Monetary Policy Under Multiple Financing Constraints *

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Abstract

We revisit the credit channel of monetary policy when firms face multiple financial constraints. We show theoretically that the multiplicity of financial constraints mutes the response of borrowing and investment to expansionary policy but amplifies the response to contractionary policy, relative to a benchmark with a single constraint. After tightening, the constraint that tightened the most tends to bind, while after an easing, the one that eased the least does. We provide strong support for our predictions using US firm microdata and a quasi-natural experiment around an accounting rule change that increases the number of tight financial constraints. We embed our mechanism into a New Keynesian heterogeneous-firm model and find that our mechanism can account for a large part of the well-documented, but previously unexplained, asymmetric response of aggregate investment to monetary policy.

Keywords: Monetary policy, asymmetry, firm heterogeneity, investment, financial frictions

JEL Classification Codes: D22, D25, E22, E44, E52

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1 Introduction

The firm credit channel is an important transmission mechanism of monetary policy (Bernanke and Gertler, 1995; Gertler and Karadi, 2015). While standard theoretical frameworks of the credit channel impose only one type of constraint on firms' access to external finance (Bernanke and Gertler, 1989; Bernanke et al., 1999; Gertler and Karadi, 2011; Christiano et al., 2014), firms often must simultaneously satisfy multiple types of financial constraints, such as collateral, earnings-based, or leverage constraints, among other types (Lian and Ma, 2021; Drechsel, 2023; Greenwald, 2019). What are the implications of the simultaneous presence of multiple occasionally binding financial constraints for the transmission of monetary policy? We show theoretically and empirically that the multiplicity of constraints can account for a large part of the well-documented—but so far unexplained—muted response of borrowing and investment to monetary easings and their strong response to tightenings.

We first develop a simple model of firm borrowing and investment in which firms face multiple occasionally binding constraints on their total borrowing, and in which at least some of those constraints are tight (i.e., close to binding).[1] Policy-induced changes in interest rates affect the tightness of each constraint differently.[2] Following a contractionary policy action, which tightens all constraints but to varying degrees, the constraint that is most likely to bind after the rate hike is the *most* rate-sensitive one; i.e., the one that tightened the most. As a result, firms that face multiple tight constraints tend to experience large drops in borrowing and investment after a rate increase compared to firms that only face one tight constraint. In contrast, following a policy easing, which relaxes all constraints but to varying degrees, the constraint that is most likely to bind after the rate cut is the *least* rate-sensitive one; i.e., the one that eased the least. It follows that firms that face multiple tight constraints tend to display a muted response to policy easings. Combined, these results imply the effects on monetary policy transmission of financial constraints in the presence of multiple constraints is asymmetric: constraints amplify the effects of tightenings and dampen the effects of loosenings. Importantly, this mechanism operates in addition to, and potentially enhancing, any underlying nonlinearity that might already exist in any individual constraint.

Next, we take the testable predictions of this simple model to our database of U.S. publicly listed firms. To do so, we require a measure of the number of tight borrowing constraints firms face. While measuring the number, type, and tightness of credit constraints is challenging (Farre-Mensa and Ljungqvist (2016)), debt covenant data can help overcome this challenge (Lian and Ma

[1] A thorough explanation of why firms face multiple constraints is beyond the scope of this paper. In the discussion of the literature, we review theoretical contributions rationalizing the presence of multiple constraints.

[2] The interest-rate sensitivity of financial constraints will likely vary across different types of constraints. In traditional macro-finance models, the tightness of collateral constraints varies strongly with changes in interest rates (Kiyotaki and Moore, 1997). However, constraints are also often enforced through legally binding financial covenants (Lian and Ma, 2021), which are based on accounting data and often not fully marked-to-market and are likely to be less affected by changes in interest rates than collateral constraints.

(2021)). Corporate bonds and loans typically feature financial covenants that specify a threshold for a financial variable that, if breached, typically results in a transfer of control rights to the creditors. A large empirical corporate finance literature finds that covenant violations are frequent and that these violations typically result in large reductions in borrowing, investment, and employment.[3] This literature argues, moreover, that covenants on outstanding debt are an important way through which financial constraints affect firm policies, including the ability to access new external financing.

We consider a covenant to be tight if the firm has a likelihood of violating it in the next quarter, based on the estimated properties of the underlying financial ratios, above a given threshold, and construct a measure for the number of tight constraints each quarter equal to the count of tight covenants. In addition to tight covenants as proxies for financial constraints, we add another potential constraint, following Farre-Mensa and Ljungqvist (2016) and Ottonello and Winberry (2020), which is the firm's distance to default. This is a distinct constraint and captures the inability to borrow due to financial distress, lack of additional debt capacity, and debt overhang. We sort firms into those that are unconstrained, those with a single tight constraint, and those with multiple tight constraints. In our sample, a large fraction (63%) of firms have multiple constraints, and this fraction is counter-cyclical.

We collect well-identified monetary policy shocks—i.e., measured using a high-frequency event-study approach around policy decisions and controlling for information about the state of the economy that might be disclosed through the policy action—and decompose these shocks into contractionary and accommodative. This strategy allows us to control for the state-dependent impact of monetary policy, given our interest in sign-dependence, as the policy innovations we use are, by construction, orthogonal to the state of the economy. We exploit cross-sectional heterogeneity in firms' number of tight constraints and trace the response of their external funding flows and their investment to monetary policy tightenings and loosenings.

We first show that financially constrained firms, regardless of the number of tight constraints, reduce their external funding and investment notably more, on average, in response to contractionary shocks than their unconstrained counterparts. The opposite is the case for expansionary shocks: firms with at least one tight constraint increase external funding and investment substantially less in response to lower interest rates. In sum, and echoing the analogy expressed by the first chairman of the Federal Reserve Marriner Eccles in 1935: "...one cannot push a string. [...], there is very little, if anything that the reserve organization can do toward bringing about recovery...". Our results suggest that contractionary shocks "pull" financially constrained firms "with a string", while expansionary shocks resemble "pushing" financially constrained firms "with a string". Importantly, our results can explain the well-documented asymmetric effects of monetary policy in the macro-econometric literature (Barnichon et al., 2017; Angrist et al., 2018; Debortoli et al., 2020; Jordà et al., 2020; Barnichon et al., 2022).

[3]See, e.g., Roberts and Sufi (2009), Chava and Roberts (2008), Falato and Liang (2016), and Acharya et al. (2020).

The main contribution of the empirical part is to show that this very muted response to easings and very strong response to tightenings of constraint firms is mostly [caused by/associated with] the multiplicity of constraints, as our theory predicts. When we classify firms according to whether they face only one or multiple constraints, we find that firms with multiple constraints display a significantly stronger asymmetry in their response of external finance and investment to policy shocks than single-constraint firms. Moreover, the asymmetry grows considerably with the number of tight constraints.

The number of tight constraints firms face is determined endogenously and, as a result, the estimates in our baseline estimation might suffer from biases. To mitigate this concern, we take advantage of an accounting rule change–ASC 842–that, we argue, introduces exogenous variation in the tightness of leverage-based covenants. The Financial Accounting Standards Board (FASB) announced in 2016 that it would start requiring in 2019 that operating leases, which were off-balance sheet items at the time, to be included as financial liabilities on U.S. firms' balance sheets. While this rule modification did not directly alter firms' fundamentals, the addition of leases to financial reports worsened many debt-based financial ratios included in debt covenants effectively tightened debt-based covenants. Indeed, we find that firms with a high ratio of estimated operating lease liabilities over total assets pre-ASC 842 are more likely to see their accounting debt rise post-shock and suffer an increase in the tightness of debt-based covenants, compared to firms with low lease ratios. In a difference-in-differences setting, we show that firms with a high lease ratio pre-ASC 842 suffered a large increase post-ASC 842 in the degree of asymmetry in their response to policy shocks. This evidence provides a compelling validation of our earlier results and a strong backing of our theoretical predictions. Taken together, these results support the role of financial factors in explaining the asymmetric effects of monetary policy—or, in other words, the asymmetry of the credit channel of monetary policy.

Finally, we develop a quantitative version of our simple model to explore the extent to which the presence of multiple financial constraints generates asymmetry in the responses of firm investment with respect to the sign of the change in the monetary policy rate. The model is a New Keynesian economy with firm investment and firm heterogeneity. It builds on Ottonello and Winberry (2020) incorporating into that framework an earnings- and an asset-based financing constraint that firms must respect when issuing debt. In equilibrium, the distribution of net worth across firms is endogenous, as are the population shares of firms facing no binding, a single binding, and multiple binding financing constraints. Multiple financing constraints can be binding for many firms in equilibrium because the marginal return of retaining equity to reinvest in general features discontinuities at levels of net worth at which different financing constraints intersect. We calibrate the model to match key moments in data concerning the distribution of the number and intensity of binding financing constraints across firms. In the calibrated model, an unanticipated tightening in the monetary policy rate of 25 basis points generates an impulse response in aggregate investment relative to steady state that is 0.06 percentage points stronger on average over the first 10 quarters after the shock than the counterpart response generated by an unanticipated easing in the monetary policy rate of the same size.

Literature Review Monetary policy tightening shocks tend to transmit more strongly into aggregate spending and employment than easing shocks, as shown in studies using aggregate time series data (Barnichon et al., 2017; Angrist et al., 2018; Debortoli et al., 2020; Jordà et al., 2020; Barnichon et al., 2022).[4] Papers in this literature typically point to two mechanisms to explain this pattern of asymmetry: downward nominal rigidity in prices and wages (Debortoli et al., 2020) and financial factors (Stein, 2014). Some evidence has been provided on the first mechanism (Debortoli et al., 2020), which turns on the idea that when monetary policy tightens, nominal wages do not adjust downward, leading to large declines in output. Instead, when monetary policy loosens, prices and wages rise, mitigating the changes in output. We consider both mechanisms to be complementary. The focus of this paper is on the second mechanism, and we are the first to study such a mechanism formally.

At the same time, studies exploiting cross-sectional variation in firm-level data show that financial frictions significantly affect firms' response to monetary policy, although these studies do not distinguish between the effects of tightening and easing policy actions (Gertler and Gilchrist, 1994; Cloyne et al., 2023; Ottonello and Winberry, 2020). We contribute to these literatures by showing that the differential effects of monetary policy tightening and easing on firm spending dynamics depend on whether firms are distressed, and that this heterogeneity explains the asymmetric effects of monetary policy documented in the macro-econometric literature.

A large empirical literature studies how firms' financial conditions affect their response to monetary policy. Monetary policy rates and credit spreads tend to comove (Gertler and Karadi, 2015; Gilchrist et al., 2015; Caldara and Herbst, 2019), and the comovement is significantly stronger for more financially distressed firms (Anderson and Cesa-Bianchi, 2020; Palazzo and Yamarthy, 2022). The sales, inventory, and debt of small financially distressed firms are more responsive to a monetary policy tightening (Gertler and Gilchrist, 1994; Caglio et al., 2021), perhaps because they have less flexibility to shift toward alternative forms of financing after banks contract their lending supply when monetary policy tightens (Becker and Ivashina, 2014).

The evidence on the role of heterogeneous firm financial conditions on the response of investment is mixed. Some studies show that more financially distressed public firms react less to (expansionary) monetary policy (Ottonello and Winberry, 2020), while others show this is not the case for small private firms (Caglio et al., 2021), for certain sample periods (Lakdawala and Moreland, 2021), and over longer horizons (Jeenas, 2019). Moreover, some authors argue that firm-level measures of financial distress are highly endogenous and capture other factors; for example, the effect of leverage on monetary policy sensitivity disappears when controlling for firm age and dividend-

[4] Tenreyro and Thwaites (2016) shows that US monetary policy is less powerful in recessions.

payer status (Cloyne et al., 2023). We contribute to this literature by reexamining this evidence separately for easing and tightening shocks and showing that this decomposition clarifies important controversies in this literature.

A thorough explanation of why firms face multiple constraints is beyond the scope of this paper. The multiplicity of constraints can arise from the many potential underlying frictions that can introduce constraints on the overall amount of external financing, on the amount of funding using one particular instrument, or on the amount of funding for one particular asset or project within the firm. Some of these frictions include asymmetric information (Townsend (1979), incomplete contracting (Hart and Moore (1994)), moral hazard (Holmström and Tirole (1998), costly enforcement of contracts (Kehoe and Levine (1993)), shareholder-debtholder conflicts (Myers (1977)), or manager-shareholder conflicts (Dewatripont and Tirole (1994)).

The macro-financial literature using firm-level data often uses event-study methodologies around big contractionary credit shocks such as the global financial crisis to trace the impact of financial factors for the employment (Chodorow-Reich, 2014), investment (Almeida et al., 2011), and productivity (Duval et al., 2020). Manaresi and Pierri (2022) show that contractionary firm-level credit availability shocks have negative productivity consequences, but positive credit supply shocks have limited effects. We contribute to this literature by exploiting cross-sectional firm-level variation in financial conditions to assess the role of financial factors in explaining this pattern.

Standard macroeconomic models of firm financial constraints tend to deliver either roughly symmetric responses to monetary policy shocks (Bernanke and Gertler (1989); Bernanke et al. (1999)), even if solved non-linearly (González et al. (2024)), or ambiguous predictions about the sign and magnitude of any asymmetry (Ottonello and Winberry (2020)). A small literature analyzes frameworks that draw a sharp distinction between normal and crisis times and deliver asymmetric responses with respect to the phase of the cycle (Karadi and Nakov (2021); Van der Ghote (2021); Akinci et al. (2023)). We contribute to these model by proposing a framework that unambiguously delivers asymmetric responses to monetary policy shocks regardless of the economic cycle under one very mild and empirically realistic assumption: the presence of multiple borrowing constraints. Interestingly, asymmetries are prominent even in log-linear approximations of the equilibrium around a steady state.

