(7.65)	(8.29)
Firm and time FEs	YES	YES	YES	YES	YES	YES	YES	YES
Firm controls interacted with surprises	YES	YES	YES	YES	YES	YES	YES	YES

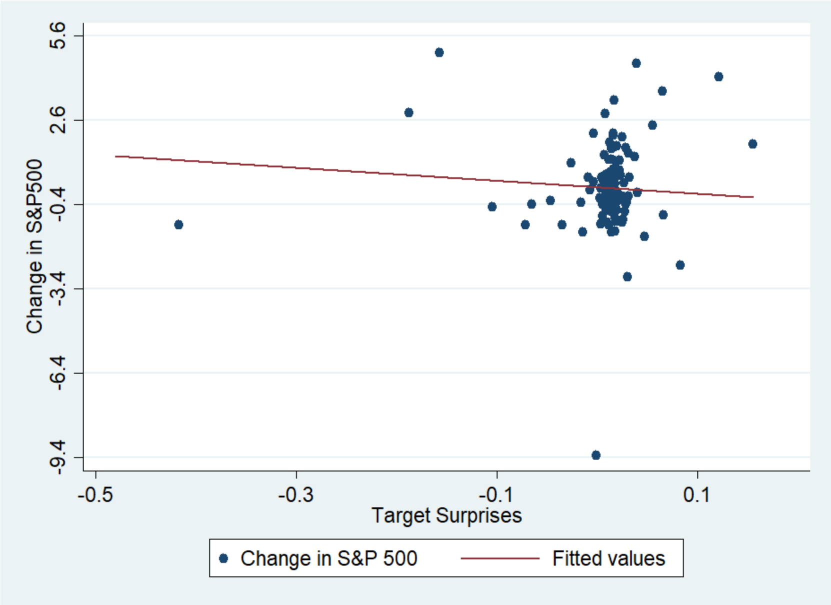
This table reevaluates the balance sheet regressions in Table 5 with the residuals obtained from the last two columns of Table 7. Other conventions are identical to those in Table 5. The results for other variables are also similar to those in Table 5.

Figure 1: Daily Aggregate Stock Price Changes in Response to Kuttner Surprises



The figure plots daily changes in S&P500 Index against Kuttner surprises on the FOMC announcement dates between January 2004 and December 2008. The line plots the OLS fitted values.

