Debt Contracts, Investment, and Monetary Policy

Özgen Öztürk*
European University Institute
Ozgen.Ozturk@eui.eu

June 17, 2022

Abstract

This paper studies the role of debt contracts on the transmission of monetary policy to firm-level investment and borrowing. Empirically, using information from a detailed loan-level data matched with balance sheet data and stock return data, I document that in response to a contractionary monetary shock, asset-based borrowers –firms with more pledgeable assets, and higher beta– experience sharper contraction in borrowing and investment than cash flow-based borrowers –firms with higher profitability and alpha. To explore the possible channels and provide microfoundation for the coexistence of these debt contracts, I setup a heterogeneous firm New Keynesian model with limited enforceability. The quantitative model suggests that the traditional collateral channel explains this heterogeneous sensitivity as the cash flow based borrowers are less vulnerable to collateral damage from asset price fluctuations. Results indicate debt contract type affects the severity of financial frictions and also shapes the monetary policy transmission.

Keywords: collateral constraints; debt covenants; firm balance sheets; investment; monetary policy

JEL classification codes: E22, E32, E44, E52

*European University Institute, Department of Economics, Villa La Fonte, Via delle Fontanelle 18, I-50014 San Domenico di Fiesole (FI) - Italy. (Email: Ozgen.Ozturk@eui.eu).

1 Introduction

How do debt contracts and firms' balance sheet features affect monetary policy transmission to firm-level investment? Further, which firm characteristics play role in choosing the debt contract type? Empirically, using information from a detailed loan-level dataset matched with firm-level balance sheet data, and stock return data, I document that in response to a contractionary monetary shock, asset-based borrowers experience sharper contraction in investment and borrowing than cash flow-based borrowers. Asset-based contracts are more popular among the firms with more pledgeable assets, more volatile stock returns, while cash flow-based borrowers are mostly firms with higher profitability and stock returns. To interpret the results and understand the channels driving the heterogeneous sensitivity to monetary policy shocks, I setup a heterogeneous firm macro-finance model. The quantitative results suggests that the traditional collateral channel through asset prices causes this heterogeneous sensitivity and it is mainly effective on asset-based borrowers. Results suggest that severity of financial frictions depends on the debt contract type, and also shapes the monetary policy transmission.

Financial accelerator theories explain the extra sensitivity of financially constrained firms by underlining the critical role of firms' borrowing constraints (Kiyotaki and Moore, 1997; Bernanke, Gertler, and Gilchrist, 1999). The conventional approach in the literature is to model the firm's borrowing limit as a function of liquidation value of the asset stock. This approach, however misses an important feature of data. As recent literature shows (Lian and Ma, 2021; Greenwald, 2019; Drechsel, 2018), while borrowing to fund their investment, firms face not only asset-based but also cash flow-based constraints.[1] In fact, cash flow-based contracts constitute the majority of real life lending practices. Additionally, as a natural implication, financial accelerator literature acclaims the extra competence of monetary policy by specifying its ability of influencing the firms' borrowing constraints through indirect channels.[2] Therefore, given the heterogeneity in debt contracts, which translates into heterogeneity in borrowing constraints, a natural question arises: how the formulation of borrowing constraints affect firm's responsiveness to monetary policy? I address this question by presenting novel empirical evidences and interpreting the findings through the lens of a heterogeneous firm New Keynesian model.

[1] The idea that borrowing capacity depends on cash flows from firms' operations is not new and goes back to Stiglitz and Weiss (1981) and Holmstrom and Tirole (1997)

[2] The direct effects of interest rate changes on the user cost of capital and firms' expected returns are well understood by researchers. These effects apply to all firms regardless of being financially constrained or not. On the contrary, the underlying mechanisms of indirect channels —operating through firm balance sheets thus affecting firm's borrowing capacity— remain elusive.

The dataset I use in the empirical analyses -to best of my knowledge- is the first attempt that merges loan-level data from DealScan, firm-level balance sheet data from Compustat, and stock return data from CRSP.[3] The underlying reason for bringing together these datasets is twofold. First, to investigate which firm characteristics at play in debt contract choice and second, to clearly identify which firm can be classified as asset-based or cash flow-based.

First set of empirical findings consists of descriptive statistics depicting the salient features asset-based and cash flow-based borrowers.[4] The statistics illustrate that firms with higher asset pledgeability ratio and higher stock beta have tendency to choose asset based debt contracts. On the other hand, cash flow based borrowers tend to have larger profitability as measured by higher Jensen's alpha and higher EBITDA.[5] In terms of loan characteristics, I find no meaningful difference between asset-based loans and cash low-based loans (*i.e.* credit spread and maturity).

Second set of empirical findings provide evidence on the sensitivity of firms' investment and borrowing to monetary policy shocks depends on their debt contract form. Following Gürkaynak, Sack, and Swanson (2005) and Gorodnichenko and Weber (2016), high frequency event study based method is used to extract monetary policy surprises. Baseline empirical specification estimates the impulse response functions using local projection method à la Jordà (2005). Three main findings arise from this exercise. First, conditional on rich set of firm-level and aggregate control variables, an unexpected interest rate increase causes asset based borrowers to cut their investment sharper than cash flow-based borrowers. Second, this responsiveness pattern in the investment also resembles in the borrowing responses. Third, I estimate the response shares of firms in each contract group. The results show that a small portion of firms with asset-based contracts switch to cash flow-based contracts, as asset-based borrowing constraints tighten when face contractionary monetary policy shock.

In order to interpret these empirical patterns and understand the active channel driving these heterogeneous sensitivity, I incorporate cash flow based borrowing method into

[3]To be clear, Lian and Ma (2021) utilizes a much larger dataset by combining DealScan, FISD, CapitalIQ, along with the hand collected data from filings. What unique to this paper is utilizing CRSP data to bring in the stock return implications.

[4]These statistics enriched by two additional stock return measure obtained via running a CAPM-type regression with single factor 36-month rolling window. The Capital Asset Pricing Model (CAPM) is widely used by analysts and investors, and describes two fundamental feature of a stock. *i*) **Stock beta:** the correlation between market and stock volatility (captured by the slope term), *ii*) **Jensen's alpha:** the performance of stock compared to market (captured by the intercept term). See Appendix B.1 for detailed discussion.

[5]EBITDA is a widely used measure of corporate cash flow and stands for **E**arnings **B**efore **I**nterest, **T**axes, **D**epreciation, and **A**mortization.

a macrofinance model consisting of heterogeneous firms, limited enforcement of debt, along with some New Keynesian elements. In the model economy, firms choose whether to borrow with an asset-based or cash flow-based contract in each of which *ex post*, firms can renege on their promise of repayment.[6] Perfectly foreseeing the outcomes, financial intermediary writes the terms of both asset based and cash flow based debt contracts and thus restrict the borrowing amount to ensure that firms repay in every state of the world next period.[7]

The model is calibrated to match some key moments regarding the firm investment and borrowing observed in the micro data. The model produces realistic behavior in the cross section as the contract choice of model firms are in line with the patterns disclosed in the descriptive statistics. Then, by employing the simulated data, I conduct a contractionary monetary policy shock experiment echoing the empirical exercise. The model well captures the observed empirical patterns, and exhibit that compared to cash flow-based borrowers, firms with asset based contracts reduce their investment and borrowing relatively larger in magnitude. Furthermore, impulse responses of investment, output, and consumption at their peak are in line with Christiano, Eichenbaum, and Evans (2005).

Finally, to assess the hypothesis that capital price fluctuations drive the differences of responses among asset-based and cash flow-based borrowers, I shut down the asset price channel by making it time-invariant and thus insensitive to monetary policy shocks. The differential responses between subgroups are dampened for both investment and borrowing. If the capital price channel was the only channel at work driving the heterogeneous sensitivity, the ideal results would be the elimination of differential responses. However, as the model predicts, most of the time well performing firms opt for cash flow-based contract, therefore the distance to the borrowing constraint differ between these subgroups which explains the differential responses even in the absence of capital price fluctuations.

Related Literature. This paper contributes to several strands of the literature. First strand is the large body of work that studies the role of financial frictions in the transmission of interest rate changes to the economy. Bernanke et al. (1999) introduces the financial accelerator mechanism and Kiyotaki and Moore (1997) studies the business cycle implications of collateral channel. I contribute to this literature by introducing the coexistence of different types of debt contracts and evaluating the relative strength of fi-

[6]Typically, consequences of a breach depends on the underlying contract. See Section 2.2 and Appendix D for further details.

[7]By this method, borrowing constraints become endogenous. As a contribution to the recent growing literature about debt covenants, this paper attempts to provide microfoundation for the implied borrowing limits of debt contracts.

nancial accelerator mechanism through these contract types.

Second, I contribute to the literature that studies the characterization of optimal dynamic financial contracts under various forms of friction. Remarkable examples include implications on conflicting objectives Albuquerque and Hopenhayn (2004), technological innovations on output Cooley, Marimon, and Quadrini (2004), asset pricing (Biais, Mariotti, Plantin, and Rochet, 2007), Q-theory of investment (DeMarzo, Fishman, He, and Wang, 2012; Cao, Lorenzoni, and Walentin, 2019). This paper contributes to this literature branch by providing a rationale for the coexistence of asset-based and cash flow-based debt contracts.