A recent, small literature has focused on the distinction between earnings-based constraints and collateral-based constraints. Lian and Ma (2021) find that, in the U.S., earnings-based constraints are more prevalent among large, old firms and that earnings-based constraints are much more common than collateral-based constraints. Similar in spirit to our work, Greenwald (2019) explores how the presence of two different constraints (in his case, two types of earnings-based constraints) affect the response of economic activity to monetary policy. His focus is on the state-dependence of the relevance of each constraint and on the impact of this state-dependence for the state-dependence of the effectiveness of monetary policy. Finally, Drechsel (2023) argues that macroeconomic models featuring earnings-based constraints deliver dynamics that are empirically more relevant than the ones delivered by models featuring collateral-based constraints and that models with earnings-based constraints, moreover, generate different conclusions about the relative importance of different shocks in explaining macroeconomic dynamics.

Layout The paper is organized as follows. Section 2 develops a simple model of firm investment under multiple financing constraints and derives with the model three testable proposition. Section 3 describes the data used to test the propositions, Section 4 lays out the empirical strategic, and Section 5 explains the empirical results. Section 6 enriches the simple model to provide quantitative support to the propositions. Section 7 concludes.

2 A Simple Model of Firm Investment under Multiple Financing Constraints

Consider a competitive firm that lives for only two time periods, $t = 0, 1$. There is no uncertainty. At time $t = 0$ the firm invests in physical capital $k \geq 0$ and at time $t = 1$ the firm produces an output good $y \geq 0$ using the invested physical capital according to a production technology with decreasing marginal returns,

$$y = F(k) \,, \tag{1}$$

with $F(0) = 0$, $F'(\cdot) > 0$, and $F''(\cdot) < 0$. Physical capital fully depreciates after production takes place.

Denote the gross real interest rate by $R \geq 1$ and assume for simplicity a constant price of physical capital normalized to 1. Then, the unconstrained optimal investment scale solves

$$\max_{k \geq 0} \left\{ -k + \frac{1}{R} F(k) \right\} , \tag{2}$$

and consequently, it is characterized by $k_* \geq 0$, with

$$F'(k_*) = R \,. \tag{3}$$

Let $n \geq 0$ denote the net worth of the firm at time $t = 0$. We assume $n < k_*$ which implies that the firm does not have sufficient internal equity to finance by its own the unconstrained optimal scale. The firm can issue debt $b \geq 0$, nonetheless, and thus can finance a leveraged investment scale $k = n + b$. However, the firm faces many different restrictions for issuing debt, which ultimately limit investment by

$$k \leq \min_j G_j(n; R) \tag{4}$$

where $j = 0, 1, 2, ...$ indexes the restrictions and $G_j(n; R)$ indicates as a function of net worth and the real interest rate how each restriction j ultimately limits the investment scale. The minimum operator implies all restrictions must be simultaneously satisfied. As discussed, we interpret each restriction as a different type of financing constraint.

For the moment, we remain agnostic about the nature and number of the financing constraints, and impose on them only the following general properties. First, the associated limits on the investment scale relax when net worth increases. Formally, $\partial G_j(n;R)/\partial n > 0$. Second, the limits tighten when the real interest rate rises, that is, $\partial G_j(n;R)/\partial R < 0$. Lastly, the limits feature in general differ sensitivities to the real interest rate. Mathematically, $\partial G_j(n;R)/\partial R \neq \partial G_{j'}(n;R)/\partial R$ in general for any $j \neq j'$.

The constrained optimal investment scale is given by $k_{**}(n;R) \geq 0$, with

$$k_{**}(n;R) = \min\left\{k_*\,,\ \min_j G_j(n;R)\right\}. \tag{5}$$

Multiple financing constraints are binding if

$$G_j(n;R) = G_{j'}(n;R) = \min_j G_j(n;R) < k_* \text{ for at least two different } j \neq j'. \tag{6}$$

Below we study the extent to which the number of binding financing constraints influences the response of firm investment to a marginal change in the interest rate.

Proposition 1 (Condition for asymmetry). *If multiple financing constraints are binding, investment responds more aggressively to a marginal increase in the interest rate than to a marginal decrease of equal size. By contrast, if a single constraint is binding, the response is symmetric.*

The proof of this proposition is as follows. If the firm is financially constrained, investment responds to a marginal increase in the interest rate as follows:

$$\left|\lim_{h\to 0^+}\frac{k_{**}(n;R+h)-k_{**}(n;R)}{h}\right| = \max_{j\in\mathcal{B}}\left\{\left|\frac{\partial}{\partial R}G_j(n;R)\right|\right\}\ , \tag{7}$$

and to a marginal decrease it does according to:

$$\left|\lim_{h\to 0^-}\frac{k_{**}(n;R+h)-k_{**}(n;R)}{h}\right| = \min_{j\in\mathcal{B}}\left\{\left|\frac{\partial}{\partial R}G_j(n;R)\right|\right\}\ , \tag{8}$$

where $\mathcal{B}$ is the set of binding financing constraints. This holds because all of the constraints must always be simultaneously satisfied. If multiple constraints are binding, following a marginal increase in the interest rate, investment contracts according to the binding constraint that tightens by more, and following a marginal decrease, it expands according to the binding constraint that relaxes by less. This naturally implies an asymmetric response of investment with respect to the sign of the change in the interest rate. By contrast, if a single constraint is binding, the response of investment is symmetric, because the minimum and the maximum responses in absolute terms coincide.

Proposition 2 (Strength of asymmetry). *If multiple financing constraints are binding, the larger the number of binding financing constraints, the stronger the asymmetry in the response of investment to a marginal change in the interest rate.*

This proposition follows directly from formulae (7) and (8). It holds because, everything else the same, the maximum operator is increasing in the number of its arguments, while the minimum operator is decreasing. The proposition naturally implies an intensive margin in the number of binding financing constraints concerning the strength of the asymmetry in the investment response.

Proposition 3 (Symmetry of unconstrained response). *If no financing constraint is binding, the responses of investment to a marginal increase and a marginal decrease in the interest rate of equal size are symmetric.*

This proposition directly follows differentiating investment scale k_* in equation (30) with respect to interest rate R. Formally, one gets

$$\left|\frac{\partial}{\partial R} k_*\right| = \left|\frac{1}{F''\left(k_*\right)}\right|, \tag{9}$$

which implies a symmetric response of investment with respect to the sign of the marginal change in the interest rate.

3 Data

We now describe the data used to examine the empirical validity of propositions 1, 2 and 3. Our sample construction starts with U.S. firms covered by Compustat at a quarterly frequency between 1990 and 2024, excluding utilities (Standard Industry Classification (SIC) codes 4900–4949) and financials (SIC codes 6000–6999). We remove observations with negative revenues, missing information on total assets or capital, or a value of total assets under \$10 million in 2012 U.S. dollar value. We winsorize all variables at the 1% level to remove outliers. Firms in the sample are required to be active for at least five years after the monetary policy shock occurs, to cover the length of the horizon of the effects we study and ensure that effects are not driven by firm samples being different at short and long horizons. We refer to investment as the log difference in the capital stock, following Ottonello and Winberry (2020). Debt growth is similarly constructed as the log difference in the total stock of debt. Employment is not available at a quarterly frequency from Compustat, so we use the annual data and linearly interpolate the data to be able to study the effect of quarterly monetary policy shocks on employment.

We complement the Compustat data with data from Refinitiv's Loan Pricing Corporation (LPC) DealScan database, a dataset of syndicated loan originations with detailed information on loan terms and financial covenants. Financial covenants require borrowers to maintain financial ratios within a specified range, and DealScan provides this information. These covenant levels that firms are required not to breach are merged with accounting data available from Compustat using a link file provided by Michael Roberts (introduced in Chava and Roberts (2008)). This merged Compustat-DealScan database is covers a large part of the U.S. corporate sector. Syndicated loans represent a sizable portion of commercial lending, accounting for about one-third of business loans on the balance sheets of large U.S. banks (Ivashina et al., 2022). We use the sample of loans originated in 1996 or later, as that is when the database started to provide quality data on financial covenants.

Our key firm-level variable is the number of "tight" financial constraints a firm faces. Conceptually, while only one constraint might be binding at any point in time, it is possible that multiple constraints are close to binding and might become binding following a large enough shock, such as a large monetary policy shock. A constraint is considered "tight" if the probability that it binds in the near future (in the next quarter, in our case) is above an arbitrary threshold. We operationalize this idea by requiring that the distance to violation of a particular covenant is below two standard deviations of quarterly changes in the underlying financial ratio. Our results, as we discuss below, are robust to other thresholds.

In addition to covenants as proxies for financial constraints, we add another potential constraint which is the firm's distance to default, which captures the likelihood of default over the near-term horizon. This is a distinct constraint and captures the inability to borrow due to financial distress, lack of additional debt capacity, and debt overhang. We include this constraint following the evidence in (Farre-Mensa and Ljungqvist, 2016) that the firm characteristic that they can most clearly associate in the data with credit-constrained behavior is closeness to default (and not other characteristics, such as not being dividend payers, being young or small, having low leverage, or no credit rating). Distance to default is computed as in Gilchrist and Zakrajšek (2012), using Compustat and CRSP data following the Merton distance to default model, which takes as inputs the firm's equity valuations and leverage. A firm is considered as facing a financial distress constraint if its distance to default is below two standard deviations.

Figure 1 provides a detailed look at the prevalence of various financial covenants across firms. Each bar represents the number of firms for which a specific covenant is tight. The horizontal axis lists the types of covenants, ranging from debt-related ratios to liquidity and leverage ratios, while the vertical axis indicates the number of firms.

The chart shows that some covenants, such as the debt-to-EBITDA ratio, are tight for a large number of firms, reflecting the common use of this metric by lenders to assess a firm's ability to meet its debt obligations. For instance, the debt-to-EBITDA covenant restricts a firm's total debt relative to its earnings before interest, taxes, depreciation, and amortization, and is often used to prevent overleveraging. Similarly, the interest coverage ratio covenant, which measures a firm's ability to cover interest expenses with its earnings, is also frequently introduced by lenders, indicating its importance in ensuring that firms can service their debt even under adverse conditions. The fixed charge coverage ratio, another critical measure of a firm's financial health, is also commonly used, further illustrating the prevalence of stringent financial constraints in corporate lending agreements.

Figure 2 presents a histogram that illustrates the distribution of the number of binding constraints across firms. The horizontal axis represents the number of constraints, ranging from zero to eight, while the vertical axis shows the fraction of firms that fall into each category.

The histogram reveals that approximately 50 percent of firms face multiple binding constraints, with some firms experiencing as many as eight different constraints simultaneously. The most common scenario involves firms with one or two binding constraints, but there is a substantial proportion of firms that deal with a higher number of constraints. This distribution indicates that it is not uncommon for firms to operate under multiple financial restrictions, which could significantly impact their investment decisions and responses to monetary policy.

The fact that a sizable fraction of firms faces several constraints simultaneously underscores the complexity of their financial environments. When firms are subject to multiple binding constraints, their financial flexibility is significantly reduced, making them more vulnerable to external shocks, including changes in monetary policy. This multi-faceted financial pressure can lead to more pronounced and potentially asymmetric responses to monetary policy interventions, as firms struggle to navigate the combined restrictions on their operations.

To construct our measure of monetary policy shocks, we follow the methodology proposed by Miranda-Agrippino and Ricco (2021). This approach aims to isolate the pure policy shock by controlling for the information effect, where market participants may react to both the policy action and the underlying economic conditions signaled by the central bank.

Following Miranda-Agrippino and Ricco (2021), we identify monetary policy shocks around FOMC meetings as exogenous shifts in the market prices that are unforecastable and not due to the central bank's systematic response to its own assessment of the macroeconomic outlook. Those monetary policy shocks are constructed by projecting market-based monetary surprises on their own lags and the central bank's information set, as summarized by Greenbook forecasts. These monetary policy shocks are therefore orthogonal to shocks to firms' borrowing and investment decisions.

We first focus on high-frequency changes in financial market variables around the time of policy announcements. Specifically, we utilize a 10-minute pre-announcement and 20-minute post-announcement window to capture immediate market reactions. The variables included in our analysis are the 3-month Federal Funds Rate Futures (FF4), the 3-month Treasury Yield (ONRUN3M), the 2-year Treasury Yield (ONRUN2Y), the 5-year Treasury Yield (ONRUN5Y), and the 10-year Treasury Yield (ONRUN10Y).

Subsequently, we aggregate the high-frequency data for each quarter, calculating the sum of the daily high-frequency shocks. We then employ principal component analysis (PCA) to extract the first principal component from these quarterly aggregated shocks across instruments. This principal component represents a composite measure of monetary policy shocks, capturing the common variation across different financial market variables. Lastly, we separate the shock series into accommodative and contractionary shocks, which takes the value of the original shock if the shock is negative and positive, respectively, and value 0 otherwise.

For our baseline monetary policy shock, we have 61 contractionary and 58 accommodative shocks. We standardize the monetary policy shocks so that one unit is equal to a one standard deviation shock. The average size of the contractionary shock has standard deviation of 0.69 and the accommodative shock of 0.73, which translates to around 4-5 basis points.

4 Empirical Strategy

We test the propositions derived in Section 2 by evaluating how shocks to the monetary policy rate impact the external financing flows and the investment of firms depending on the number of tight financing constraints they face. We first implement a strategy in which we directly measure the number of constraints firms face using data on financial covenants. We next introduce a quasi-natural experiment that provides exogenous variation in the number of tight constraints firms face and mitigates potential endogeneity concerns in our results.

4.1 Baseline Strategy

To estimate how shocks to the policy rate affect external funding and investment, we estimate the following Jordà (2005) local projection specification as our baseline framework:

$$\begin{aligned}\Delta_{h+1} Y_{i,t+h} =& \beta^h_{c,m}(\text{Contr. MP Shock}_t * \text{Mul. Constraint}_{i,t}) + \beta^h_{a,m}(\text{Acc MP Shock}_t * \text{Mul. Constraint}_{i,t})\\ & \beta^h_{c,s}(\text{Contr. MP Shock}_t * \text{Single Constraint}_{i,t}) + \beta^h_{a,s}(\text{Acc MP Shock}_t * \text{Single Constraint}_{i,t})\\ & \beta^h_{c,u}(\text{Contr. MP Shock}_t * \text{Unconstrained}_{i,t}) + \beta^h_{a,u}(\text{Acc MP Shock}_t * \text{Unconstrained}_{i,t})\\ & + \mathbf{X}'\gamma + \epsilon_{i,t}\end{aligned}$$

where $\Delta_{h+1} Y_{i,t+h}$ is the dependent variable and can be either $\Delta_h ExFin_{i,t+h}$, the cumulative debt and equity financing flows between the end of quarter $t-1$ and the end of quarter $t+h$ over total assets, or $\Delta_h \log K_{i,t+h}$, the change in the log of the real stock of capital K between the end of quarter $t-1$ and the end of quarter $t+h$. *MP Shock*$_t$ is the monetary surprise in quarter t. The variables $Mul.\ Constraint$, $Single\ Constraint$, and $Unconstrained$ are dummy variables that take value 1 if the firm in that quarter faces multiple tight financing constraints, only one tight financing constraint, or none, respectively, and they are 0 otherwise. The variable $\mathbf{X}'$ contains various control variables that vary depending on the specification.