Figure 2: Daily Aggregate Stock Price Changes in Response to GSS Surprises

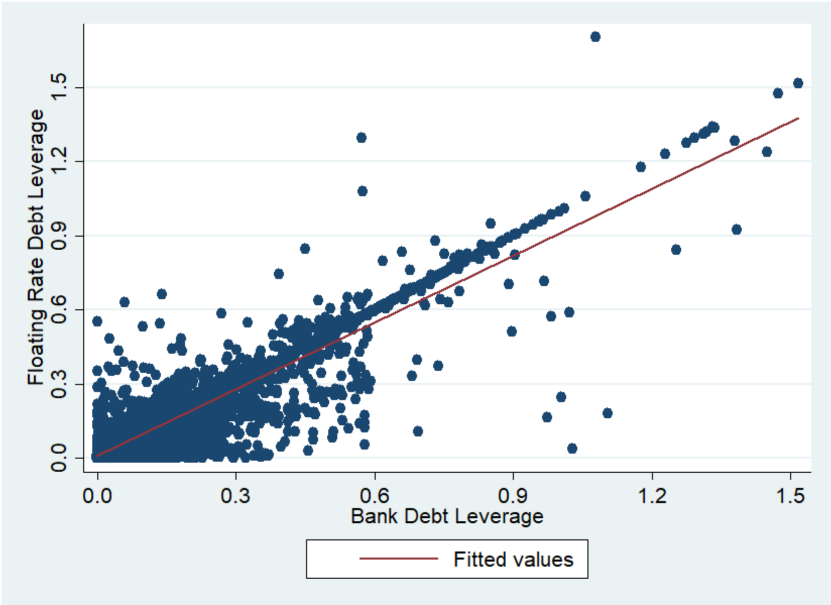


(a) Target Surprises

(b) Path Surprises

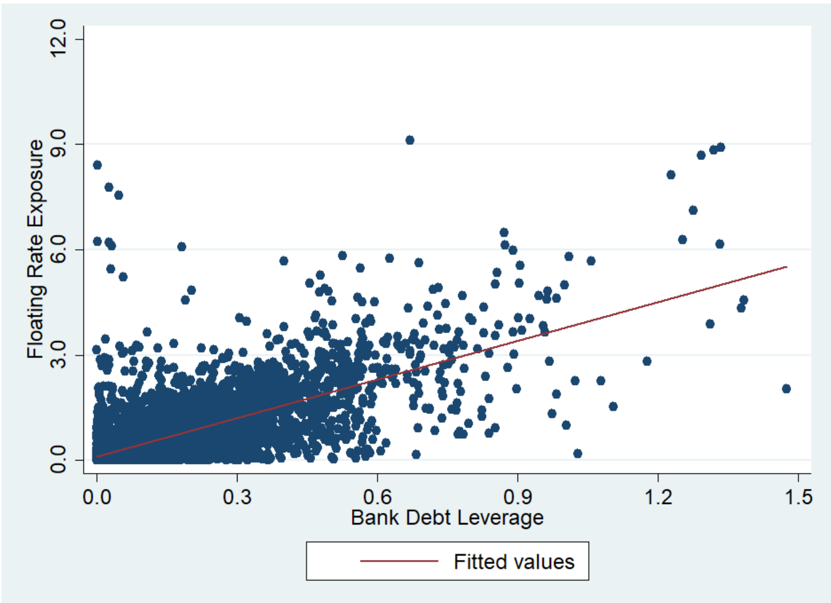
The panel above plots daily changes in S&P500 Index against the target surprises on the FOMC announcement dates between January 2004 and December 2018, and the panel below the same time series against the path surprises. The lines plot the OLS fitted values.

Figure 3: Floating Rate Debt Leverage and Bank Debt Leverage



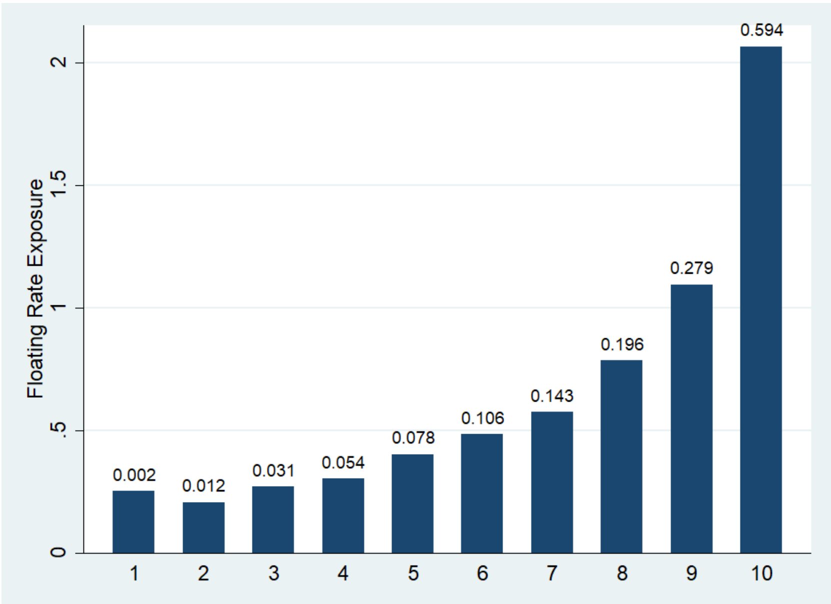
Floating rate debt is all obligations whose interest rates are variable. Bank debt is the sum of term loans and (drawn) credit lines. They are expressed as fractions of total assets to give "Floating Rate Debt Leverage" and "Bank Debt Leverage" respectively. The line plots OLS fitted values.