Third, there is a relatively new strand of literature about the debt covenants. Lian and Ma (2021) empirically presents that debt covenants are often written as asset based or cash flow based while the latter is more dominant. Sharing the similar findings, Drechsel (2018) develops a representative firm New Keynesian model to study the implications of investment shocks. Greenwald (2019) focuses on an environment in which only earnings based covenants exist and study the transmission of monetary policy shocks. I contribute to this literature by deriving these borrowing limits from first principles, instead of imposing *ad hoc* functional forms, hence developing a microfoundation for the different forms of borrowing constraints.

In spirit, this paper is closely related to the literature body that investigates the heterogeneous sensitivity to monetary policy shocks by focusing on various aspects. The balance sheet liquidity (Jeenas, 2018), age/dividend status (Cloyne, Ferreira, Froemel, and Surico, 2018), leverage/credit spread (Anderson and Cesa-Bianchi, 2020), and distance to default (Ottonello and Winberry, 2020). I contribute to this literature by introducing cash flow-based collateral constraints and their implications. Results presented in this paper should not be seen as a contradiction to the above-mentioned studies; instead, as a complementary study that focuses on debt contract heterogeneity.

Finally, this paper borrows key insights from the corporate finance literature which focuses on the implications of debt covenants. Prominent examples include Chava and Roberts (2008), Nini, Smith, and Sufi (2009), Roberts and Sufi (2009a), Roberts and Sufi (2009b), Nini, Smith, and Sufi (2012), and Chodorow-Reich and Falato (2017). This paper contributes to this literature by employing a heterogeneous firm model to investigate how debt covenants affect the monetary policy transmission.

Road Map. The rest of the paper is organized as follows. Section 2 explains the data used in this paper, presents empirical specifications along with the results. Section 3 develops the heterogeneous firm model, discusses selected equilibrium properties. Section

4 explains the calibration strategy. Section 6 presents the contract choices and firms' heterogeneous sensitivity to monetary policy shocks. Section 7 concludes.

2 Empirical Framework

In this section, I discuss the datasets and the empirical strategy employed in the paper. The final dataset I use in the empirical analyses -to best of my knowledge- is the first attempt that merges loan-level data from DealScan, firm-level balance sheet data from Compustat, and stock return data from CRSP. The underlying reason for bringing together these datasets is twofold. First, to investigate which firm characteristics at play in debt contract choice and second, to clearly identify which firm can be classified as asset-based or cash flow-based. Throughout, in Section 2.1, I discuss the methodology of identifying the monetary policy surprises. In Section 2.2, I briefly describe the loan level DealScan dataset, then elaborate the relevance of debt contracts concept from the macroeconomics perspective. In Section 2.3, I discuss Compustat, a firm level balance sheet and income statement dataset and present cross sectional properties of asset based and cash flow based borrowers. In Section 2.4, I document that compared to the asset based borrowers, cash flow based borrowers are less sensitive to monetary policy shocks.

2.1 Identification of Monetary Policy Shocks

As it is well documented by researchers, identifying the unanticipated component of monetary policy changes requires to overcome the bilateral interaction between the federal funds rate and the aggregate economy. An extensive literature strand utilizes the asset price fluctuations around Federal Open Market Committee (FOMC) announcements to extract the unanticipated component of the monetary policy announcements.[8]

I identify shocks to monetary policy following the literature which employs high-frequency movements in financial markets around Federal Open Market Committee (FOMC) press releases to make inference about the unexpected components of monetary policy announcements.[9] In order to extract the unexpected component of the monetary policy announcements, following Gürkaynak et al. (2005) and Gorodnichenko and Weber

[8]Using event study based approach to extract monetary policy shocks builds on the influential works of Kuttner (2001) Cochrane and Piazzesi (2002),Bernanke and Kuttner (2005), Gürkaynak et al. (2005) and goes back to Cook and Hahn (1989).

[9]This extensive literature about using event study based methods to extract monetary policy shocks goes back to Cook and Hahn (1989), and some early prominent examples are Kuttner (2001), Cochrane and Piazzesi (2002), Bernanke and Kuttner (2005), and Gürkaynak et al. (2005).

(2016), I utilize the change in the implied fed funds rate –obtained from a fed funds futures contract– in a 30-minute window encompassing the issuance of FOMC press release. There are two identifying assumptions: (*i*) Fed funds futures provide a good proxy for the market's expectation for the interest rates, (*ii*) 30-minute window is so narrow that market's expectations are not contaminated by any other factor. I construct the shock as below.

$$\varrho_{\tau_j} = \text{ffr}_{\tau+\Delta_+} - \text{ffr}_{\tau-\Delta_-} \tag{1}$$

where τ is the exact time of FOMC press releases. ffr is the current month fed funds futures rates (at time τ), Δ_- is defined as 10 minutes before the FOMC announcement and Δ_+ is 20 minutes after the FOMC announcement.

Since FOMC meetings are held 8 times in a year, the frequency of monetary policy shock is higher than quarterly. Therefore, to obtain quarterly monetary policy shock, ε_t^m, I aggregate the high-frequency measures of monetary policy shocks. Process involves summing ϱ_{τ_j} up within quarter t, as presented below:

$$\varepsilon_t^m \equiv \sum_{\tau_j \in (\tau_{j,1}, \tau_{j,2})} \varrho_{\tau_j} \tag{2}$$

where $\tau_{j,1}$ and $\tau_{j,2}$ exact dates of the beginning and the ending of quarter t, and τ_j corresponds to the date at which FOMC press release is issued.[10]

Given the fact that ε_t^m is only a proxy for the purely unanticipated quarterly monetary policy shocks ε_t, a relatively recent literature indicates that this measure of interest rate surprises are still contaminated, because shocks still include signals about the determinants of monetary policy (Nakamura and Steinsson, 2018; Miranda-Agrippino and Ricco, 2018; Jarociński and Karadi, 2020). These studies state that within each monetary policy shock extracted à la Gürkaynak et al. (2005), monetary component should be disentangled from other contemporaneous non-monetary component. Therefore, as a robustness exercise, to check if my results are significantly affected from the non-monetary component of the monetary policy shock, I use Nakamura and Steinsson (2018) shocks. The results are less pronounced, but qualitatively still persists. Details are provided in Section A.6.

[10] The exact times of these announcements and corresponding measures of shocks are taken from Gorodnichenko and Weber (2016).

2.2 Loan-level Debt Information

In this section, I explain the data I use for loan-level information and briefly describe the debt contracts and their relevant features to the macroeconomics literature. Specifically, I collect the contract data from DealScan database and using the linking file of Chava and Roberts (2008), merge it with Compustat.[11] Although DealScan goes back to older dates, following Greenwald (2019), sample starts in 1997 Q1, since before 1997 covenant variable in DealScan is sparsely populated. The sample ends in 2017 Q3, which is dictated by the most recent version of Chava and Roberts (2008)'s linking file (April, 2018).

In what follows, I provide some background information on the debt contracts, and discuss how borrowing method translates into different forms of borrowing constraint. The main variables of interest are the indicator variables for having cash flow based or asset based debt contract. The details about classification procedure is discussed in Appendix A.2.

The main difference between asset-based lending and cash flow-based lending is that asset-based lending determines debt limit by focusing on the liquidation value of particular assets while in cash flow based lending, borrowing limit is based on the cash flow value from the firms' ongoing operations.[12]

Asset-based Contracts. In these contracts, borrowing limit is mainly dictated by the liquidation value of the pledged assets. Pledgeable assets could be physical (e.g. machinery, inventory, building *etc.*) as well as suitable intangible assets such as usage rights or patents. The lending procedure is as follows. Before granting the amount requested, lenders employ specialized appraisers to conduct on-site field examinations and simulate various liquidation scenarios to estimate the liquidation value of the assets pledged. Then, lenders set a borrowing limit by using their discretion in setting the borrowing limit. During the life time of the agreement, lenders keep conducting field exams and updating the liquidation value estimates in a quarterly basis. Therefore, the borrowing limit is a dynamic object and its enforcement utilizes the most recent estimate.

Given the lending procedure, in asset-based contracts, *ad hoc* contractual borrowing constraint takes the form

$$b' \leq \theta q k \tag{3}$$

[11]Details of the merging procedure are presented in the Appendix A.4

[12]This discussion about asset-based versus cash flow-based contracts should not be confused with the discussion about secured versus unsecured debt. Both contract types can be secured or unsecured. See Kermani and Ma (2020) for further details.

where θ is the borrowing base, q is the appraised price of capital, and k is the pledged asset stock. Asset based contracts are the traditional treatment in the classic macrofinance models (Kiyotaki and Moore, 1997).