The β coefficients in specification (45) measure the response of external financing flows or investment for each subgroup of firms to tightening vs easing shocks. While we expect all of them to have a negative sign, our theory has clear predictions for the size of some of these elasticities. In particular, our theory predicts that the response of multiple-constraint firms to easing shocks ($\beta^h_{a,m}$) should be weaker than the response of single-constrained firms ($\beta^h_{a,s}$) and, moreover, that the response to tightening shocks of multiple-constraint firms ($\beta^h_{c,m}$) should be stronger than for single-constrained firms ($\beta^h_{c,s}$). In other words, our theory predicts that the response of multiple-constraint firms ($|\beta^h_{c,m}| - |\beta^h_{a,m}|$) is strongly asymmetric. It is important to note that our theory in Section 2 does not have specific predictions about the magnitude and sign of any asymmetry in the response of single-constrained and unconstrained firms and allows for these firms to possibly also exhibit some degree of asymmetry.

4.2 A Quasi-Natural Experiment: The 2019 Leverage Accounting Rule Change in the U.S. (ASC 842)

The number of tight constraints firms face is determined endogenously and, as a result, the estimates in our baseline estimation might suffer from biases. For example, firms facing multiple constraints might be riskier, more opaque, or face more serious agency frictions, and all of these characteristics could themselves lead to asymmetric responses to monetary policy. To mitigate this concern, we take advantage of an accounting rule change that, we argue, introduces exogenous variation in the tightness of leverage-based constraints.

The Financial Accounting Standards Board (FASB) announced in 2016 that it would start requiring operating leases, which were off-balance sheet items at the time, to be included as financial liabilities on U.S. firms' balance sheets. This accounting rule change, dubbed ASC 842, became effective at the beginning of 2019 for public firms. While this rule modification did not directly alter firms' fundamentals in any way, the addition of leases to financial reports did, from a legal and contractual standpoint, worsen many debt-based financial ratios included in debt covenants. Absent specific provisions about this event, or absent a decision by lenders to costlessly waive any violations induced by the rule change, this accounting change effectively tightened debt-based covenants.[5]

We first compute the estimated liabilities associated with off-balance sheet operating leases as the present value of projected future lease payments disclosed by firms in their financial reports, following Jung and Scarlat (2024). We discount these projected leases using a 10% discount rate as an approximation, although our results are robust to other reasonable discount rate choices. We next compute the ratio of the estimated liabilities over total assets each year and consider this ratio to be the measure of the exposure to the accounting change shock; firms with a higher ratio before the accounting rule change (the "shock") are more likely to see their accounting debt rise post-shock

[5] At the time of the transition to the new accounting regime for leases, accounting advisory firms warned their customers of the potential consequences for covenant violations. For example, *CPA Practice Advisor* warned clients that "even though a company's operations and results haven't changed, adding leases to financial statements ... may adversely affect those ratios. The result can be a debt covenant violation." Accounting firm *KatzAbosch* alerted their companies that "If you have financial covenants in your long-term debt agreements, implementing the standard may impact those calculations and cause you to violate the covenants. Covenant violations result in default of the debt agreement and give the lender the legal right to terminate the debt agreement and demand immediate repayment of the entire loan. While lenders will frequently provide written waivers for covenant violations, this is not without cost as lenders will usually require a waiver fee be paid. Plus, covenant violations could damage your relationship with your lender."

and suffer an increase in the tightness of covenants based on the accounting debt measure.

Evidence of the relevance of our strategy to identify variation in leverage (and thus in the number of constraints) is found in Figures 5, 6 and 7. Figure 5 shows the lease share was negatively associated with balance sheet leverage pre-shock. This negative relationship is intuitive given that operating lease liabilities share many similarities with financial leverage and a high share of operating leases might limit the capacity or the need for higher financial leverage. This negative relationship disappears post-shock, suggesting that firms with higher operating lease burdens grew their leverage relative to this with low operating lease volumes. Consistent with this observation, Figure 6 displays a strong positive association between the number of tight credit constraints post-shock and the lease share pre-shock. This positive relationship is absent pre-shock. Likewise, Figure 7 shows the effect of the lease share on the number of constraints over time and makes it clear that the lease share became a statistically significant determinant of the number of tight constraints following the shock.

The empirical specification for this quasi-natural experiment builds on specification (45) and extends it to a difference-in-differences framework. We start by restricting the sample to firm-quarter observations with at least one tight financial constraint and, within financially constrained firms, we use the operating liabilities share as an instrument for the change in the number of tight constraints firms face between the pre-shock and the post-shock periods. The testable prediction is that firms with a higher burden of operating liabilities are more likely to display an increase in their asymmetric response to monetary policy post-shock, because they are more likely to see their leverage increase, their debt-based covenants tighten, and their number of tight constraints increase.

More specifically, we run the following specification:

$$\begin{aligned}\Delta_{h+1} Y_{i,t+h} =& \beta_c^h(\text{Contr. MP Shock}_t * \text{High Lease}_{i,t}) + \beta_a^h(\text{Acc MP Shock}_t * \text{High Lease}_{i,t}) \\ &+ \beta_{cp}^h(\text{Contr. MP Shock}_t * \text{High Lease}_{i,t}) * Post \\ &+ \beta_{ap}^h(\text{Acc MP Shock}_t * \text{High Lease}_{i,t}) * Post + \mathbf{X}'\gamma + \epsilon_{i,t},\end{aligned} \tag{10}$$

where *High Lease* is a dummy variable that takes value 1 if the share of operating lease liabilities over total assets exceeds the median. The testable prediction of our simple model is that the asymmetric response to policy prior to the accounting change, $\beta_c^h - \beta_a^h$, should be smaller than the one after the shock, $(\beta_c^h + \beta_{cp}^h) - (\beta_a^h - \beta_{ap}^h)$.

5 Results

5.1 Baseline Results

The results of estimating specification (45) using external financing flows are found in Figure 3. The response of external funding to increases in the policy rate for unconstrained firms is negative and symmetric: the cumulative drop in debt and equity financing 8 quarters after a one standard deviation rate increase is around 4% of total assets, regardless of whether the shock is contractionary (top right panel) or expansionary (bottom right panel). The response of constrained firms that only face one tight constraint (the middle panels) displays a small degree of asymmetry. Firms with only one tight constraint have a similar response to policy tightenings than unconstrained firms but a modestly weaker response to easings. Firms that face multiple constraints, in contrast, display a strong asymmetry (left panels). While their response to tightenings (top left panel) is stronger than that of single-constrained or unconstrained firms, their response to policy easings (bottom left panel) is essentially muted.

To provide robustness to our results, we test for the stability of our estimates under different specifications in Table 2. In that table, we display the response of the external financing flows of single and multiple constraint firms relative to unconstrained firms, in response to contractionary and accommodative shocks. Our results remain stable regardless of whether we include firm fixed effects, additional firm controls, or macroeconomic controls. After 2 years, single constraint firms display a response of funding flows to tightening shocks that is statistically insignificantly different from unconstrained firms' average response, while their response to accommodative shocks is modestly weaker, by around 1pp, in some specifications. Multiple constraint firms display a notably (between 1.7 and 3.6 pp) stronger response to tightenings and a notably (between 2 and 3 pp) weaker response to easings relative to unconstrained firms. These results are consistent with those found in Figure 3.

Figure 4 illustrates the relationship between the number of financial constraints a firm faces and its responsiveness to monetary policy shocks. The x-axis represents the number of constraints, while the y-axis depicts the predicted effect of monetary policy on investment. The blue line and markers represent the response to an accommodative shock, while the red line and markers represent the response to a contractionary shock. Error bars indicate the standard errors at the 90% confidence interval. For firms with no constraints, the effect of contractionary and accommodative monetary policy shocks is symmetric. However, the negative impact of contractionary shocks increases in the number of financial constraints the firm faces. This suggests that financially constrained firms are particularly vulnerable to tightening monetary policy. In contrast, the response to accommodative shocks weakens as the number of constraints increases, suggesting that monetary policy may have a limited impact on stimulating investment for firms with a large number of financial constraints.

In Table 2 we repeat the exercise of Table 2 for the response of investment. Our results mirror those of external financing flows. After 2 years, the cumulative investment of single constraint firms displays, again, a response to tightening shocks that is statistically insignificantly different from unconstrained firms' average response, while the response to accommodative shocks is modestly weaker by around one percentage point in some specifications. Multiple constraint firms display a moderately stronger investment response (between 0.8 and 2.2 pp) to tightenings and a markedly (between 1.1 and 2.4 pp)weaker response to easings relative to unconstrained firms.

5.2 The 2019 Leverage Accounting Rule Change (ASC 842): Results

The results of our estimation based on the 2019 leverage accounting rule change ASC 842 are found in Table 5. The left panel displays the estimates *pre*-shock of the interaction of *High Lease* with, respectively, contractionary policy shocks (β_c^h) and easing shocks (β_a^h). The right panel displays the estimates *post*-shock of the interaction of *High Lease* with, respectively, contractionary policy shocks ($\beta_c^h + \beta_{cp}^h$) and easing shocks ($\beta_a^h + \beta_{ap}^h$).

The results show that, post-shock, the external financing flows of firms with high pre-shock operating leases are significantly more responsive to contractionary shocks than those of low-lease firms, and are significantly less responsive to easing shocks. In stark contrast, pre-shock, the external financing flows of firms with high pre-shock operating leases are about equally sensitive to contractionary or accommodative shocks than low-lease firms. Results are stable and robust to the presence of time fixed effects, firm fixed effects, firm controls, or macro controls. Quantitatively, the external financial flows decline by between 4.2 and 8.6 pp more in response to a contractionary monetary policy shock for firms that have high leases before the lease accounting change, while they increase by between 4.3 and 7.5 pp *less* in response to an accommodative monetary policy shock.

We replicate those results for investment in Table 6 and find qualitatively similar results, especially that firms with more leases before the accounting change are less responsive to accommodative monetary policy.

These results provide further support to the predictions of our simple model. As we showed in Section 4.2, the firm-level operating lease share pre-ASC 842 helps identify variation in the total number of tight constraints firms face because these firms are more likely to see their leverage increase and their debt-based covenants tighten. We, thus, interpret the results in Table 5 and 6 as providing strong support for the role of the multiplicity of constraints in explaining why financially constrained firms display a weak response to monetary easings but a strong response to monetary contractions.

Having provided a theoretical microeconomic foundation for our proposed mechanism and robust evidence in support of its predictions for the cross-sectional behavior of firms in response to contractionary and accommodative monetary policy, we next turn to exploring the macroeconomic implications of the multiplicity of constraints.

6 Quantitative Model

Finally, we develop a macroeconomic model with firm investment and multiple occasionally binding financing constraints to provide quantitative support to the mechanisms proposed in Section 2 and to study implications for aggregate investment. Following Ottonello and Winberry (2020), the model is represented with three blocks: an investment block, which captures the extent to which the number of binding financing constraints influences the response of firm investment to disturbances to the monetary policy rate; a New Keynesian block, which incorporates stickiness in nominal prices and thus enables real effects from monetary policy in the short term; and a representative household block, which closes the economy. Time $t = 0, 1, 2, ...$ is discrete and unbounded, and there is no uncertainty.

6.1 Investment Block

This block is composed of a continuum of competitive firms of unit measure. Firms produce an intermediate good $y_t = A_t l_t^{\alpha_l} k_{t-1}^{\alpha_k} \geq 0$, combining labor hours $l_t \geq 0$ and physical capital $k_{t-1} \geq 0$, according to a production technology with productivity $A_t > 0$ and decreasing returns to scale $\alpha_l + \alpha_k < 1$. Additionally, firms accumulate physical capital over time, according to a storage technology that transforms a final consumption good into physical capital one-to-one. Physical capital is a predetermined variable when production takes place and it depreciates over time at a constant rate $\delta > 0$.

Let $p_t > 0$ denote the price of the intermediate good in units of the final consumption good and let $w_t > 0$ denote the real wage. We set the final good as the numeraire. The profit maximization problem of firms is

$$\max_{l_t \geq 0} \left\{ p_t A_t l_t^{\alpha_l} k_{t-1}^{\alpha_k} - w_t l_t + (1-\delta) k_{t-1} \right\} . \tag{11}$$

Then, the optimal quantity of labor that maximizes profits is

$$l_t = \left(\frac{\alpha_l}{w_t} p_t A_t \right)^{\frac{1}{1-\alpha_l}} k_{t-1}^{\frac{\alpha_k}{1-\alpha_l}} , \tag{12}$$

and the maximized profits as a function of physical capital are $\zeta_t(k_{t-1}) \geq 0$, with

$$\zeta_t(k_{t-1}) \equiv (1-\alpha_l) \left[\left(\frac{\alpha_l}{w_t} \right)^{\alpha_l} p_t A_t \right]^{\frac{1}{1-\alpha_l}} k_{t-1}^{\frac{\alpha_k}{1-\alpha_l}} + (1-\delta) k_{t-1} . \tag{13}$$

Once production concludes and profits are accrued, firms decide the amount of dividends to distribute and the amount of physical capital to carry to the next period. Let $n_t \geq 0$ denote the net worth of firms after production takes place but before financial and reinvestment decisions are made. Firms can distribute their net worth as dividends $d_t \geq 0$, reinvest it in physical capital $k_t \geq 0$, or save it at a real interest rate $r_{t+1} \in \mathbb{R}$. They cannot issue equity. This restricts net worth and dividend distributions to be nonnegative. Firms can issue debt $b_t \in \mathbb{R}$, nonetheless, but only with a maturity of one period and subject to multiple financing constraints. For simplicity, we consider only an earnings- and an asset-based constraint.