Figure 4: Floating Rate Exposure and Bank Debt Leverage



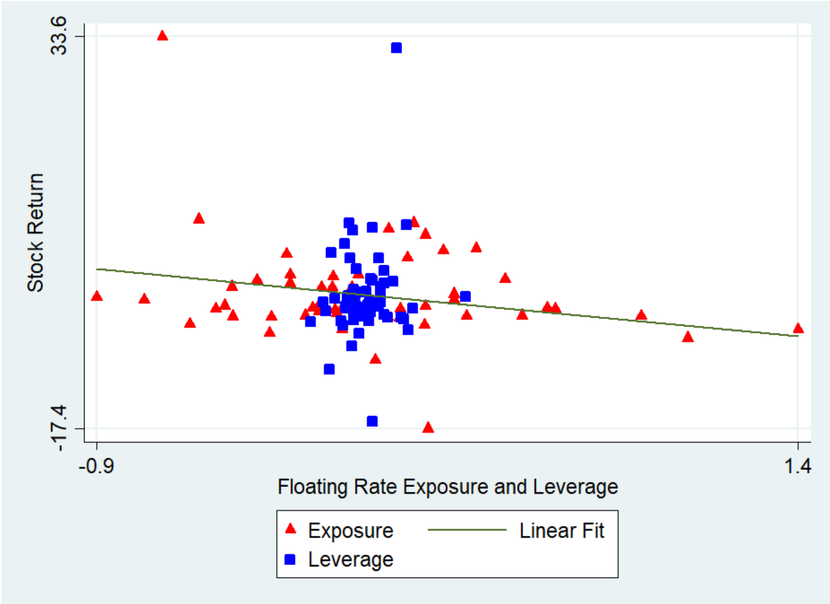
"Bank Debt Leverage" is the ratio of bank debts (term loans + drawn credit lines) to total assets. "Floating rate exposure" is constructed by multiplying each floating rate debt item by its maturity and expressing the resulting sum as a fraction of total assets. The line plots the OLS fitted values.

Figure 5: Floating Rate Exposure over Deciles of Bank Debt Leverage

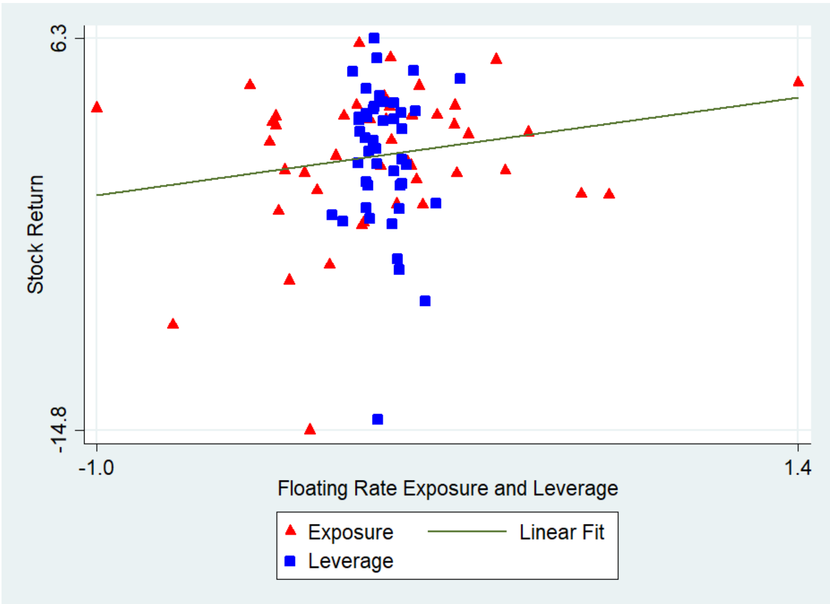


The figure plots the simple average of the floating rate exposure in each decile of the bank debt leverage. "1" along the horizontal axis means between the bottom and the 1st decile, "2" means between the 1st and the 2nd decile, and so on. The simple average of the bank debt leverage within each decile is reported above the corresponding bar.

Figure 6: Partial Regression Plots with Floating Rate Exposure and Leverage for Non-hedgers



(a) March 28, 2006



(b) August 8, 2006

The figure shows partial regression plots between stock return and floating rate exposure (in triangle) and floating rate leverage (in square) respectively for non-hedgers, on the same figure. The OLS fitted line for the former is also provided. The top panel is for the FOMC announcement on March 28, 2006, which was associated with path surprise of 18bps (contractionary). The bottom panel is for the FOMC announcement on August 8, 2006 whose path surprise was -3bps (expansionary).