Cash flow-based Contracts. In cash flow-based contracts, the debt limit is calculated based on the going-concern value of the borrowing firm. This is due to the fact that under cash flow-based debt contracts lenders have claims against the firm entity and have the right to take over the management of the firm. Significant share of cash flows based contracts belong to the syndicated loans, therefore the lending procedure is shaped by this practice (Lian and Ma, 2021). With cash flow-based contracts, the procedure is as follows. When the requested loan amount exceeds a single lender's targeted risk exposure level, a consortium of lenders is formed and they cooperate to provide the money requested. Forming consortium in this way mitigates the risk undertaken by each lender, as the associated risks are shared between group members. To coordinate the operation, one of the lenders in the consortium take the role of lead financial institution and carry out all the necessary procedures throughout the duration of the loan such as initial transaction, corresponding fees, and repayments. This leader bank also in charge of due diligence, monitoring the firm's compliance and reporting to member banks.

The entire lending process is covered by a solitary loan agreement. However, depending on each lender's individual condition, terms could vary for each lender. Each bank is liable for their own portion of the total loan. Loan amount undertaken by each lender, loan maturity and collateral requirements could be different for each firm. If more than one of the lenders require collateral, then the consortium leader assigns different assets of the borrowing firm for each lender.

With cash flow-based contracts as the lenders have claims against the company entity, the debt limit is calculated via the firm's going-concern cash flow value. However, due to the contractibility issues, lenders calculate the going concern cash flow value of a firm by taking the multiples of firm's operating earnings.[13] Due to its verifiability, borrowing limits are calculated based on a cash flow measure called EBITDA.[14] Because of this relative valuation method, contracts most commonly require a variation of the following formulation

[13]This valuation method is called relative valuation (multiples of EBITDA) as opposed to absolute valuation (Discounted Cash Flow analysis). The underlying reason, along with more details about both valuation methods are discussed thoroughly in Appendix D.1.

[14]Acronym for (**E**arnings **B**efore **I**nterest, **T**axes, **D**epreciation and **A**mortization).

$$b' \leq \phi\pi \tag{4}$$

where π is EBITDA and ϕ is the multiple. These cash flow based agreements are enforced through legally binding financial covenants.[15] As being easy to monitor, max. Debt-to-EBITDA covenant is popular among lenders.[16] Drechsel (2018) states more than 60% of the agreements carry max. Debt-to-EBITDA covenant.[17] As cash flow-based contracts have one master loan agreement, these debt covenants bind at the firm level. Namely, the limit dictated by max. Debt-to-EBITDA is also effective on other types borrowing such as issuing bonds. Throughout the life time of the loan, due diligence is carried out and -on behalf of all lenders- consortium leader continuously monitor cash flows and debt stock of the borrowing firm to check its compliance with the covenant.

Prevalence of Cash flow Based Contracts. By compiling the data from various data sources and hand-collected data from 10-K filings, Lian and Ma (2021) shows that (median) share of asset-based lending is less than 20% while cash flow-based is over 80%, and more importantly the shares are steady over time. The sample set consists of US large non-financial firms of which the total debt of these firms constitute over 96% of debt outstanding among Compustat firms. Similarly, by using DealScan data, Drechsel (2018) presents that cash flow-based debt agreements are more common than other practices in the lending markets.

2.3 Firm-level Balance Sheet and Income Statement Data

Firm-level balance sheet and income statement items come from the quarterly Compustat database. Apart from being widely accepted in the literature, Compustat has nice features that makes it suitable for the empirical analyses. Quarterly frequency makes it possible to observe the implications of monetary policy. Furthermore, being a long panel dataset, it is

[15]Debt covenants are terms and conditions that borrowers are obliged to fulfill and written explicitly in the debt contracts. These terms may include limits on financial ratios as well as levels of capital expenditure, leverage and so on. Although there are various types of covenants in these contracts, the focus of this paper is cash flow based covenants. These loan covenants mandate that throughout the life of loan agreement, firms must satisfy some financial ratios —most prominently, Debt-to-assets or Debt-to-EBITDA. More details can be found in Appendix D.

[16]Max. debt-to-EBITDA ratio is nothing but the rearranged version of (4). It is simply $\frac{b'}{\pi} \leq \phi$. Since b' and ϕ is observable, it is easy for the lender to track the firm's compliance to the covenant.

[17]In fact, cash flow based covenants also have two broad categories in itself: interest payment-to-total debt or cash flow-to-total debt. Greenwald (2019) exclusively focus on these two covenants and suggest a state dependent mechanism in interest rate transmission.

possible to analyze not only cross-sectional variation but also the within firm variation.[18]

This paper utilizes a firm level dataset which is -to best of my knowledge- the first attempt that merges loan-level data from DealScan, firm-level balance sheet data from Compustat, and stock return data from CRSP. To merge DealScan and Compustat I use the linking file provided by Chava and Roberts (2008) and connect the firm identifiers of both datasets. In particular, I extract the entirely available loan data from DealScan, and keep the portion matched to the balance sheet data from Compustat. Then, I merge Compustat with CRSP by employing the Compustat/CRSP link-table available in WRDS. The aim of merging CRSP data is to measure firm performans with the well-known financial indicators. Below, I briefly discuss the variable construction for some selected variables. Further details on data treatment can be found in Appendix A.4.

Corporate finance variables of interests include (but not limited to) investment (calculated via perpetual inventory method), cash flow (proxied by EBITDA), short term and long term debt, interest related expenses, dividend paying status, collateral value, and sales revenue. Using these variables, I construct some firm measures such as size (book value of total assets), age (years since incorporation), leverage (ratio of total debt to total assets), liquidity (short term cash, and investments), and Tobin's Q. Instead of employment, firm size is proxied by value of total assets, since Compustat reports employment measures annually rather than quarterly and further, employment data is relatively less populated than total assets. Moreover, following Cloyne et al. (2018) age variable is not taken directly from Compustat's native initial public offering date as it is not well populated, but instead I blend the Compustat's IPO date and incorporation date from WorldScope Database. Also, some of the Compustat variables are provided (from the source) as cumulative within the firm's fiscal year. Therefore to obtain quarterly data, I calculate the first differences of those variables within the firm's own fiscal year. Finally, variables in levels are normalized by firm size and nominal items are deflated by GVA deflator. Exact data items, variable codes, and corresponding variable construction procedures can be found in Appendix A.1.

[18] The only drawback is that Compustat only includes publicly listed firms which restricts the sample set to mostly have relatively large firms. Moreover, large firms are considered more trustworthy and less financial constrained by several studies (Gertler and Gilchrist, 1994; Farre-Mensa and Ljungqvist, 2016). However, within the framework of this paper, the aim is to show that asset based borrowers have relatively impeded access to external financing than cash flow based borrowers. On the other hand, Cloyne et al. (2018) points out, private firms face similar or more severe financial frictions than publicly listed firms. Therefore, results in this paper can be imagined as a lower bound of the effectiveness of proposed channels of the monetary policy transmission.

Table 1

SUMMARY STATISTICS: ASSET VS. CASH FLOW BASED

	Asset Based				
	Mean	SD	P25	Median	P75
Firm Total Assets ($M)	1679.83	3708.59	167.66	527.41	1514.06
Firm Age (years)	32.94	31.86	11.75	21.50	39.50
Firm Leverage	0.32	0.24	0.14	0.28	0.46
Firm Asset Pledgeability	0.70	0.19	0.59	0.74	0.85
Firm Profitability (x10^{-2})	0.15	3.02	-0.63	0.55	1.64
Firm Tobin's Q	1.57	1.50	1.03	1.28	1.73
Firm EBITDA	0.44	1.60	0.02	0.10	0.39
Loan Spread (pp)	2.36	0.95	1.75	2.25	2.75
Loan Maturity (months)	53.62	23.41	36.00	60.00	60.00
Stock Jensen's Alpha (x10^{-2})	-0.54	3.39	-2.00	-0.30	1.15
Stock Beta	1.68	1.06	0.99	2	2.29
Total Observations	8,135				

	Cash flow Based				
	Mean	SD	P25	Median	P75
Firm Total Assets ($M)	2596.18	4659.20	378.98	973.15	2419.20
Firm Age (years)	34.73	35.05	11.25	22.25	44.25
Firm Leverage	0.32	0.25	0.16	0.29	0.44
Firm Asset Pledgeability	0.57	0.23	0.40	0.59	0.75
Firm Profitability (x10^{-2})	0.75	2.47	0.05	0.97	1.92
Firm Tobin's Q	1.77	1.12	1.15	1.47	2.00
Firm EBITDA	0.84	1.82	0.10	0.30	0.84
Loan Spread (pp)	1.99	1.15	1.25	1.75	2.50
Loan Maturity (months)	59.16	18.37	57.00	60.00	60.00
Stock Jensen's Alpha (x10^{-2})	-0.33	2.80	-1.39	-0.10	0.97
Stock Beta	1.44	0.99	0.82	1	1.89
Total Observations	55,405				

NOTE. Summary statistics for asset-based and cash flow-based in the sample. The sample period covers the period between 1997Q1 and 2017Q3. Asset pledgeability refers to the ratio of tangible fixed assets to total assets as in Cloyne et al. (2018) and Dinlersoz, Kalemli-Ozcan, Hyatt, and Penciakova (2018). Profitability is measured as Return-on-Assets as widely used in corporate finance literature. Loan spread is measured in percentage points. The sample consists of 2,236 firms of which 614 firms are asset based borrowers and 1602 are cash flow based borrowers. There are 30,591 loans and 11,457 packages.