Firms face a standard budget constraint,

$$d_t + k_t = n_t + b_t \,, \tag{14}$$

where the price of physical capital is already set to 1 because of the one-to-one storage technology. The earnings-based constraint limits debt issuance according to

$$(1 + r_{t+1})\, b_t \leq \lambda_e \,\zeta_{t+1}\,(k_t)\,, \tag{15}$$

where parameter $\lambda_e \in (0,1)$ is the share of profits that firms can pledge. The asset-based constraint instead does so according to

$$(1 + r_{t+1})\, b_t \leq \lambda_a q_{t+1} k_t \,, \tag{16}$$

with $\lambda_a \in (0,1)$ being the share of physical capital that can be pledged and $q_t \in [0,1]$ being the price at which bond holders can liquidate the capital. The price is exogenous, and in the calibration, it is set to match the empirical sensitivity of asset-based constraints to interest rates. Firms must respect both constraints and therefore they are effectively subject to the following borrowing constraint:

$$(1 + r_{t+1})\, b_t \leq \min\{\lambda_e \,\zeta_{t+1}\,(k_t)\ , \lambda_a q_{t+1} k_t\}\,. \tag{17}$$

A simple micro-foundation for this constraint is that firms can declare bankruptcy without costs either before or after production takes place. If they do so before, debt holders get the RHS on (16), while if they do so after, the holders get the RHS on (15). Assuming a debt renegotiation process following bankruptcy declaration in which firms can make a single take-or-leave offer, debt holders can only secure for themselves the worst of the two payoffs, ergo the minimum operator.

The net worth of firms evolves over time according to

$$n_{t+1} = \zeta_{t+1}\,(k_t) - (1 + r_{t+1})\, b_t - \tau \tag{18}$$

where $\tau > 0$ is a fixed, operating cost. Firms discount future payoffs by combining real interest rate $1 + r_{t+1}$ with a subjective time discount rate $(1 - \theta) \in [0,1]$. The subjective time discount rate is idiosyncratic to each firm. The cross-section distribution of discount rates across the firms is given by cumulative distribution function $F(\theta) \in [0,1]$. Heterogeneity in discount rates is motivated as differences in preferences between distributing dividends and retaining equity or as differences in outside options available to equity holders. As shown by Lemma 1 below, in general, the heterogeneity generates a cross-section distribution of firms, in which some of them face no binding financing constraint, others face a single binding financing constraint, and some others face multiple binding financing constraints. In what follows, we index firms by their type θ.

Let $V_{\theta,t}(n_t) \geq 0$ denote the value of a firm of type θ with net worth n_t. The dividend distribution

/ reinvestment problem of firms can be recursively represented as

$$
\begin{aligned}
V_{\theta,t}\left(n_t\right) = & \max_{d_{\theta,t},k_{\theta,t}\geq 0}\{d_{\theta,t} + \frac{1-\theta}{1+r_{t+1}}V_{\theta,t+1}\left(n_{t+1}\right)\} \\
& \text{subject to:} \\
& n_{t+1} = \zeta_{t+1}\left(k_{\theta,t}\right) - \left(1+r_{t+1}\right)k_{\theta,t} + \left(1+r_{t+1}\right)\left(n_t - d_{\theta,t}\right) - \tau \\
& k_{\theta,t} \leq \min\{k_{e,t}\left(n_t - d_{\theta,t}\right), k_{a,t}\left(n_t - d_{\theta,t}\right)\}
\end{aligned}
\tag{19}
$$

where earnings- and asset-based limits on physical capital $k_{e,t}\left(\cdot\right)$ and $k_{a,t}\left(\cdot\right)$ are respectively given by

$$k_{e,t}\left(n\right) = n + \frac{1}{1+r_{t+1}}\lambda_e\zeta_{t+1}\left[k_{e,t}\left(n\right)\right] \tag{20}$$

and

$$k_{a,t}\left(n\right) = \frac{1+r_{t+1}}{1+r_{t+1}-\lambda_a q_{t+1}}n\,. \tag{21}$$

We postulate that for any given level of net worth, if its marginal value at time t equals 1, then its marginal value at time $t+1$ equals 1 as well. Formally,

$$\text{if } V'_{\theta,t}\left(n\right) = 1\text{, then } V'_{\theta,t+1}\left(n\right) = 1\,, \tag{22}$$

where note that marginal values cannot be below 1, since the marginal value of distributing dividends is always 1. Naturally, conjecture (22) holds in steady state, and under the baseline calibration, it also holds for small perturbations around the steady state.

Lemma 1. *Under conjecture (22) the optimal distribution of dividends and reinvestment of physical capital are respectively given by*

$$d_{\theta,t}\left(n\right) = \max\{n - \bar{n}_{\theta,t}, 0\} \tag{23}$$

and

$$k_{\theta,t}\left(n\right) = \min\{k_{e,t}\left(n\right), k_{a,t}\left(n\right), \bar{k}_{\theta,t}\}\,, \tag{24}$$

where targets for net worth $\bar{n}_{\theta,t} \geq 0$ and physical capital $\bar{k}_{\theta,t} \geq 0$ are given by

$$\bar{n}_{\theta,t} = \begin{cases} n_{e,t}\left(\theta\right) & \text{if } \theta \leq \bar{\theta}_{e,t} \\ n_{a,e} & \text{if } \theta \in \left(\bar{\theta}_{e,t}, \bar{\theta}_{a,t}\right) \\ n_{a,t}\left(\theta\right) & \text{if } \theta \geq \bar{\theta}_{a,t} \end{cases} \text{ and } \bar{k}_{\theta,t} = \begin{cases} k_{e,t}\left(\bar{n}_{\theta,t}\right) & \text{if } \theta \leq \bar{\theta}_{e,t} \\ k_{a,e} & \text{if } \theta \in \left(\bar{\theta}_{e,t}, \bar{\theta}_{a,t}\right) \\ k_{a,t}\left(\bar{n}_{\theta,t}\right) & \text{if } \theta \geq \bar{\theta}_{a,t} \end{cases}, \tag{25}$$

with net worth functions $n_{j,t}(\theta) \geq 0$ *for* $j \in \{e, a\}$ *being implicitly characterized by*

$$\theta = \frac{1-\theta}{1+r_{t+1}} \left\{ \alpha_k \left[\left(\frac{\alpha_l}{w_t} \right)^{\alpha_l} p_t A_t \right]^{\frac{1}{1-\alpha_l}} \left[k_{j,t} \left[n_{j,t}(\theta) \right] \right]^{\frac{\alpha_k}{1-\alpha_l}-1} - (r_{t+1}+\delta) \right\} k'_{j,t} \left[n_{j,t}(\theta) \right] , \tag{26}$$

thresholds $\bar{\theta}_{j,t} \geq 0$ *being such that*

$$n_{j,t}\left(\bar{\theta}_{j,t}\right) = n_{ae,t} , \tag{27}$$

and $n_{ae,t} \geq 0$ *and* $k_{ae,t} \geq 0$ *being jointly determined by*

$$k_{e,t}(n_{ae,t}) = k_{a,t}(n_{ae,t}) = k_{ae,t} . \tag{28}$$

The lemma is shown in the Appendix.[6] The intuition behind the lemma is as follows.

Firms face a trade-off between distributing dividends and retaining equity to reinvest in physical capital. If they have a net worth below target $\bar{n}_{\theta,t}$, they prefer to distribute no dividends and retain all their equity. Otherwise, they prefer to distribute $n - \bar{n}_{\theta,t}$ and retain only $\bar{n}_{\theta,t}$. Target $\bar{n}_{\theta,t}$ is such that firms are indifferent on the margin between the two alternatives.

Assuming a single financing constraint $j \in \{e, a\}$ is binding, the target is characterized by

$$1 = \frac{1-\theta}{1+r_{t+1}} \left\{ \left\{ \alpha_k \left[\left(\frac{\alpha_l}{w_t} \right)^{\alpha_l} p_t A_t \right]^{\frac{1}{1-\alpha_l}} \left[k_{j,t}(\bar{n}_{\theta,t}) \right]^{\frac{\alpha_k}{1-\alpha_l}-1} - (r_{t+1}+\delta) \right\} k'_{j,t}(\bar{n}_{\theta,t}) + (1+r_{t+1}) \right\} , \tag{29}$$

where the LHS is the marginal value of distributing dividends and the RHS is the marginal value of retaining equity to reinvest. Note that under conjecture (22) $V'_{\theta,t+1}(\bar{n}_{\theta,t}) = 1$ because $V'_{\theta,t}(\bar{n}_{\theta,t}) = 1$.

Expression (29) is indeed the characterization of the target in Lemma 1 for firms with either $\theta \leq \bar{\theta}_{e,t}$ or $\theta \geq \bar{\theta}_{a,t}$. The former firms face a (weakly) binding earnings-based constraint whereas the latter ones face a binding asset-based constraint. The rationale is twofold. First, the former firms are relatively patient and thus prefer to accumulate net worth to operate at a relatively large scale. For instance, firms with $\theta = 0$ operate at financially unconstrained scale $k_{*,t} \geq 0$, with

$$k_{*,t} = \left(\frac{\alpha_k}{r_{t+1}+\delta} \left[\left(\frac{\alpha_l}{w_t} \right)^{\alpha_l} p_t A_t \right]^{\frac{1}{1-\alpha_l}} \right)^{\frac{1-\alpha_l}{1-(\alpha_l+\alpha_k)}} . \tag{30}$$

Second, because of decreasing returns to scale in production, the earnings-based constraint is tighter for relatively large levels of net worth, and softer for relatively small levels. In effect, note that $k_{e,t}(n) < k_{a,t}(n)$ for $n > n_{ae,t}$ and $k_{e,t}(n) > k_{a,t}(n)$ for $n < n_{ae,t}$, where $n_{ae,t} > 0$ is such that the two constraints intersect.

The characterization of the target is a bit different for the remnant firms with $\theta \in \left(\bar{\theta}_{e,t}, \bar{\theta}_{a,t}\right)$ because for such firms both constraints are binding. Two binding financing constraints generates a

[6] The lemma assumes $k_{ae,t} < k_{*,t}$ where $k_{*,t} \geq 0$ is defined by (30).

discontinuity in the marginal return from retaining equity to reinvest at threshold $n = n_{ae,t}$ since $k'_{e,t}(n_{ae,t}) < k'_{a,t}(n_{ae,t})$. This discontinuity implies that all those firms prefer to accumulate net worth up to the threshold at which the two constraints intersect. Note that they would rather prefer to accumulate less net worth, were they only subject to the earnings-based constraint, and more were they only subject to the asset-based constraint, as shown by Figure 8.

All in all, the investment block features a natural tendency to cluster firms at the net worth level at which the two constraints are binding. Put differently, in general, an endogenous population share of firms of positive mass prefer to target the scale at which the two constraints intersect.

6.2 New Keynesian Block

The New Keynesian block closely follows Ottonello and Winberry (2020). There is a continuum of retailers in the unit interval, indexed by $i \in [0,1]$, each of which produces a differentiated variety $\tilde{y}_{i,t} = y_{i,t}$ according to a one-to-one technology using the intermediate good, where $y_{i,t} \geq 0$ is the quantity demanded by retailers of type i of the good. Retailers can set the real price for their variety $\tilde{p}_{i,t} \geq 0$, but to adjust their price, they must pay a quadratic cost $\frac{\varphi}{2}\left(\frac{\tilde{p}_{i,t}}{\tilde{p}_{i,t-1}} - 1\right)^2 Y_t$, where $\varphi \geq 0$ is a parameter and $Y_t \geq 0$ is the aggregate quantity of the final good. This adjustment cost is the source of nominal rigidities. Retailers face a downward-sloping demand curve, which results from a representative final good producer, who uses the varieties to produce the final good according to

$$Y_t = \left(\int_0^1 \tilde{y}_{i,t}^{\frac{\gamma-1}{\gamma}}\, di\right)^{\frac{\gamma}{\gamma-1}}, \tag{31}$$

where $\gamma > 0$ is the elasticity of substitution across the varieties.

Both retailers and the final good producer maximize the present discounted value of profits. Their optimality conditions combined yield a standard Phillips curve,

$$\ln(1+\pi_t) = \frac{\gamma-1}{\varphi} \ln \frac{p_t}{p_{ss}} + \beta \ln(1+\pi_{t+1}) \,, \tag{32}$$

where $\pi_t \equiv P_t/P_{t-1} - 1$ is the rate of inflation in the price of the final good, $P_t > 0$, and $p_{ss} \equiv \frac{\gamma-1}{\gamma} > 0$ is the price of the intermediate good in steady state. Relative to steady state, an increase in reinvestment boosts demand for the final good and consequently it also boosts demand for varieties and for the intermediate good. Because of the costs to adjust prices, the increases in demand exert upward pressure on the price of the intermediate good, which generates inflation in the price of the final good according to the Phillips curve.

A monetary authority can set the nominal interest rate $i_t \geq 0$. The Fisher equation relates the nominal and the real interest rates as follows $1 + r_{t+1} = (1+i_t)/(1+\pi_{t+1})$. We assume the monetary authority sets the nominal interest rate according to

$$\ln(1+i_t) = \ln(1+r_{ss}) + \varphi_\pi \ln(1+\pi_t) + \varepsilon_t \,, \tag{33}$$

where $r_{ss} \in \mathbb{R}$ is the real interest rate in steady state, $\varphi_\pi > 0$ is the weight of inflation in the response of the Taylor rule, and $\varepsilon_t \in \mathbb{R}$ is an unanticipated disturbance to the rule.

6.3 Household Block

Lastly, the household block includes only a representative household, who consumes the final good and supply labor hours, and whose preferences over consumption $C_t \geq 0$ and labor supply $L_t \geq 0$ are given by

$$\sum_{t=0}^{+\infty} \beta^t \left(\ln C_t - \chi L_t\right) , \tag{34}$$

where $\beta \in (0,1)$ is the time discount factor and $\chi > 0$ is the disutility weight from labor supply. The households faces a sequence of budget constraints,

$$C_t - B_t = w_t L_t + \Gamma_t - \left(1 + r_t\right) B_{t-1} , \tag{35}$$

where $-B_t \in \mathbb{R}$ are holdings of firm debt and $\Gamma_t \in \mathbb{R}$ are net transfers received from firms and retailers. We assume the household is the residual claimants of the dividends distributed by firms and of the profits made by retailers.

The household maximizes utility (34) subject to budget constraints (35). The optimality conditions of the problem are

$$w_t = \chi C_t \tag{36}$$

and

$$1 = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-1} \left(1 + r_{t+1}\right) . \tag{37}$$

6.4 Equilibrium

Let $n_{\theta,t} \geq 0$ denote the net worth of firms of type θ after production takes place. The distribution of firm net worth at initial period $t = 0$ is exogenous.

An equilibrium is a set of decision rules $\{d_{\theta,t}(n), k_{\theta,t}(n)\}$, distribution of firm net worth $\{n_{\theta,t+1}\}$, quantities $\{l_{\theta,t}, L_t, K_t, Y_t, C_t\}$, and prices $\{p_t, \pi_t, i_t, w_t\}$ such that:

i. $\{d_{\theta,t}(n), k_{\theta,t}(n)\}$ are consistent with Lemma 1;

ii. $n_{\theta,t+1}$ evolves according to

$$n_{\theta,t+1} = \zeta_{t+1}\left[k_{\theta,t}\left(n_{\theta,t}\right)\right] - \left(1 + r_{t+1}\right) k_{\theta,t}\left(n_{\theta,t}\right) + \left(1 + r_{t+1}\right)\left[n_{\theta,t} - d_{\theta,t}\left(n_{\theta,t}\right)\right] - \tau \,;$$

iii. $l_{\theta,t+1}$ is given by (12), with $k_t = k_{\theta,t}(n_{\theta,t})$; $L_{t+1} = \int l_{\theta,t+1} dF(\theta)$; $K_t = \int k_{\theta,t}(n_{\theta,t})\, dF(\theta)$; $Y_{t+1} = A_{t+1} \int [l_{\theta,t+1}]^{\alpha_l} [k_{\theta,t}(n_{\theta,t})]^{\alpha_k} dF(\theta)$; and market clearing $C_{t+1} + K_{t+1} - (1 - \delta) K_t = Y_{t+1}$;

iv. $\{p_t, \pi_t, i_t\}$ satisfy $\{(32), (33), (37)\}$, with $1+r_{t+1} = (1+i_t)/(1+\pi_{t+1})$; and w_t satisfies (36).

A steady state is an equilibrium in which all variables are constant over time. We restrict attention to steady state and to small perturbations around steady state. The perturbations are triggered by temporary monetary disturbances $\varepsilon_t \neq 0$ and consequently feature non-stationary dynamics that eventually revert back to steady state. We solve non-stationary dynamics numerically assuming perfect foresight. The next subsection details the parametrization of liquidation price q_t and cumulative distribution function $F(\theta)$ and the values of the parameters in the baseline calibration.

6.5 Parametrization and Parameter Values

We take the values for the parameters from other studies or set them to match key variables in steady state to data. The time frequency is quarterly.

Productivity $A_t = 1$ is kept constant over time and is normalized to 1. The share of output of labor in the production of the intermediate good is set equal to $\alpha_l = 0.64$ and the corresponding share of physical capital is set equal to $\alpha_k = 0.21$. This implies returns of scale of $\alpha_l + \alpha_k = 0.85$. These values are consistent with Ottonello and Winberry (2020). Physical capital depreciates at a rate of $\delta = 0.035$ which is consistent with Khan and Thomas (2008). The elasticity of substitution in the production of the final good is set equal to $\gamma = 10$ to generate a markdown in the price of the intermediate good in steady state of 10%. Note that as in Ottonello and Winberry (2020), $\gamma = 10$ and $\alpha_l = 0.64$ combined imply a share of output of labor in the production process of the final good of $\frac{\gamma-1}{\gamma}\alpha_l \simeq 0.58$, which is also consistent with Karabarbounis and Neiman (2014). The parameter in the adjustment cost of the prices for varieties is $\varphi = 90$ to generate a slope in the Phillips curve of 0.1. This value is consistent with Kaplan et al. (2018). The coefficient on inflation in the Taylor rule is set equal to $\varphi_\pi = 1.5$ which is a common value in the literature.

The discount factor of the household is $\beta = 0.99$. This value implies an annualized real interest rate in steady state of 2%. The disutility weight from supplying labor hours is set equal to $\chi = 3$ to match an aggregate quantity of labor in steady state of 1/3 per unit of time.

The cumulative distribution function of subjective time discount rates across firms is parametrized as follows:

$$F(\theta) = \begin{cases} \mu_0 & \text{if } \theta = 0 \\ \mu_0 + \frac{\theta}{\bar{\theta}_e}\mu_1 & \text{if } \theta \in \left(0, \bar{\theta}_e\right) \\ 1 & \text{if } \theta \geq \bar{\theta}_e \end{cases}, \tag{38}$$

where $\mu_0 \in (0,1)$ is the population share of firms facing no binding financing constraint, $\mu_1 \in (0,1)$ is the corresponding share of firms facing a single binding financing constraint, and $1-(\mu_0+\mu_1)$ is the population of firms facing multiple binding financing constraints. This parametrization is well-defined since threshold $\bar{\theta}_e$ is independent of function $F(\theta)$. In steady state, firms with $\theta = 0$

are both able and willing to operate at financially unconstrained scale, $k_0 = k_*$. Moreover, since they earn a positive return on equity in the baseline calibration (as shown below), those firms are also able and willing to operate at the financially unconstrained scale even for small perturbations around steady state. In our impulse-response analysis, therefore, we refer to them as firms facing no binding financing constraint. Firms with $\theta \in \left(0, \bar{\theta}_e\right)$ face in steady state a binding earnings-based constraint but a slack asset-based constraint. For sufficiently small perturbations around steady state, therefore, the binding status of their financing constraints does not change. In our impulse-response analysis, we then refer to them as firms facing a single binding financing constraint. Lastly, firms with $\theta = \bar{\theta}_e$ face in steady state both a binding earnings-based constraint and a binding asset-based constraint. Thus, even for small perturbations around steady state, the binding status of their financing constraints can depend on the sign of the monetary disturbance or on the sensitivity of the financing constraints to interest rates. We then refer to them as firms facing multiple (occasionally) binding financing constraints in the impulse response.[7]

The population share of firms facing no binding financing constraint is set equal to $\mu_0 = 10\%$ and the corresponding share of firms facing a single binding financing constraint is set equal to $\mu_1 = 26\%$. These values match estimates of the shares in our database. They imply a population share of firms facing multiple binding financing constraints of 64%.

The liquidation price of physical capital is parametrized by

$$q_t = \left(\frac{r_{ss}}{r_t}\right)^{\epsilon}, \tag{39}$$

where $\epsilon \geq 0$ is the elasticity of the price to the real interest rate and $r_{ss} = 1/\beta - 1$ in steady state. The elasticity is set equal to $\epsilon = 2$ which is line with the response of the distance-to-default constraint in our database. In sensitivity analysis, we consider different values for the elasticity and for the population shares of firms.

Parameter $\lambda_e = 0.20$ in earnings-based constraint and parameter $\lambda_a = \frac{1}{\beta}0.34$ in asset-based constraint are respectively set to match the average leverage ratios of firms facing a single binding and multiple binding financing constraints. The empirical estimates of the leverage ratios (defined as debt over assets) in our database respectively are 0.28 and 0.34. The implied leverage ratio in the calibration for firms facing no binding financing constraint is 0.21. This value is line with our empirical estimate of 0.24.

[7] Note that the equilibrium outcome would be the same were population share $1 - (\mu_0 + \mu_1)$ in parametrization (38) continuously distributed over subjective time discount rates $\theta \in \left[\bar{\theta}_e, \bar{\theta}_a\right]$. We do not consider distribution functions $F(\theta)$ with positive mass over discount rates $\theta > \bar{\theta}_a$ to thus be able to interpret firms subject to multiple financing constraints as the most financially constrained—as measured by the distance of operating scale $k_\theta \leq k_*$ to financially unconstrained scale k_*. In our numerical solution method, we discretize the range for the subjective time discount rate and set an evenly spaced grid for values $\theta \in \left(0, \bar{\theta}_e\right)$.

Lastly, the fixed, operating cost of firms is set according to

$$\tau = \zeta_{ss}\left(k_{a,e}\right) - \left(1 + r_{ss}\right) k_{a,e} + r_{ss} n_{a,e} = 0.035 > 0\,, \tag{40}$$

to obtain $n_{+1}\left(n_{a,e}\right) = n_{a,e}$, where $n_{+1}\left(\cdot\right)$ is the net worth of firms at the next period after production takes place. This value ensures that the net worth of firms with $\theta = \bar{\theta}_a$ remains around $n = n_{a,e}$ in the impulse response. Note that firms with $\theta > \bar{\theta}_a$ earn a positive return on equity in steady state because of decreasing returns to scale. We assume cost τ is ultimately a transfer to the household and thus its set value does not affect the steady state except for the distribution of dividends.

6.6 Impulse Responses to Monetary Disturbances

Figure 9 shows the impulse responses of firm investment to a positive and a negative monetary disturbance of equal size. The size is set to $|\varepsilon_0| = 0.25\%$. The positive disturbance is interpreted as an unanticipated tightening in monetary policy relative to steady state while the negative disturbance is interpreted as an unanticipated monetary easing.

A monetary disturbance in general has a positive effect on the real interest rate. This is because its direct effect on the nominal interest rate outweighs its negative effect on the inflation rate. The positive effect on the real rate negatively impacts firm investment through two channels. First, it increases the user cost of physical capital and thus reduces the willingness to reinvest even for firms subject to no binding financing constraint. This force materializes as downward pressure over financially unconstrained scale $k_{*,t} \leq k_{*,ss}$. Second, it increases the costs of servicing debt and consequently triggers a tightening of financing constraints. This force reduces the ability to reinvest of firms subject to binding financing constraints regardless of the number of those constraints.

The sign of the disturbance in general does not significantly influence the willingness to reinvest. As a consequence the aggregate investment response across firms facing no binding financing constraint tends to be roughly symmetric to a monetary tightening and a monetary easing of similar size. The sign of the disturbance does not significantly influence individual financing constraints either. Therefore, the aggregate investment response across facing a single binding financing constraint (i.e., the earnings-based constraint, in our simulations) tends to be roughly symmetric as well.[8] By contrast, the aggregate investment response across firms facing multiple binding financing constraint tends to be larger in absolute terms for the monetary tightening than for the monetary easing. This is because in our baseline calibration the asset-based constraint is more sensitive to the real interest rate than what the earnings-based constraint is. In effect, for the monetary tightening, the asset-based constraint is the single binding constraint over the impulse response for the firms subject to multiple binding constraints in steady state, whereas for the easing the earnings-based constraint is the single binding constraint. The stronger response for the tightening is long-lasting,

[8] In our numerical simulations, fluctuations in threshold $\bar{\theta}_{e,t}$ have only negligible effects on aggregate investment responses, because of the restriction to small perturbations around steady state.

indeed, because a larger change in external financing exerts further pressure on the return on retaining equity to reinvest and, consequently, it further influences the pace of accumulation of net worth and of build up of physical capital.[9]

The asymmetry in the aggregate investment response across firms subject to multiple occasionally financing constraints together with the symmetry in the other investment responses naturally generates asymmetry in the response of aggregate investment. In our baseline calibration, we obtain that aggregate investment responds on average 0.06 percentage points more aggressively to the tightening than to the easing over the first ten quarters after the disturbance. These estimates critically depend on the difference in the sensitivity to the real interest rate between the two constraint and on the population share of firms subject to multiple binding financing constraints. Specifically, departing from the baseline calibration, an increase in the difference between the elasticities by 1 point increases the asymmetry in the response of aggregate investment by 0.07 percentage points. An increase in the population share of firms facing multiple binding financing constraints by 1 percentage point increases the asymmetry by 0.02 percentage points.

7 Conclusion

In this paper, we revisit the credit channel of monetary policy by examining the implications of the presence of multiple financial constraints on firm borrowing. Our research addresses a critical gap in the literature, moving beyond the standard theoretical frameworks that typically impose only one constraint on firms' access to external finance.

Our simple theoretical model predicts that following a contractionary policy action, the most interest-rate sensitive constraint becomes binding, leading to significant reductions in borrowing and investment. Conversely, during policy easings, the least sensitive constraint remains binding, resulting in a muted response. By leveraging debt covenant data and distance-to-default measures, we construct a novel measure of the number of tight constraints faced by firms, and find strong support for the predictions of our theoretical model. Quantitatively, with a realistic share of firms facing financial constraints, our proposed credit channel leads to strong economy-wide asymmetric effects of monetary policy.

Our results carry an important policy implication, which is that the effectiveness of monetary policy depends on the aggregate distribution of financial conditions in nonfinancial firms. In particular, the effects of monetary policy easings are dampened in the presence of a large share of firms with multiple financing constraints, while the effects of monetary contractions are exacerbated.

[9]Our model also features second-round effects that operate through real wage w_t. Specifically, to fix ideas, a reduction in aggregate investment depresses the aggregate demand of labor, which exerts down pressure on the real wage, boosting the profitability of firms and thus encouraging reinvestment as well as relaxing the earnings-based constraint. These effects influence relatively more the investment responses that are relatively less sensitive to the real interest rate.