Summary Statistics. Before starting the dynamic analysis, to explore the link between firm characteristics and debt contracts, I report some descriptive statistics depicting the salient features of each firm group. Details about the classification into asset-based or cash flow-based categories are in Appendix A.2. Table 1 presents the descriptive statistics for firms with asset based and cash flow based debt contracts.[19] It would be beneficial to state that these statistics enriched by two additional stock return measure obtained via running a CAPM-type regression.[20]

Summary statistics illustrate that firms with higher asset pledgeability ratio (measured by the ratio of tangible fixed assets to total assets as in Cloyne et al. (2018) and Dinlersoz et al. (2018)) have tendency to choose asset based debt contracts. Asset based borrowers are mostly among the firms with higher stock beta implying a positive correlation between having more volatile stock return and use of collateral in the contracts. Cash flow based borrowers mostly have larger profitability as measured by higher Jensen's alpha, EBITDA and Return-on-Assets.

Table 1 also shows that there is no serious heterogeneity in the age and leverage dimensions. In line with Lian and Ma (2021), asset based borrowers are, in general, smaller (as measured by total assets).

In terms of loan characteristics, asset-based and cash flow-based loans' average credit spread are close to each other (with only minor difference of 37 basis points). Loan maturities also don't exhibit heterogeneity as both groups have 60 months maturities at the median (with 5.5 month difference at the mean).

2.4 Heterogenous Sensitivity to Monetary Policy Shocks

The central thought in the empirical analyses is to provide evidence on the heterogeneous responsiveness of firms' investment and borrowing to monetary policy shocks depends on their debt contract form. Following the recent literature on heterogeneous monetary policy transmission (Cloyne et al., 2018; Jeenas, 2018; Anderson and Cesa-Bianchi, 2020; Ottonello and Winberry, 2020), I estimate the impulse response functions using local pro-

[19] As the final version of data set only includes the observations that could be matched via Chava and Roberts (2008) linking file, the number of observations for the asset based and cash flow based borrowers are not representative of the population. However, the analyses of Lian and Ma (2021) which includes manual entries from 10-K filings suggests cash flow based borrowers constitute the major portion of all observations. My data set here is in line with their findings in this sense.

[20] The Capital Asset Pricing Model (CAPM) is widely used by analysts and investors, and describes two fundamental feature of a stock. *i*) the correlation between market and stock volatility (captured by the slope term), *ii*) the performance of stock compared to market (captured by the intercept term). See Appendix B.1 for detailed discussion.

jection method à la Jordà (2005). I then estimate variants of the baseline empirical specification to provide a better identification about the impact of debt contract type.

I start the exercises by regressing the variables of interest on the interaction terms of the firms' borrowing method indicator at time $t-1$ and the monetary policy shock at time t. The borrowing method indicator splits the entire sample into two, based on whether each firm utilize an asset based or cash flow based debt contract. Regressions are carried out in quarterly frequency. (5) presents the baseline empirical specification.

$$y_{j,t+h} - y_{j,t-1} = \alpha_j^h + \beta_1^h \left(\epsilon_t^m \mathcal{I}_{j,t-1}^{Asset} \right) + \beta_2^h \left(\epsilon_t^m \mathcal{I}_{j,t-1}^{Cash} \right) + \sum_{p=1}^{P_Z} \Gamma_p \mathbf{Z}_{j,t-p} + \sum_{p=1}^{P_X} \Gamma_p \mathbf{X}_{t-p} + e_{j,t+h} \quad (5)$$

$h = 0, 1, ..., H$ represents the active time horizon ($H = 20$ quarters) in which I estimate the relative impact effect on the dependent variable of interest. $y_{j,t+h}$ is the dependent variable of interest at horizon h: investment and borrowing. α_j^h is the firm fixed effect, ϵ_t^m is the quarterly monetary policy surprise of which calculation is described in Section 2.1. $\mathscr{I}_{j,t-1}^{Asset} = 1$ when firm j use asset based borrowing practices in the quarter that precedes the monetary policy surprise (otherwise zero) and $\mathscr{I}_{j,t-1}^{Cash} = 1$ when firm j use cash flow based borrowing practices in the quarter that precedes the monetary policy surprise (otherwise zero). Baseline empirical specification also controls for a variety of idiosyncratic and aggregate factors that may simultaneously affect dependent variables and borrowing method.[21] $\mathbf{Z}$ is the firm level control variable set including leverage, size, age, and current assets share, with $P_Z = 1$. $\mathbf{X}$ is the aggregate control variable set including GDP, inflation, unemployment rate and the VIX volatility index, with $P_X = 4$. β_1^h and β_2^h are the regression coefficients of interest capturing the impulse responses among subgroups. Finally, I limit the sample to firms that are observed for at least five years since I estimate impulse response functions over a five-year forecast horizon (20 quarters).

There are two themes in these exercises: *i*) response of borrowing and investment, *ii*) compositional change between contract groups.

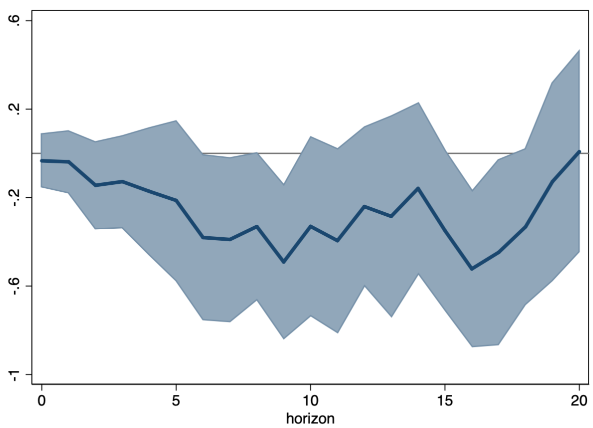
Investment and Borrowing. Figure 1 exhibits the estimated impulse responses using (5). β_1^h and β_2^h belong to the subgroups asset based and cash flow based, respectively. The top row, Panel (A) and Panel (B) are for investment and the bottom row, Panel (C) and Panel (D) are for borrowing. The shaded areas are the 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter. Impulse response

[21] Some of the control variables included in (5) are beyond the scope of the quantitative economic model depicted in Section 3.

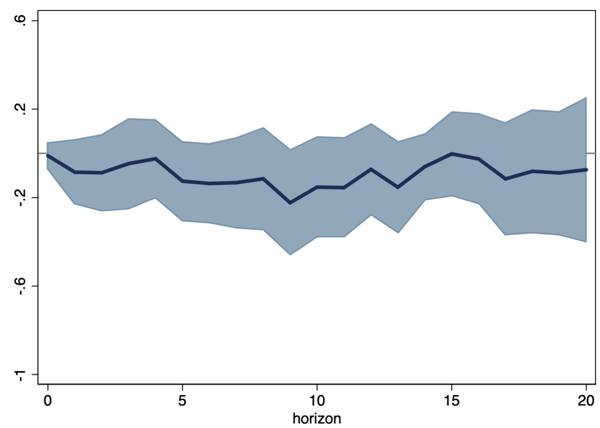
Figure 1

Impulse Responses:
Asset-based vs. Cash flow-based

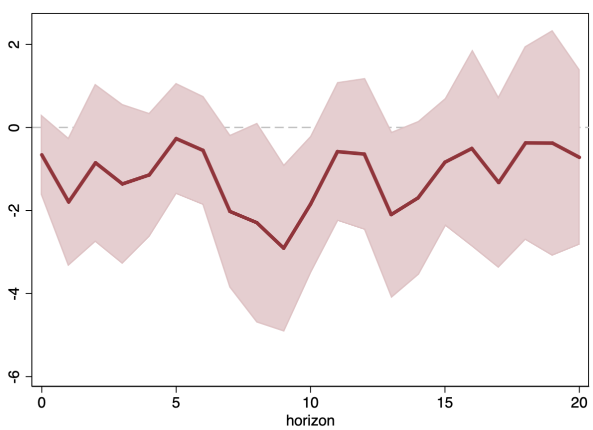
(**a**) **Investment:** Asset Based



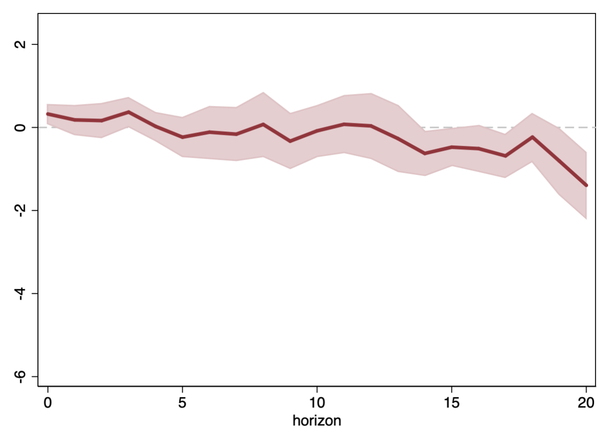
(**b**) **Investment:** Cash-flow Based



(**c**) **Borrowing:** Asset Based



(**d**) **Borrowing:** Cash-flow Based



Note. This figure shows the average impulse response functions for the investment rate and net debt issuance following a 25 bps increase in 3-month T-bill rate. The responses are classified into asset-based and cash flow-based borrowers and estimated with the local projection specification given by (5). Monetary policy shock is interacted with indicator variable based on the firm borrowing status. The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

functions estimated over 20 quarters period.