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Appendix

The proof of Lemma 1 is as follows:

The problem of firms is

$$
\begin{aligned}
V_{\theta,t}\left(n_t\right) = \max_{d_{\theta,t},k_{\theta,t}\geq 0} & \{d_{\theta,t} + \frac{1-\theta}{1+r_{t+1}} V_{\theta,t+1}\left(n_{t+1}\right)\} \\
& \text{subject to:} \\
& n_{t+1} = \zeta_{t+1}\left(k_{\theta,t}\right) - \left(1+r_{t+1}\right) k_{\theta,t} + \left(1+r_{t+1}\right)\left(n_t - d_{\theta,t}\right) - \tau \\
& k_{\theta,t} \leq \min\{k_{e,t}\left(n_t - d_{\theta,t}\right), k_{a,t}\left(n_t - d_{\theta,t}\right)\}
\end{aligned}
\tag{41}
$$

Define net worth functions $n_{j,t}\left(\theta\right) \geq 0$ for $j \in \{e, a\}$ as

$$
\theta = \frac{1-\theta}{1+r_{t+1}} \left\{ \alpha_k \left[\left(\frac{\alpha_l}{w_t}\right)^{\alpha_l} p_t A_t \right]^{\frac{1}{1-\alpha_l}} \left[k_{j,t}\left[n_{j,t}\left(\theta\right)\right]\right]^{\frac{\alpha_k}{1-\alpha_l}-1} - \left(r_{t+1}+\delta\right) \right\} k'_{j,t}\left[n_{j,t}\left(\theta\right)\right] \,, \tag{42}
$$

and net worth threshold $n_{a,e} \geq 0$ as

$$
k_{e,t}\left(n_{a,e}\right) = k_{a,t}\left(n_{a,e}\right) = k_{a,e} \,. \tag{43}
$$

Consider first $n > n_{a,e}$. This implies that the asset-based constraint cannot be binding. Assume corner solution for $k_{\theta,t}$ and interior solution for $d_{\theta,t}$. Then, the first-order condition with respect to $d_{\theta,t}$ is

$$
\begin{aligned}
1 = & \frac{1-\theta}{1+r_{t+1}} V'_{\theta,t+1}\left(n_t - d_{\theta,t}\right) \times \\
& \times \left\{ \left\{ \alpha_k \left[\left(\frac{\alpha_l}{w_t}\right)^{\alpha_l} p_t A_t \right]^{\frac{1}{1-\alpha_l}} \left[k_{j,t}\left(n_t - d_{\theta,t}\right)\right]^{\frac{\alpha_k}{1-\alpha_l}-1} - \left(r_{t+1}+\delta\right) \right\} k'_{j,t}\left(n_t - d_{\theta,t}\right) + \left(1+r_{t+1}\right) \right\} \,,
\end{aligned}
\tag{44}
$$

The first-order condition holds only if $d_{\theta,t} = n_t - n_{e,t}\left(\theta\right)$. Note that substituting $d_{\theta,t} = n_t - n_{e,t}\left(\theta\right)$ into (41) implies $V'_{\theta,t}\left(n_t\right)$ for all $n_t \geq n_{e,t}\left(\theta\right)$ and hence $V'_{\theta,t+1}\left(n_{e,t}\left(\theta\right)\right)$. Note also that $k_{e,t}\left(n_{e,t}\left(\theta\right)\right)$ which ensures (weakly) corner solution for $k_{\theta,t}$.

Consider now $n < n_{a,e}$. This implies that the asset-based constraint must be binding. Recall that the lemma assumes $k_{a,e} < k_{*,t}$. Assume as before corner solution for $k_{\theta,t}$ and interior solution for $d_{\theta,t}$. Then, the resulting first-order condition with respect to $d_{\theta,t}$ holds only if $d_{\theta,t} = n_t - n_{a,t}\left(\theta\right)$.

Finally consider $n = n_{a,e}$. The asset-based constraint must be binding. Note that the dividend distribution is corner for $\theta \leq \bar{\theta}_{a,t}$ and interior for $\theta > \bar{\theta}_{a,t}$ given in the latter case by $d_{\theta,t} = n_t - n_{a,t}\left(\theta\right)$.

This shows the lemma.

Table 1: **Summary Statistics**

	Multiple Constraints		Single Constraint		No Constraint	
	(1)	(2)	(3)	(4)	(5)	(6)
	mean	sd	mean	sd	mean	sd
Size	6.762	1.489	7.372	1.598	7.883	1.547
Leverage	0.338	0.184	0.276	0.176	0.240	0.157
Sales Volatility	0.272	0.232	0.214	0.207	0.172	0.171
Cash/Assets	0.074	0.098	0.101	0.123	0.115	0.124
Tangibility	0.310	0.245	0.299	0.238	0.293	0.241
Observations	81030		33271		13621	

This table presents the summary statistics for firm characteristics across three groups based on their constraint status: Multiple Constraints, Single Constraint, and No Constraint. The variables include Size (log of total assets), Leverage (ratio of total debt to total assets), Sales Volatility (standard deviation of sales growth over the past three years), Cash (ratio of cash holdings to total assets), and Tangibility (ratio of tangible assets to total assets). Means and standard deviations (sd) are reported for each variable. The sample comprises 81,030 observations for firms with Multiple Constraints, 33,271 observations for firms with a Single Constraint, and 13,621 observations for firms with No Constraints.

Table 2: Response of External Financing Flows to Tightening and Easing Shocks by Number of Constraints

	$\Delta_8 ExFin_{i,t+7}$			
	(1)	(2)	(3)	(4)
Contr. Shock × Single Constraint	-1.521	-0.697	-0.170	-0.293
	(1.203)	(1.152)	(0.676)	(0.738)
Contr. Shock × Mult. Constraint	-3.361***	-2.640**	-2.044***	-1.748***
	(1.196)	(1.141)	(0.751)	(0.654)
Acc. Shock × Single Constraint	0.709	-0.054	0.962***	1.131***
	(1.282)	(1.037)	(0.323)	(0.374)
Acc. Shock × Mult. Constraint	2.963***	2.144***	2.053***	2.339***
	(1.073)	(0.773)	(0.504)	(0.491)
R-squared	0.030	0.030	0.338	0.041
N	106,881	106,881	106,707	100,060
Time FE	✓	✓	✓	✓
Firm FE			✓	
Firm Controls				✓
Macro Controls		✓	✓	✓

This table displays the coefficients from the following estimated equation:

$$\Delta_8\text{ExFin}_{i,t+7} = \beta_1 \textit{Contr. Shock}_t \times \textit{Single Constraint}_{i,t} + \beta_2 \textit{Contr. Shock}_t \times \textit{Mult. Constraints}_{i,t} + \beta_4 \textit{Acc. Shock}_t \times \textit{Single Constraint}_{i,t} + \beta_6 \textit{Acc. Shock}_t \times \textit{Mult. Constraints}_{i,t} + \mathbf{X}'\gamma + \epsilon_{i,t}$$

where $\Delta_8\text{ExFin}_{i,t+7}$ is the cumulative debt and equity financing flows over seven quarters (2 years) following the shock. *Contr. Shock$_t$* is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is positive, and *Acc. Shock$_t$* is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is negative. *Contr. Shock × Single Constraint* refers to the differential effect of a contractionary shock for firms with one constraint relative to unconstrained firms, while *Contr. Shock × Multiple Constraints* captures the differential effect for firms with multiple constraints relative to unconstrained firms. Similarly, *Acc. Shock × Single Constraint* represents the differential effect of an accommodative shock for firms with one constraint relative to unconstrained firms, and *Acc. Shock × Multiple Constraints* shows the differential effect for firms with multiple constraints relative to unconstrained firms. The controls ($\mathbf{X}$) and fixed effects vary by column specification. Columns (1)-(4) progressively include Time Fixed Effects, Firm Fixed Effects, Firm Controls, and Macro Controls. Standard errors are double clustered at the firm level and reported in parentheses. Statistical significance is denoted as follows: * for 10%, ** for 5%, and *** for 1%.

Table 3: Response of the Cumulative Change in Capital to Tightening and Easing Shocks by Number of Constraints

	$\Delta_8 Capital_{i,t+7}$			
	(1)	(2)	(3)	(4)
Contr. Shock × Single Constraint	-1.762**	-0.764	-0.364	-0.642+
	(0.726)	(0.558)	(0.336)	(0.417)
Contr. Shock × Mult. Constraint	-2.227***	-1.353**	-0.873*	-0.966**
	(0.842)	(0.657)	(0.523)	(0.473)
Acc. Shock × Single Constraint	1.520	0.615	0.498	1.252***
	(1.154)	(0.904)	(0.537)	(0.459)
Acc. Shock × Mult. Constraint	2.399**	1.542*	1.141+	1.757***
	(1.136)	(0.866)	(0.689)	(0.516)
R-squared	0.054	0.054	0.358	0.061
N	111,673	111,673	111,523	101,129
Time FE	✓	✓	✓	✓
Firm FE			✓	
Firm Controls				✓
Macro Controls		✓	✓	✓

This table displays the coefficients from the following estimated equation:

$$\Delta_8\text{Capital}_{i,t+7} = \beta_1 \textit{Contr. Shock}_t \times \textit{Single Constraint Constraint}_{i,t} + \beta_2 \textit{Contr. Shock}_t \times \textit{Mult. Constraints}_{i,t} + \beta_4 \textit{Acc. Shock}_t \times \textit{Single Constraint}_{i,t} + \beta_6 \textit{Acc. Shock}_t \times \textit{Mult. Constraints}_{i,t} + \mathbf{X}'\gamma + \epsilon_{i,t}$$

where $\Delta_8\text{Capital}_{i,t+7}$ is the change in firm capital over seven quarters (2 years) following the shock. *Contr. Shock*$_t$ is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is positive, and *Acc. Shock*$_t$ is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is negative. *Contr. Shock × Single Constraint* refers to the differential effect of a contractionary shock for firms with one constraint relative to unconstrained firms, while *Contr. Shock × Multiple Constraints* captures the differential effect for firms with multiple constraints relative to unconstrained firms. Similarly, *Acc. Shock × Single Constraint* represents the differential effect of an accommodative shock for firms with one constraint relative to unconstrained firms, and *Acc. Shock × Multiple Constraints* shows the differential effect for firms with multiple constraints relative to unconstrained firms. The controls ($\mathbf{X}$) and fixed effects vary by column specification. Columns (1)-(4) progressively include Time Fixed Effects, Firm Fixed Effects, Firm Controls, and Macro Controls. Standard errors are double clustered at the firm level and reported in parentheses. Statistical significance is denoted as follows: * for 10%, ** for 5%, and *** for 1%.

Table 4: Summary Statistics— Lease Status

	High Leases		Low Leases	
	(1)	(2)	(3)	(4)
	mean	sd	mean	sd
Size	7.586	1.291	7.957	1.323
Leverage	0.315	0.181	0.313	0.167
Sales Volatility	0.178	0.171	0.226	0.198
Cash/Assets	0.082	0.088	0.084	0.100
Tangibility	0.281	0.215	0.318	0.260
Observations	30881		30840	

This table presents the summary statistics for firm characteristics across two groups based on their lease as a share of assets in 2016, split by the median: High Lease and Low. The variables include Size (log of total assets), Leverage (ratio of total debt to total assets), Sales Volatility (standard deviation of sales growth over the past three years), Cash (ratio of cash holdings to total assets), and Tangibility (ratio of tangible assets to total assets). Means and standard deviations (sd) are reported for each variable. The sample comprises 30,881 observations for firms with High Leases, 30,840 observations for firms with a Low Leases.

Table 5: Response of External Financing Flows to Tightening and Easing Shocks by Lease Status

	Pre-Shock			Post-Shock		
	(1)	(2)	(3)	(4)	(5)	(6)
Contr. Shock × High Lease	0.059	0.000	-0.082	-5.603**	-4.233*	-8.562***
	(0.638)	(0.000)	(0.705)	(2.181)	(2.246)	(2.942)
Acc. Shock × High Lease	-0.091	0.000	0.452	5.560**	4.277*	7.543**
	(0.165)	(0.000)	(0.513)	(2.483)	(2.429)	(2.719)
R-squared	0.028	0.236	0.044	0.012	0.434	0.029
N	34,491	34,461	32,811	10,467	10,438	10,402
Time FE	✓	✓	✓	✓	✓	✓
Firm FE		✓			✓	
Firm Controls			✓			✓
Macro Controls	✓	✓	✓	✓	✓	✓

This table displays the coefficients from the following estimated equation:

$$\Delta_8 \text{ExFin}_{i,t+7} = \beta_1 \textit{Contr. Shock}_t \times \textit{High Lease}_i + \beta_2 \textit{Acc. Shock}_t \times \textit{High Lease}_i + \mathbf{X}'\gamma + \epsilon_{i,t}$$

where $\Delta_8 \text{ExFin}_{i,t+7}$ is the cumulative debt and equity financing flows over seven quarters (2 years) following the shock. *Contr. Shock*$_t$ is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is positive, and *Acc. Shock*$_t$ is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is negative. *Contr. Shock × High Lease* refers to the differential effect of a contractionary shock for firms with high share of leases in 2016 relative to those with a low share of leases. *Acc. Shock × High Leases* represents the differential effect of an accommodative shock for firms with a high share of leases in 2016 relative to those with a low share of leases. The controls ($\mathbf{X}$) and fixed effects vary by column specification. Pre-Shock is the sample before 2018. Post-Shock is the sample after 2018. Standard errors are double clustered at the firm level and reported in parentheses. Statistical significance is denoted as follows: * for 10%, ** for 5%, and *** for 1%.

Table 6: Response of Cumulative Change in Capital to Tightening and Easing Shocks by Lease Status

	Pre-Shock			Post-Shock		
	(1)	(2)	(3)	(4)	(5)	(6)
Contr. Shock × High Lease	-0.075	0.000	-0.004	-8.586	-8.311	-10.351
	(0.304)	(0.000)	(0.384)	(8.221)	(8.070)	(8.210)
Acc. Shock × High Lease	0.143	0.000	0.239	16.318**	15.987**	17.360**
	(0.469)	(0.000)	(0.555)	(6.320)	(6.214)	(6.247)
R-squared	0.028	0.264	0.039	0.198	0.553	0.212
N	41,308	41,288	38,072	13,361	13,341	12,865
Time FE	✓	✓	✓	✓	✓	✓
Firm FE		✓			✓	
Firm Controls			✓			✓
Macro Controls	✓	✓	✓	✓	✓	✓

This table displays the coefficients from the following estimated equation:

$$\Delta_8\text{Capital}_{i,t+7} = \beta_1 \textit{Contr. Shock}_t \times \textit{High Lease}_i + \beta_2 \textit{Acc. Shock}_t \times \textit{High Lease}_i + \mathbf{X}'\gamma + \epsilon_{i,t}$$

where $\Delta_8\text{Capital}_{i,t+7}$ is the change in capital over seven quarters (2 years) following the shock. *Contr. Shock*$_t$ is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is positive, and *Acc. Shock*$_t$ is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is negative. *Contr. Shock × High Lease* refers to the differential effect of a contractionary shock for firms with high share of leases in 2016 relative to those with a low share of leases. *Acc. Shock × High Leases* represents the differential effect of an accommodative shock for firms with a high share of leases in 2016 relative to those with a low share of leases. The controls ($\mathbf{X}$) and fixed effects vary by column specification. Pre-Shock is the sample before 2018. Post-Shock is the sample after 2018. Standard errors are double clustered at the firm level and reported in parentheses. Statistical significance is denoted as follows: * for 10%, ** for 5%, and *** for 1%.

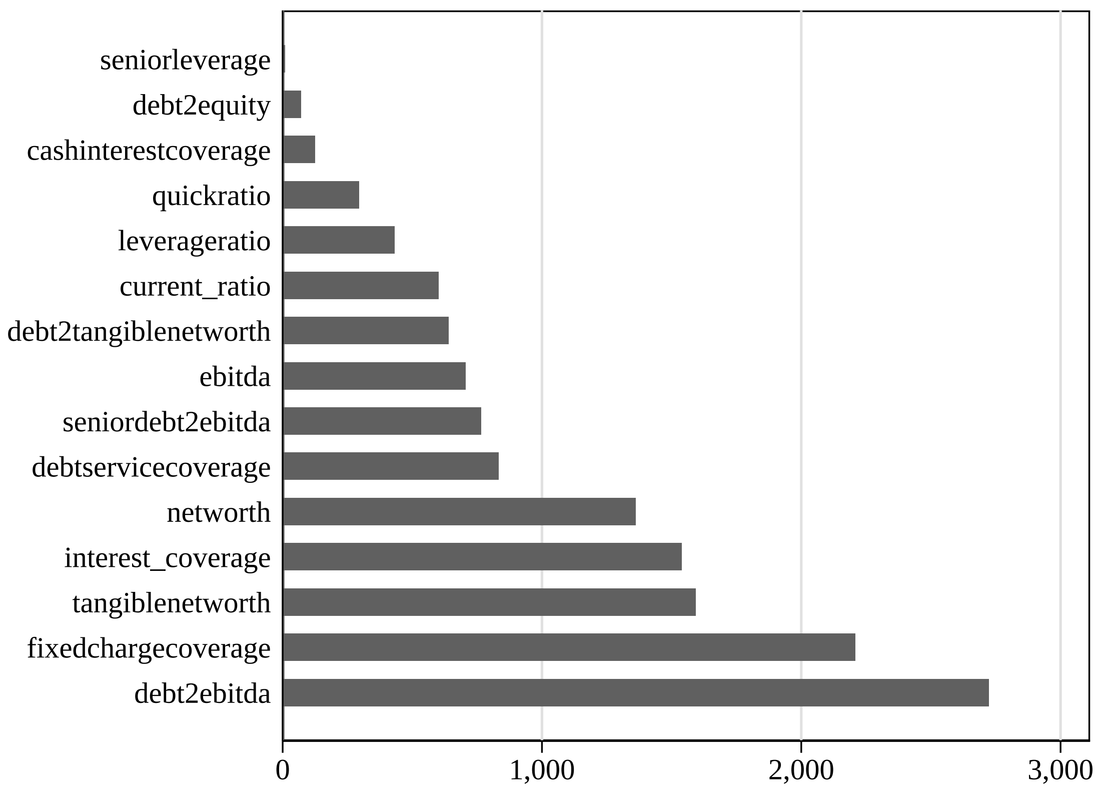

Figure 1: Types and Prevalence of Financial Covenants.

Notes: This chart displays the frequency of various tight financial covenants per firm-quarter observation from 1990 to 2020. A tight covenant is defined as being within two standard deviations of the binding limit. Data is sourced from the Compustat and Dealscan database and is based on a sample of publicly traded US firms.

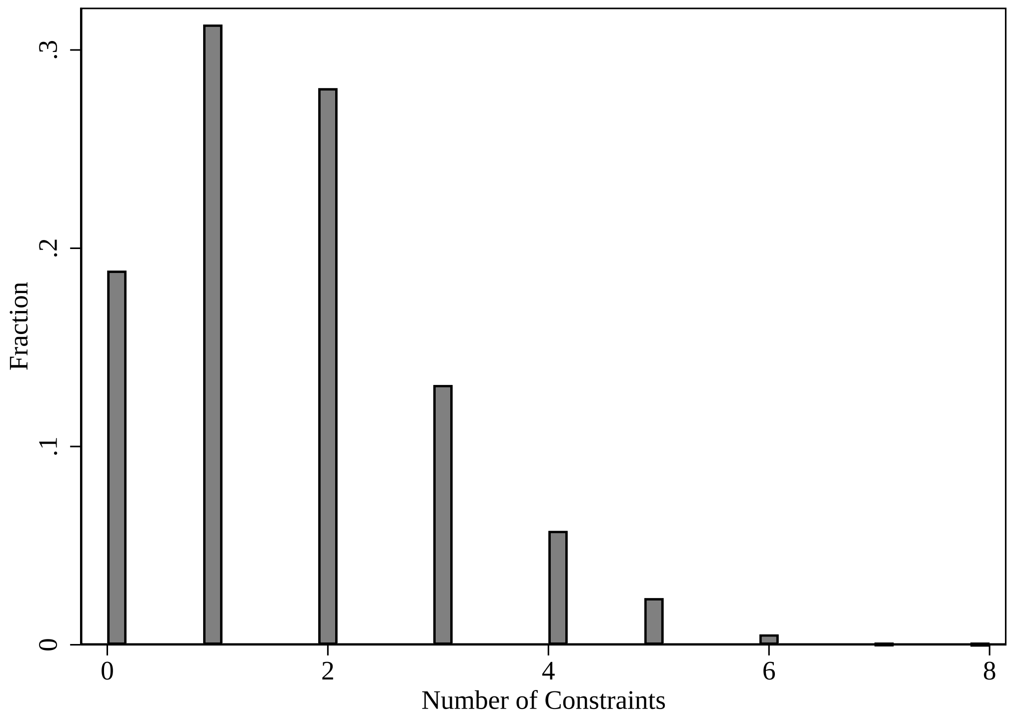

Figure 2: Distribution of the Number of Tight Financial Constraints.

Notes: This chart displays the fractions of firms with a given number of tight financial covenants per firm-quarter observation from 1990 to 2020. A tight covenant is defined as being within two standard deviations of the binding limit. Data is sourced from the Compustat and Dealscan database and is based on a sample of publicly traded US firms.

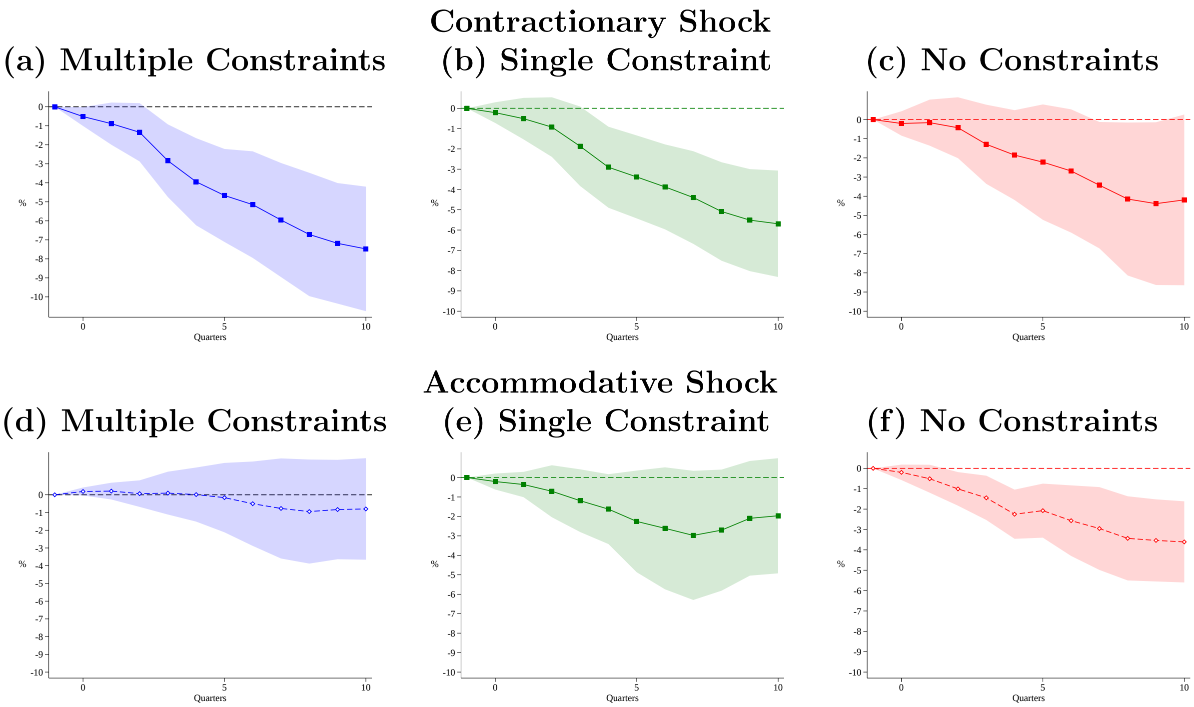

Figure 3: Local Projections: Effect of Tightening and Easing Shocks on External Financing by Constraint Status.

Notes: This figure displays the coefficient estimates from the following specification:

$$\begin{aligned}\Delta_h ExFin_{i,t+h} =& \beta^h_{c,m}(\text{Contr. MP Shock}_t * \text{Mul. Constraint}_{i,t}) + \beta^h_{a,m}(\text{Acc MP Shock}_t * \text{Mul. Constraint}_{i,t})\\ & \beta^h_{c,s}(\text{Contr. MP Shock}_t * \text{Single Constraint}_{i,t}) + \beta^h_{a,s}(\text{Acc MP Shock}_t * \text{Single Constraint}_{i,t})\\ & \beta^h_{c,u}(\text{Contr. MP Shock}_t * \text{Unconstrained}_{i,t}) + \beta^h_{a,u}(\text{Acc MP Shock}_t * \text{Unconstrained}_{i,t})\\ & + \mathbf{X}'\gamma + \epsilon_{i,t}\end{aligned}$$

where $\Delta_h ExFin_{i,t+h}$ is the cumulative debt and equity financing flows between the end of quarter $t-1$ and the end of quarter $t+h$ over total assets. *Contr. Shock$_t$* is a contractionary monetary policy shock and *Acc. Shock$_t$* is an accommodative monetary policy shock. The variables $Mul.\ Constraint$, *Single Constraint*, and $Unconstrained$ are dummy variables that take value 1 if the firm in that quarter faces multiple tight financing constraints, only one tight financing constraint, or none, respectively, and they are 0 otherwise. Panels (a)-(c) show the effect of constraints for tightening shocks, while panels (d)-(f) show the effect for easing shocks. The monetary surprise in quarter t is calculated by adding up the monthly monetary policy shocks obtained from Miranda-Agrippino and Ricco (2021). Shaded areas represent the 90% confidence intervals of the estimates.

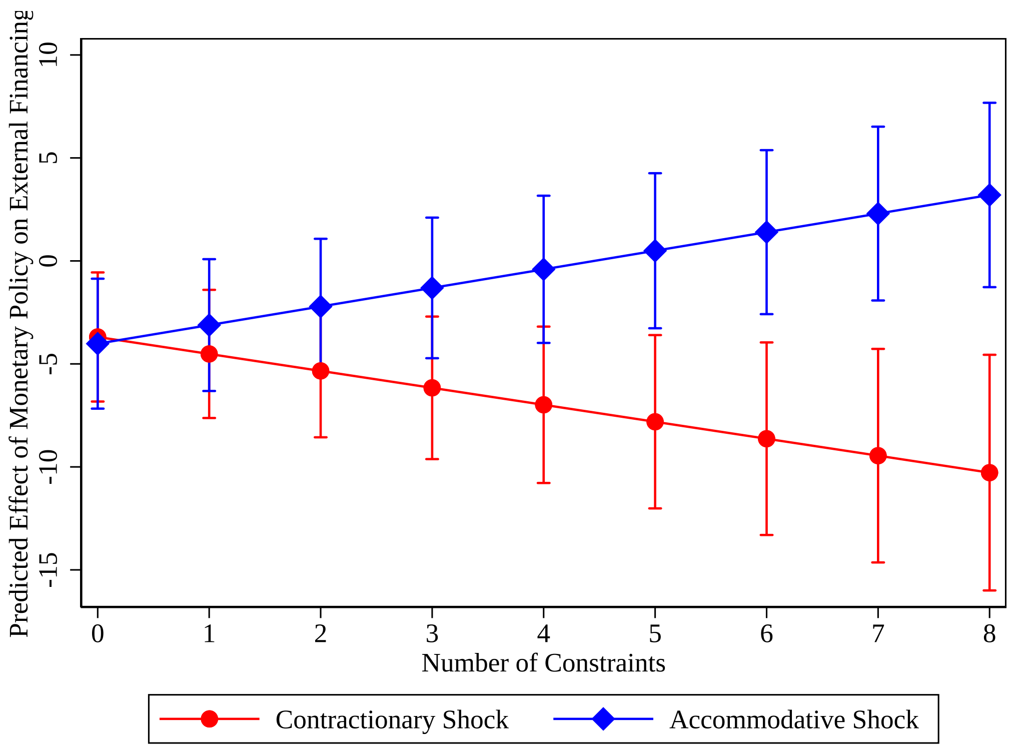

Figure 4: Relationship between Number of Financial Constraints and Responsiveness to Easing and Tightening Shocks.