Investment declines significantly following a 25 bp rise in the interest rate. The effect becomes significant around the middle of the second year and the peak effect is reached at the end of the second year after the shock, at a value around -0.5. After that, the dynamic effects dissipate and become statistically negligible by the end of the forecast horizon. There are three key takeaways from Figure 1. First, Panel (A) shows that the decline in investment of asset based borrowers is statistically significant, while Panel (B) shows that cash based borrowers' response is not statistically significant. Second, the peak response of investment among asset based borrowers (which occurs at 2 years after impact) are almost three times larger than cash based borrowers. Third, these two main points echo in Panel (C) and Panel (D). The response of borrowing among cash based borrowers is not statistically significant and small in magnitude, while asset based borrowers respond in a statistically significant way and larger in magnitude. Again the peak response is experienced around 2 years after the impact.

At this point, it is worth to mention that firms in Compustat are publicly listed and thus relatively larger compared to private firms. Literature typically assumes that large firms have comparatively easy access to external funding and thus use size as a proxy for the financial constraints (Gertler and Gilchrist, 1994; Farre-Mensa and Ljungqvist, 2016). However, the empirical results suggest that financial frictions are effective even among the firms that are considered as relative unconstrained. As a bottom line, Figure 1 shows that mostly asset based borrowers are affected from an unexpected interest rate increase, as their borrowing and invesment response resembles each other, suggesting that mostly asset-based borrowers respond to an interest rate increase.

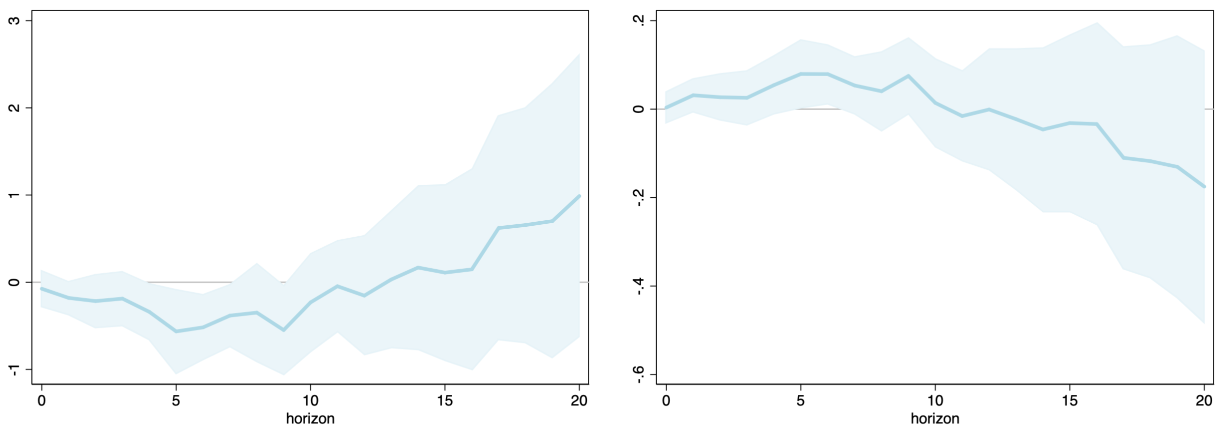
Compositional Change. A possible challenge to the baseline results is the endogenous changes in firms' group composition. This exercise is crucial in the sense that it directly measures the reliability of the main analysis. First, after receiving a monetary shock if there are too many switchers between asset-based and cash flow-based firms, then basically the impulse responses would not be reliable as the effect is not isolated enough. Second, if there are no effect on firm groups, then this would suggest there is no correlation between monetary shock and debt contracts. Figure 2 shows that a small portion of firms with asset-based contracts switch to cash flow-based contracts and both groups' response is significant. This finding supports the evidences provided above, as asset-based borrowers are severely affected from a contractionary monetary policy shock while cash flow based borrowers are relatively not responsive. Indeed, the question arises: if there was nothing wrong with asset based contracts, then why would the firms try to switch cash flow based contracts? Furthermore, the responses are limited in magnitude since monetary policy shocks are not strong enough for most firms to change their contracts. Consequently, Figure 2 indicates that the baseline empirical results remain valid.

Figure 2

Impulse Responses: Shares

Asset-based vs. Cash flow-based

(**a**) **Share:** Asset Based (**b**) **Share:** Cash-flow Based



Note. This figure shows the average impulse response functions for the spread following a 25 bps increase in 3-month T-bill rate. The responses are classified into asset-based and cash flow-based borrowers and estimated with the local projection specification given by $y_{j,t+h} - y_{j,t-1} = \alpha_j^h + \beta^h(\epsilon_t^m) + \sum_{p=1}^{P_Z} \Gamma_p \mathbf{Z}_{j,t-p} + \sum_{p=1}^{P_X} \Gamma_p \mathbf{X}_{t-p} + e_{j,t+h}$. The dependent variable is the share of asset based contract (for panel (a) and cash flow based contract (for panel (b)). The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

Taking stock of the empirical evidences. First set of findings include the descriptive statistics. The comprehensive dataset used in the paper suggest that majority of firms use cash flow-based borrowing. Firms with higher asset pledgeability ratio and higher beta have tendency to choose asset based debt contracts while cash flow based borrowers typically have larger profitability.

Second set of findings are obtained via dynamic monetary policy shock experiment. Three main findings arise from this exercise. First, conditional on rich set of firm-level and aggregate control variables, an unexpected interest rate increase causes asset based borrowers to cut their investment sharper than cash flow-based borrowers. Second, this responsiveness pattern in the investment also resembles in the borrowing responses. Third, a small portion of firms with asset-based contracts switch to cash flow-based contracts, as asset-based contracts are affected more severely from the monetary policy shock. Finally, even though the central focus is the debt contract as the main source of firm-level heterogeneity, the main result –the response of borrowing and investment for the asset-based borrowing firms is significantly larger in magnitude– still persist after carrying out robustness checks for the possible confounding factors. Particularly, I check whether the baseline results are driven by the spread response, external finance dependence, and regional heterogeneity. See Appendix B.2 for further details about the robustness exercises.

Putting together all of these evidences, a likely explanation about the underlying mechanism behind the heterogeneous responses between asset-based and cash flow-based firms are as follows. The firms issuing new debt with asset based contract have to rely on the value of their asset stock to serve as collateral. Therefore, by reducing the asset price, contractionary monetary policy shocks tighten the borrowing constraint for these firms and force them to cut back their borrowing and investment. Whereas the debt limits of cash flow based debt contracts do not depend on asset prices, and they are not affected from the decreasing values of asset prices/collateral values. If there had been a firm-level appraised value of capital data available, I would asses the validity of this collateral channel. Therefore, to evaluate the validity of this mechanism, I setup a quantitative model which captures both the cross-sectional and the dynamic empirical patterns, then I assess the relevance of this asset price/collateral channel by switching it off and compare the differential responses.

3 Model

In this section, I develop a heterogeneous firm New Keynesian model to explain the empirical results presented in Section 2. It is beneficial to summarize key parts of the model: production side which generates heterogeneous responses to monetary policy; financial side which captures the coexistence of different types of debt contracts; and New Keynesian components which helps to embed price stickiness.

Heterogeneous production firms are specified in a standard way (Khan and Thomas, 2013; Jeenas, 2018; Ottonello and Winberry, 2020). Mainly following the design philosophy of Cao et al. (2019), I extend this structure by including cash flow based debt contracts. In order to ensure that both asset-based and cash flow-based contracts can coexist in the economy and further -depending on their idiosyncratic state- firms can switch between contract types, contracts imply state contingent borrowing limits which are derived from first principles (via limited enforcement).

Moreover, as in typical models of the financial accelerator literature, in order to generate time varying capital price, model economy also inhabits capital good producers which are subject to convex adjustment cost of aggregate capital. This brings in the financial accelerator mechanism to the model and results in a positive correlation between capital price and aggregate investment.

In the model, there is no aggregate uncertainty and I study the perfect foresight transition paths in response to an unexpected monetary policy shock. Finally, I use time-subscripts to indicate variations in equilibrium prices and value functions. Prime notation is employed to refer to future values in the choice variables.