Notes: This chart plots the marginal effects of a one standard deviation monetary policy shocks on the 2-year response of external financing depending on the number of constraints the firm faces from the following equation:

$$\Delta_8 \text{ExFin}_{i,t+7} = \beta_1 \textit{Contr. Shock}_t \times \textit{Nr. Constraints}_{i,t} + \beta_2 \textit{Acc. Shock}_t \times \textit{Nr. Constraints}_{i,t} \\ + \mathbf{X}'\gamma + \epsilon_{i,t}$$

where $\Delta_8 \text{ExFin}_{i,t+7}$ is the cumulative debt and equity financing flows over seven quarters (2 years) following the shock. *Contr. Shock*$_t$ is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is positive, and *Acc. Shock*$_t$ is defined if the Miranda-Agrippino and Ricco (2021) monetary policy shock is negative.

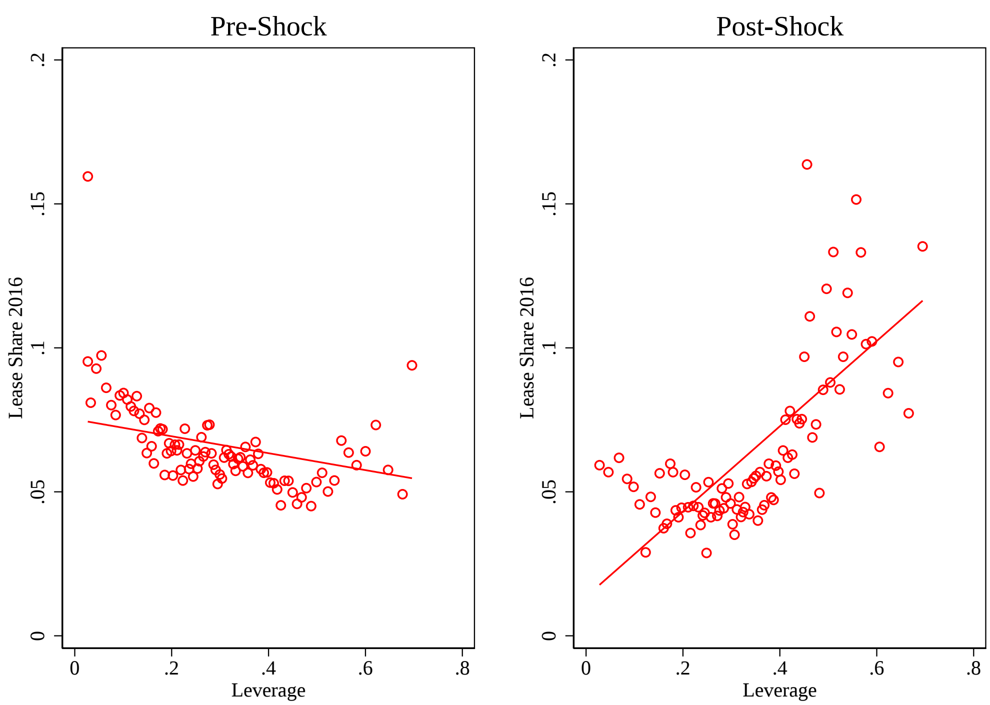

Figure 5: Lease Share and Leverage

Notes: The charts display binscatterplots between the leverage of the firm and their share of leases in 2016. The left panel shows the scatterplot after 2018 and the right scatterplot shows the data before 2018.

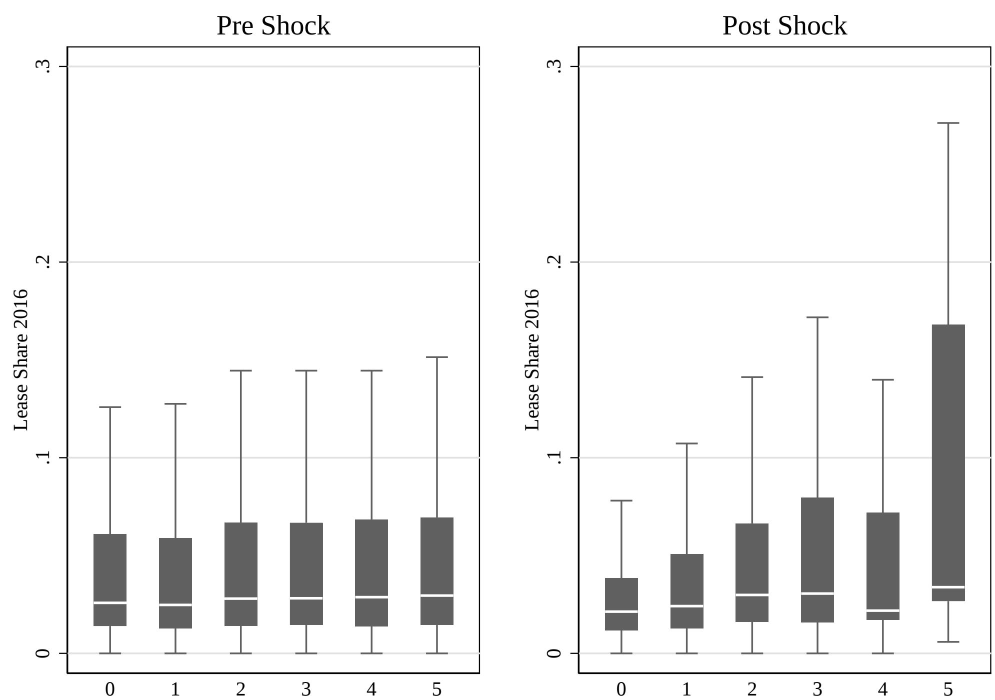

Figure 6: Lease Share and Number of Financial Constraints.

Notes: The charts display boxplots of the lease share for firms in 2016 with different numbers of financial constraints. The box represents the interquartile range (IQR), with the line inside indicating the median. The whiskers extend to 1.5 times the IQR. The left panel shows data from before the accounting change when leases were not part of debt, while the right panel shows data from after the accounting change.

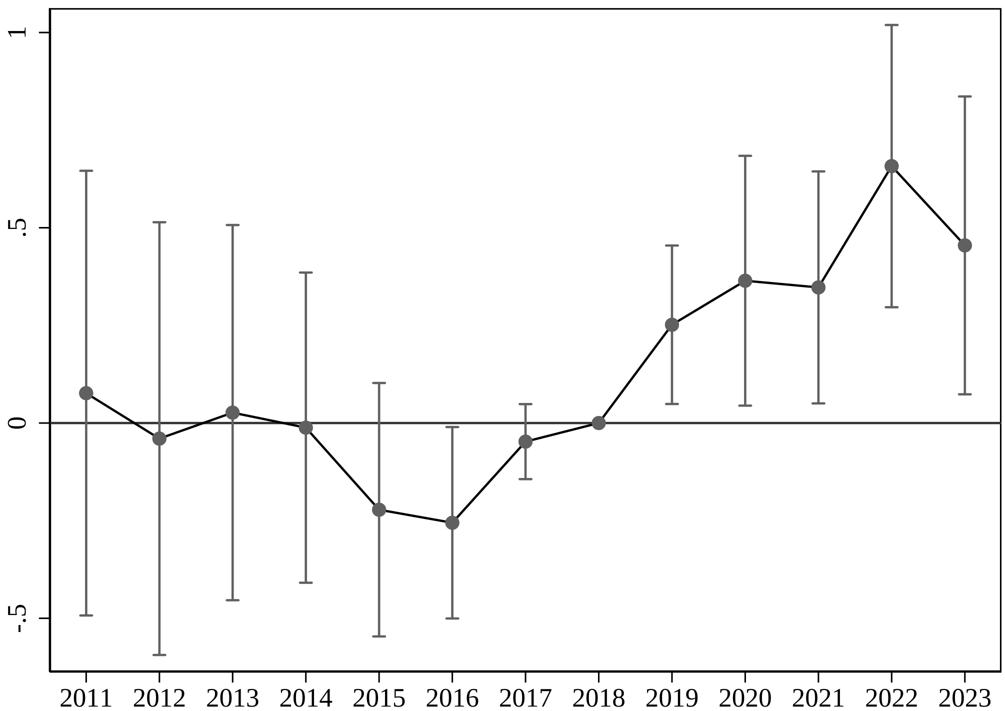

Figure 7: Diff-in-Diff around Lease Treatment Accounting Change.

Notes: This chart presents the estimated impact of lease share on the number of financial constraints, using a difference-in-differences approach around the year of the accounting change (2019) based on the following equation:

$$\text{Nr.Constraints}_{i,t} = \beta_0 + \sum_{t \neq 2018} \beta_t(\text{Year}_t \times \text{Lease Share}_{i,2016}) + \alpha_i + \gamma_t + \varepsilon_{i,t}$$

The vertical axis represents the estimated change in financial constraints, and the horizontal axis shows the year. The shaded areas represent 95% confidence intervals. Nr.Constraints$_{i,t}$ is the number of financial constraints faced by firm i at time t. Year$_t$ are year dummy variables (with 2018 as the omitted base year). Lease Share$_{i,2016}$ is the lease share of firm i in 2016. α_i are firm fixed effects. γ_t are time fixed effects. $\varepsilon_{i,t}$ is the error term. The figure plots the estimated coefficients β_t, which capture the year-specific effects of lease share on financial constraints relative to the base year 2018. Standard errors are double clustered at the firm and date-quarter level.

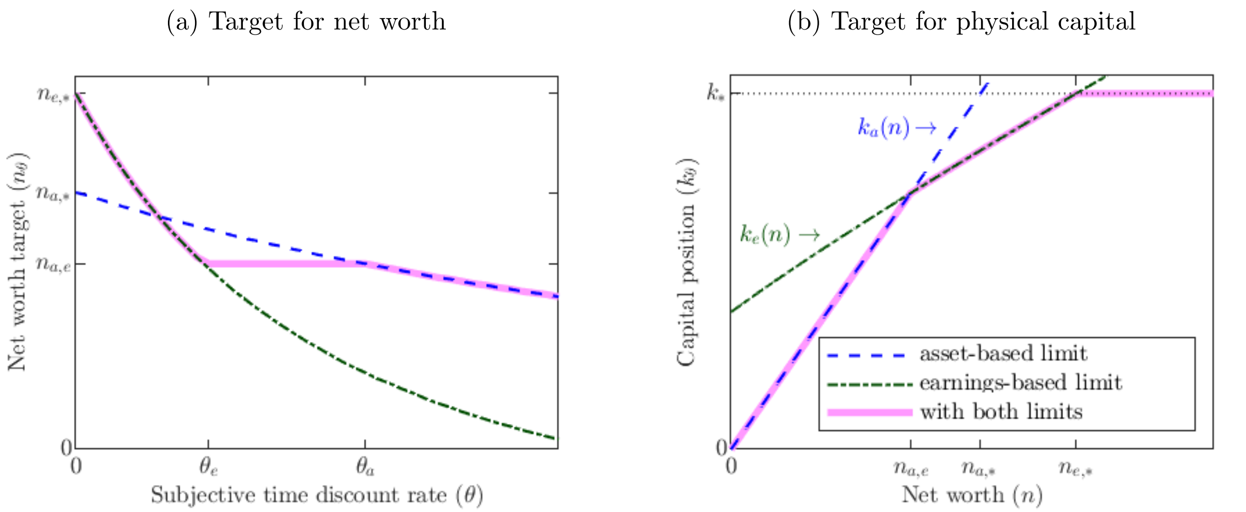

Figure 8: Schematic representation of targets for net worth and physical capital.

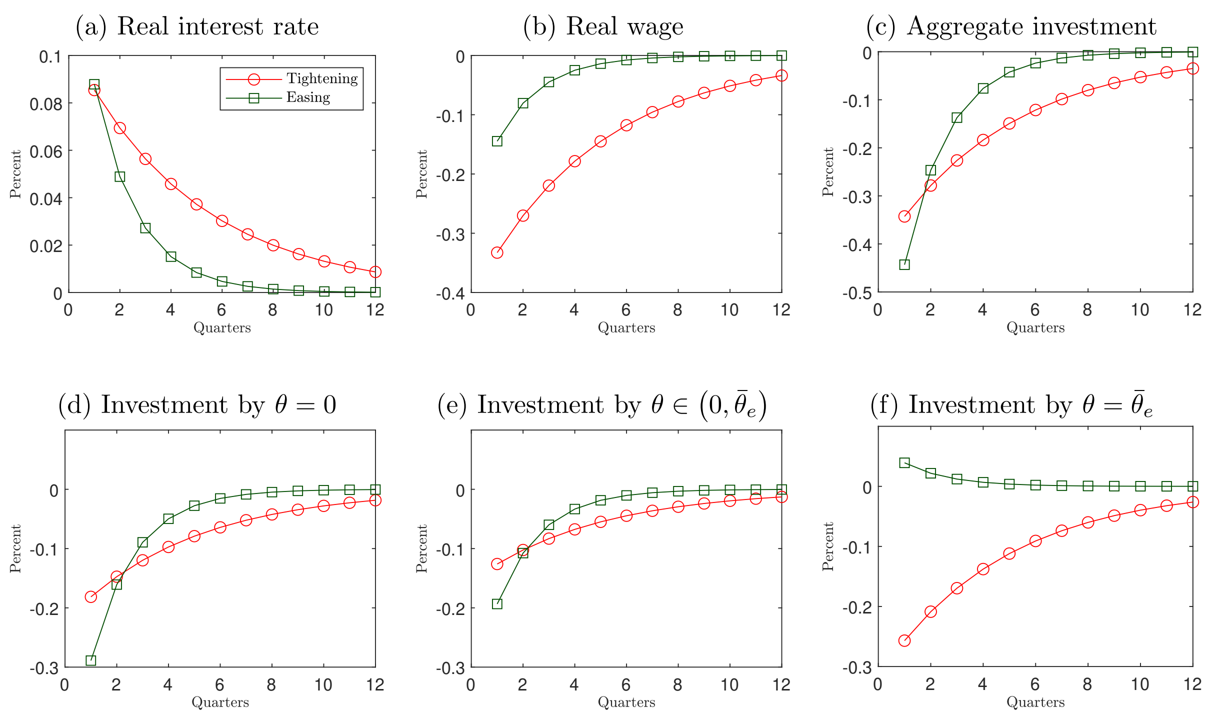

Figure 9: Impulse responses.

Notes: Impulse responses to a monetary tightening and a monetary easing of 25 basis points. The sign of the responses to the monetary easing is flipped to facilitate comparison between the two cases.