3.1 Production Firms.

Each period, there is a unit mass of heterogeneous production firms investing in capital and participating in the financial markets.[22] Each production firm $i \in [0,1]$ produces an undifferentiated good i, by using labor $l_{i,t}$ and predetermined capital $k_{i,t}$ using a decreasing returns to scale production function given below

$$y_{j,t} = z_{i,t} k_{i,t}^{\theta} l_{i,t}^{\nu}. \tag{6}$$

Labor market is perfectly competitive, and firms hire labor at the real wage, w_t. Idiosyncratic firm productivity $z_{i,t}$ follows a log–$AR(1)$ process presented by (7)

$$z_t = \rho z_{t-1} + \sigma \epsilon_t; \quad \epsilon \sim N(0,1). \tag{7}$$

Since the focus of this paper is to understand how different formulations of borrowing constraints shape the monetary policy transmission, I incorporate three measures to prevent firms circumventing these frictions. First measure is imposing non-negativity constraint on the firms which prevents firms to raise equity in order to avoid the borrowing limits.

Second measure is that each period with probability π_d firms may hit by an exogenous exit shock which pushes the firm out of the economy regardless of its financial situation. By this method, I prevent that all firms in the economy become so big that they will never constrained by a borrowing limit. To keep the mass fixed each period, exiting firms are replaced by an equal mass of entrants.

Third measure is the inclusion of operating cost. By incorporating this additional cost

[22]For brevity, hereafter I refer production firms as "firms", and other firms are distinguished by using their exact names (*i.e.* retailers, capital good producers etc.).

of production, dependence of firms to an external source is increased as more firms need to borrow to be able to produce due to this extra cost.

Timing of events Within each period, following events take place consecutively.[23]

i. The entrant firms with a mass of exiting incumbents enter to the economy at the beginning of period t. They hold an initial capital stock k_0, and no initial debt $b_0 = 0$.

ii. Idiosyncratic productivity shock and exogenous exit shock are realized for both incumbents and new entrants.

iii. Firms produce intermediate good by using their existing capital stock and hiring labor $l_{i,t}$ from a frictionless, competitive labor market. Firms pay the operating cost Φ and the wage bill at w_t, then sell their undifferentiated goods to the retailers with nominal price p_t.

iv. Firms repurchase all outstanding debt.

v. Exiting firms liquidate their total capital stock, and pay the remaining funds as dividends to the households. Conditional on survival, firms decide the following simultaneously. *i*) purchase new capital $k_{i,t+1}$ with capital price q_t, *ii*) purchase new debt $b_{i,t+1}$, and *iii*) contract type of the newly issued debt (*i.e.* as offered by the financial intermediary).

vi. The remaining funds (if any) are distributed to the households as dividend payments.

Recursive formulation. The set of individual state variables of a firm includes idiosyncratic productivity shock, net worth, and the debt contract it holds; (z, nw, χ). Here, net worth nw is defined as firms' total funds before acquiring new debt or purchasing new capital. Due to its static nature, given the idiosyncratic productivity shock, labor choice problem can be merged with the definition of net worth.

In this economy, a firm's investment decision is intertwined by its ability to borrow and thus the level of debt it carries into the next period. However, as discussed in detail in Section 3.2, financial intermediary writes debt contracts by taking into account their *future* ability of repayment, and thus focuses on not today's but instead next period's capital.

[23] Note that the timing of events ensures that firms always repay their debt in every state and thus there is no default caused by the exogenous exit shock.

Therefore, it is important to keep in mind that in this economy a firm's individual levels of k and b do not directly influence any of its decisions outside of their impact on net worth.[24] The firm value depends only on z and nw and does not depend separately on k and b because nw completely captures earlier choices that influenced its current choice set. This enables to lower the dimension of state vector and thus the value and policy functions.

$$nw = \max_{l} p_t z(k)^{\theta} l^{\nu} - w_t l + q_t(1-\delta)k - b - \Phi \tag{8}$$

where Φ is the operating cost. Conditional on surviving the exit shock, the recursive problem of the heterogeneous production firm is:

$$\begin{aligned} v_t(z, nw; \chi) = \max_{k', b'; \chi'} \quad & nw - q_t k' + \mathcal{Q}_t b' + \mathbb{E}_t[\Lambda_{t+1}(\pi_d \hat{nw}_{t+1}(z', k', b') + \\ & (1-\pi_d) v_{t+1}(z', \hat{nw}_{t+1}(z', k', b'); \chi'))] \end{aligned} \tag{9}$$

subject to the non-negativity constraint on dividends

$$nw - qk' + \mathcal{Q}b' \geq 0,$$

and the terms of the debt contract, χ

$$\chi \in \left\{ \chi_{t+1}^{Asset} \left\{ z', \hat{nw}_{t+1}(z', k', b'); q \right\}, \chi_{t+1}^{Cash} \left\{ z', \hat{nw}_{t+1}(z', k', b'); \pi \right\} \right\}$$

The terms for both contract types will be explained in the next subsection in detail. The complete exposition of the production firms along with specifications of the debt contracts are explicitly presented in Appendix C.2.

3.2 Debt Contracts and Financial Intermediary

Compared to the recent literature about debt covenants, there are two distinguishing features of the model. First one is the coexistence of asset-based and cash flow-based contracts. State contingency is required to introduce this multiple contract structure. Therefore following Cao et al. (2019), the model also includes state-contingent borrowing limits which are derived from limited enforcement. In the model economy, *ex post* firms can

[24] This result is impossible in the models with capital adjustment frictions. The adjustment cost is a direct function of investment and today's capital level.

renege on their promise to repay, thus breaching their contracts. By having perfect information, financial intermediary writes both asset-based and cash flow-based contracts by ensuring that firms repay their debt in every state of tomorrow. To do so, it imposes incentive compatibility constraints which mandate that the value of repayment has to be greater than the value of breaching the contract for all possible states of tomorrow. As a result, firms have an incentive to pay back the debt rather than to default, for all states of tomorrow, thus firms can only borrow up to the amount which satisfies the above incentive compatibility constraints. Therefore, limited enforceability of loan contracts directly maps into the firm's *ex ante* borrowing capacity and thus in the model, borrowing constraints are derived from first principles rather than imposing exogenously.

In the model, each period lenders offer two types of debt contracts: asset-based or cash flow-based which differ in terms of resolution of the contract breach. By observing the terms of both contracts, firms choose the optimal one. However, given the initial state (z, nw), the financial intermediary may not ensure the repayment with one of the contracts. Therefore for the firms with (z, nw) there is only one contract offer on the table. In this setup, firm's borrowing decisions have two dimensions. In the extensive margin whether to opt for asset-based or cash flow-based contract, and in the intensive margin how much to borrow.

Asset based contracts, $\chi_{t+1}^{Asset}\left\{z', \hat{nw}_{t+1}\left(z', k', b'\right); q\right\}$**.** In these contracts, borrowing limit is directly dictated by the liquidation value of the pledged assets. In case of a contract breach, firms run away from their debt, and as penalty, lose a fraction Θ of their existing capital stock. Incentive compatibility constraint in asset based contracts are presented below.

$$v_{t+1}^{Asset}\left(z', \hat{nw}_{t+1}\left(z', k', b'\right)\right) \geq v_{t+1}^{Asset}\left(z', \hat{nw}_{t+1}\left(z', (1-\Theta)k', 0\right)\right) \tag{10}$$

(10) states that continuation value under repayment has to exceed (or be equal to) continuation value under default. Also notice that since the penalty is based on losing some portion of the capital stock, the associated borrowing limit has a close connection with the capital price.

Cash flow-based contracts, $\chi_{t+1}^{Cash}\left\{z', \hat{nw}_{t+1}\left(z', k', b'\right); \pi\right\}$**.** In cash flow-based contracts, lenders have claims against the firm entity and have the right to take over the management, therefore the value of the borrowing firm should dictate the debt limit. And following the real life practices, the value of the firm is approximated by its cash flow. In case of a default, if firms choose to run away from their debt, they lose an amount -a multiple of their cash flow- which is basically an estimation for the firm's contingent value.

$$v_{t+1}^{Cash}\left(z', \hat{nw}_{t+1}\left(z', k', b'\right)\right) \geq v_{t+1}^{Cash}\left(z', \hat{nw}_{t+1}\left(z', k', 0\right)\right) - W_{t+1}\left(z', \hat{nw}_{t+1}\left(z', k', b'\right)\right) \quad (11)$$

where

$$W_{t+1}\left(z', \hat{nw}_{t+1}\left(z', k', b'\right)\right) = \varphi[\overbrace{p_{t+1} z' \left(k'\right)^{\theta} \left(l'\right)^{\nu} - w_{t+1} l'}^{\approx \pi}] \quad \text{for all } z'.$$

As opposed to the asset-based contracts, the penalty in the cash flow-based contracts is based on losing a multiple of cash flow, therefore the associated borrowing limit is a directly connected to the firm's cash flow.

To stay consistent with the notion regarding the interpretation of the borrowing limits as "debt contracts", I define the contracts, χ belong to time $t+1$, not time t. Note that this choice does not affect any of the results, as there is no staggering mechanism between the contract types.

Financial intermediary. Financial intermediary operates in a perfectly competitive market and takes deposits from the representative households and lends these funds to the production firms in need. Financial intermediary is owned by the household. This *pass-through* financial intermediary does not differentiate between the firms whether they sign up for asset-based or cash flow-based contracts. The recursive problem of the intermediary is:

$$V_I(D, B) = \max_{D', B'} \quad D' - B' + \Lambda^h V_I(D', B') \quad (12)$$

subject to

$$D' - B' \leq (1 + r^B)B - (1 + r^D)D \quad (13)$$

where Λ^h is the households' stochastic discount factor, D stands for the deposit and B is loans granted.

Financial intermediary's optimality condition reads:

$$r'_B = r'_D \tag{14}$$

3.3 Capital Good Producers

Capital good producers operate in a perfectly competitive market, thus take the capital price q_t as given. To produce next period's capital stock K_{t+1}, these firms purchase the existing capital stock, K_t and I_t units of final good. Capital good producer solves the below problem.[25]

$$\max_{I_t} \quad q_t K_{t+1} - q_t(1-\delta)K_t - I_t \tag{15}$$

subject to the production function

$$K_{t+1} = \Phi\left(\frac{I_t}{K_t}\right) K_t \tag{16}$$

and the capital adjustment cost

$$\Phi\left(\frac{I_t}{K_t}\right) = \frac{\hat{\delta}^{1/\phi}}{1-1/\phi}\left(\frac{I_t}{K_t}\right)^{1-1/\phi} - \frac{\hat{\delta}}{\phi-1} \tag{17}$$

where $\hat{\delta}$ is the investment rate at the steady state.

Above profit maximization problem yields the relative price of capital as

$$q_t = \frac{1}{\Phi'\left(\frac{I_t}{K_t}\right)} = \left(\frac{I_t/K_t}{\hat{\delta}}\right)^{1/\phi} \tag{18}$$

3.4 Retailers, Final Good Producers, and the Monetary Authority

Retailers. Model inhabits a continuum of retailers of which mass is fixed, $i \in [0,1]$. Each retailer operates in a monopolistically competitive market, thus can set a price with markup. Retailers buy the undifferentiated intermediat good from the heterogeneous production firm i, produce a differentiated variety $\tilde{y}_{j,t}$ by the production process:

$$\tilde{y}_{j,t} = y_{j,t} \tag{19}$$

[25] Note that, since capital good producers have to buy the entire aggregate capital stock, only choice variable for these firms is how much final good to use to produce new aggregate capital stock.

Having market power, retailers can set a relative price, $\tilde{p}_{j,t}$ for their variety subject to the quadratic price adjustment cost: $\frac{\varphi}{2}\left(\frac{\widetilde{p}_{j,t}}{\widetilde{p}_{j,t-1}}-1\right)^2 Y_t$, where Y_t is the final good. Retailers take the demand curve for the differentiated good as given which is an outcome of final good producers' problem.

Final Good Producer. Final good producer operates in a perfectly competitive market and thus take the prices of the retail goods, $\tilde{p}_{j,t}$ and the final good p_t as given. Final good producers use the retail goods as input and bundles them into the final good by using the CES production technology:

$$Y_t = \left(\int \tilde{y}_{j,t}^{\frac{\gamma-1}{\gamma}} \mathrm{d}j\right)^{\frac{\gamma}{\gamma-1}}. \tag{20}$$

Note that final good is the numeraire in this economy. Cost minimization problem of the final good producer generates the retailers' demand curve.

Monetary Authority. Monetary policy is conducted by the monetary authority which sets the interest rate on the risk-free bond r_t^f according to the Taylor rule given below.

$$\log r_t^f = \log \frac{1}{\beta} + \varphi_\pi \log \Pi_t + \varepsilon_t^{\mathrm{m}}, \text{ where } \varepsilon_t^m \sim N\left(0, \sigma_m^2\right), \tag{21}$$

φ_π is the inflation coefficient in the Taylor rule, and $\varepsilon_t^{\mathrm{m}}$ is the monetary policy shock.

3.5 Household and Equilibrium

There is a representative household who consumes the final good c_t and supplies labor l_t in exchange for the real wage w_t. In order to accumulate their wealth, the household use two different financial instruments: (*i*) one period risk-free bond, a (issued by financial intermediary), (*ii*) one period firm share, η^h. Distribution of the households' ownership over the heterogeneous production firms' shares is represented by the measure η^h. Along with the production firms, households own retailers and final good producers, as well as the financial intermediary in the economy. Furthermore, I assume that the price adjustment cost is rebated lump sum to the household and thus it does not exhaust resources in the economy.

Representative household's lifetime utility is governed by the Bellman equation:

$$V(a, \eta) = \max_{c,l,a',\eta'} \quad (\log c - \Psi l) + \beta V(a', \eta') \tag{22}$$

subject to

$$
\begin{aligned}
c + a' + \int_{\mathbf{S}} \rho_t^1 \left(z', nw'\right) \eta' \left(z', nw'\right) = \\
w_t l + (1 + r_t) a + \int_{\mathbf{S}} \rho_t^0 \left(z, nw\right) \eta \left(z, nw\right) + \Upsilon + \vartheta
\end{aligned}
\tag{23}
$$

where $\rho_t^0 \left(z, nw\right)$ is the *cum dividend* price of production firms' shares at the beginning of period t with the state vector (z, nw). $\rho_t^1 \left(z', nw'\right)$ is the price of new shares of firms which begin the next period with the state vector (z', nw'). Υ is the profit of the retail goods producers. Note that since financial intermediary, final good producer and production firms operate in perfectly competitive markets, for brevity, their profits are omitted in the budget constraint. ϑ is the lump sum amount household receive from the price adjustment cost.

In this economy, since households own all firms and financial intermediary, these entities share the stochastic discount factor of households, obtained from Euler equation of risk-free bonds, which is given below:

$$
\Lambda^h = \beta \frac{u_c(c', l')}{u_c(c, l)} \tag{24}
$$

(14) and (24) together yields:

$$
\Lambda^h \left(1 + r_B'\right) = 1 \tag{25}
$$

Note that full characterization of the equilibrium can be found in Appendix C.3.

4 Calibration

Calibration strategy involves two main stages: external and internal calibration. In the external calibration, I fix some model parameters *a priori* based on the estimated values in the previous literature. Whereas in the internal calibration, by focusing on the mechanisms of interest at work, the remaining parameters are chosen to match model's moments at the stationary equilibrium to the observed data moments. Majority of the data moments are calculated based on merged Compustat/DealScan/CRSP dataset. I also compare the resulting parameter values and moments with their already existing counterparts in the literature. Finally, The main anchor in the calibration strategy is to make sure that a firm can always repay its debt outstanding and thus there is no equilibrium default.

External Calibration. Length of a model period is one quarter. I set the household discount factor β, to imply an average annual interest rate of 4 percent.[26] and I set $\theta = 0.21$ and $\nu = 0.64$ which imply decreasing returns to scale of 0.85. Quarterly capital depreciation rate is $\delta = 0.025$. Elasticity of substitution between the differentiated intermediate goods (produced by retailers to be sold to the final goods producers) is $\gamma = 10$, which implies a steady state markup of 11% over marginal costs through the formula $\frac{\gamma}{\gamma-1} = 1.11$.[27] Following Ottonello and Winberry (2020) which in turn builds on Kaplan, Moll, and Violante (2018), I set $\varphi = 90$ which yields the NKPC slope $\frac{\gamma-1}{\varphi} = 0.1$. Again, following Ottonello and Winberry (2020) and Bernanke et al. (1999), I set the curvature parameter of the aggregate adjustment costs which govern the price elasticity with respect to investment rate as $\phi = 4$. I set the exogenous exit rate $\eta = 0.087$ to match the exit rates of Jeenas (2018) and Ottonello and Winberry (2020) which are calculated from the survey of Business Dynamics Statistics.

Internal Calibration. I set the parameters in the internal calibration to match the empirical targets depicted in Table 3. Targeted empirical moments are calculated from the Compustat/DealScan merged sample I used in the empirical exercises in Section 2.

First, I set $k_0 = 0.27$ so that, in any given quarter, new entrants start their lifecycle with an initial capital that is 0.27 relative to the average firm's size in the economy. This calibrated value is higher than its empirical counterpart from the Compustat sample (0.25). It is due to the fact that model economy includes operating costs so that firms need to have enough capital in order to survive their first period.[28]

Naturally, each parameter affects all of the model results, but since the novel part of this paper is the inclusion of cash flow based contracts, I first discipline the parameters of idiosyncratic productivity shock $AR(1)$, then using these calibrated parameters try to match the empirical moments regarding the borrowing concept. Parameters governing the $AR(1)$ idiosyncratic productivity shock process; persistence parameter ρ and the dispersion of innovations σ to the productivity are chosen to reproduce firm level investment dynamics (mean and dispersion of investment rate) in the data.

[26]Quarterly discount rate $\beta = 0.99$ corresponds to the 4 percent annual rate of return. This value can be considered as the sum of risk-free policy rate and the average corporate borrowing spread. For the sample period of the dataset (1997-2018), average annual fed funds rate is approximately 2 percent. Median corporate borrowing spread the period is 200 basis points (see Table 1).

[27]For most production and New Keynesian parameters, I follow Ottonello and Winberry (2020). The resulting moments: the decreasing returns to scale of 0.85 is from Winberry (2021) and the steady state labor share $\frac{\gamma-1}{\gamma}\nu = 0.58$, is in line within range of the labor share of U.S. estimated in Karabarbounis and Neiman (2014)

[28]The value is still close to 0.23 in Begenau and Salomao (2019) and 0.24 in Jeenas (2018).

Table 2

PARAMETERS

Parameter	Description	Value
	External Calibration	
β	Discount factor	0.99
θ	Capital share	0.21
ν	Labor share	0.64
δ	Depreciation rate	0.025
ϕ	Capital Adjustment Cost Coeff.	4
γ	Demand elasticity	10
φ_π	Taylor rule coefficient	1.25
φ	Price adjustment cost	90
π_D	Exogenous exit rate	0.087
	Internal Calibration	
ρ	Persistence of TFP	0.90
σ	SD of innovations to TFP	0.05
k_0	Initial capital	0.27
Φ	Operating cost	0.02
Θ	Recoverability parameter	0.71
φ	Value-to-EBITDA ratio	9

Having set the other parameters, I target the three moments regarding the firm level borrowing: *i*) shares of asset-based and cash flow-based borrowers, *ii*) mean of firm-level gross leverage ratio and *iii*) the percentage of firms having positive debt. Here note that for the third target, I choose 0.81 from Crouzet and Mehrotra (2020), not the Compustat sample from Section 2. The reason is that merged Compustat/Dealscan sample mostly consists of firms with positive debt.

The calibration strategy leads to the values presented in Table 3. The model performs well in matching the shares of asset based and cash flow based debt. Also, the model roughly matches the debt related moments: leverage ratio and firms with positive debt. In terms of investment rate moments, the model overpredicts the dispersion, since model does not include cost of capital adjustment at the firm-level. However, mean investment rate is lower than the data. The underlying reason could be in this type of models firms accumulate capital very quickly and reach their optimal scale (Ottonello and Winberry, 2020). Therefore, the model could be producing the ratio of investment to capital lower

Table 3
CALIBRATION TARGETS AND MODEL FIT

Moment	Description	Data	Model
k_0	Initial capital	0.25	0.27
$\frac{b}{k}$	Average Gross Leverage Ratio	0.42	0.47
Share (b_A)	Fraction of asset based to total debt	0.16	0.16
Share (b_C)	Fraction of cash flow based to total debt	0.84	0.84
Share $(b > 0)$	Firms with positive debt	0.81	0.63
$\mathbb{E}\left(\frac{i}{k}\right)$	Average investment rate	0.23	0.21
$\sigma\left(\frac{i}{k}\right)$	SD investment rate	0.45	0.48

than the data.

The calibrated loan recovery rate is 0.71 which is higher than 0.54 in Khan, Senga, and Thomas (2016) and Ottonello and Winberry (2020), and 0.62 in Jeenas (2018). It is because, lower values of Θ lead to underborrowing in the model economy, as in their early life, most firms are not able to borrow with cash flow based contracts. Similarly, φ value is 9, lower than 14 in Lian and Ma (2021). The reason is higher values of φ lead most cash flow based borrowers to renege on their promise to repay and run away which causes tighter borrowing constraint for cash flow based debt than the data predicts.

In terms of gross leverage ratio, the empirical moment 0.42 is higher than 0.34 as reported in Crouzet and Mehrotra (2020), since the merged dataset of Section 2 is a subgroup that consists of loan borrowers. Therefore, gross leverage ratio is higher than the Census data employed in Crouzet and Mehrotra (2020) which is obtained from the US Census Bureau's Quarterly Financial Report (QFR), a survey that collects income statements and balance sheets of manufacturing, retail, and wholesale trade firms.

About the investment rate moments, it is helpful to compare the moments with the moments of Cooper and Haltiwanger (2006) which is widely used as benchmark in the literature. Both mean and standard deviation of investment rate are higher than their Cooper and Haltiwanger (2006) counterparts (0.12 and 0.33, respectively). It is because, balanced dataset of Cooper and Haltiwanger (2006) includes large, manufacturing plants that unceasingly operate between the years 1972 and 1988. Therefore, their dataset and results are not contaminated with firm entry/exit which exists in my Compustat/DealScan dataset. Furthermore, since they only focus on large plants, their need for investment is relatively weaker compared to newly established, younger firms which are also included in my dataset. Putting together, having firm entry/exit and the existence of younger firms in the sample boosts the mean investment rate and its standard deviation.

5 Debt Contracts Heterogeneity in the Model

This section discusses the firm's contract choice in the steady state and validates that the quantitative model stays consistent with the empirical patterns observed in Section 2.3. The central thought in the analyses is to investigate how firm characteristics affect the debt contract choice in the stationary equilibrium. The analysis identifies three major factors of contract heterogeneity across firms: net worth, productivity and volatility.

Figure 3 depicts the firm's contract preferences in the state space (z, nw). Blue area and red area represent the firms adopting cash flow-based, and asset-based contracts, respectively. Note that both Panel (A) and (B) could be used for the exposition as they imply the same mechanisms, however for the sake of consistency I use Panel (A) in the discussions throughout, and employ Panel (B) only when I analyze the impact of volatility.

Before moving on to the underlying mechanisms, it is beneficial to recall how contracts are written. Perfectly foreseeing the all possible outcomes (*i.e.* whether to pay or renege), financial intermediary restricts the borrowing amount to ensure that firms repay in every state of the world next period. Naturally, the tightness of the borrowing constraints are not the same due to the state contingency. Depending on the firm's place in the state space, one of the contracts could have looser borrowing limit than the other. Then, seeing the contracts, firms choose whether to borrow with an asset-based or a cash flow-based contract.

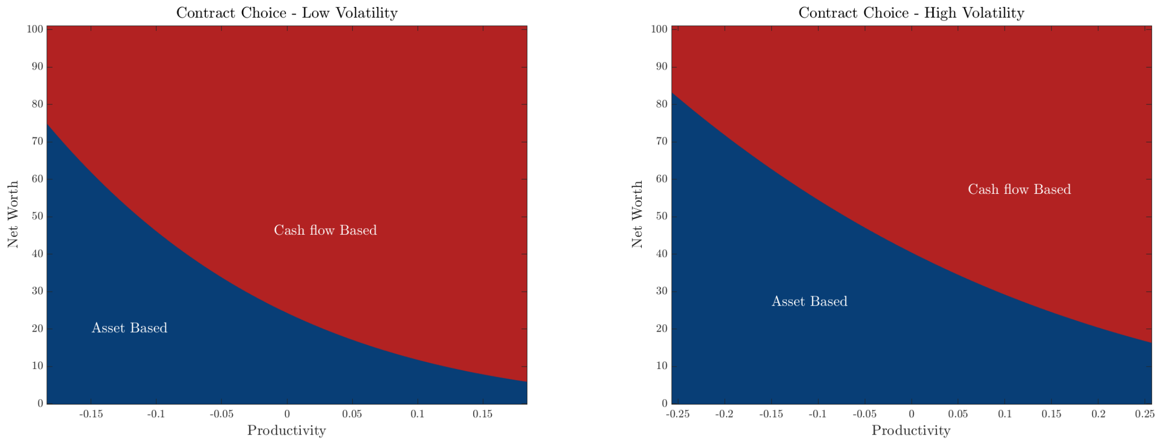
As can be seen from Figure 3, steady state analyses reveal that, in line with the empirical evidences presented in Section 2 and Lian and Ma (2021) as well, the quantitative model well captures the fact that cash flow-based borrowing is the prevalent method for most of the states.

In order to illustrate the underlying mechanisms at work producing Figure 3, it would be helpful to discuss extreme conditions. When a firm with high productivity but low net worth (i.e. bottom right of Figure 3,), financial intermediary offers the contract as follows. First the intermediary calculates the amount of penalty attached to each type of contract. By knowing that losing a portion of capital is not painful for this firm, the

Figure 3

Contract Choices

(a) Low Volatility **(b)** High Volatility



Note. This figure shows the policy function of debt contracts. High (low) volatility means the dispersion of the error term is high (low) in (7).

intermediary offers a tighter borrowing limit under asset-based contract. On the contrary, as the firm have high productivity, penalty as a multiple of its cash flow would be a more convincing threat. Therefore, the intermediary offers looser borrowing constraints with cash flow-based contract. On the other extreme, if a firm with low productivity but high net worth (*i.e.* firms at the left hand side of Figure 3) applies for a loan, in this case the intermediary knows that losing a portion of its capital stock would be more painful then losing a multiple of its cash flow, as the firm's ability of generating cash flow -productivity- is low. Therefore, the intermediary tighten the borrowing constraint under cash flow-based contracts and makes the firms with similar conditions to sign asset based contracts. These findings are in line with the empirical patterns presented in Section 2.3, as more profitable firms mostly choose cash flow-based contracts.

The last factor investigated is the volatility. Volatility is defined as the dispersion of idiosyncratic productivity shock distribution and governed by σ in (7). The experiment is increasing the σ value by 10%, and compare the policy functions of the debt contracts. Compared to Panel (A), firms prefer asset-based debt contracts in more states. Again, here the underlying mechanism originates from financial intermediary. Since the intermediary writes contracts to ensure that firms repay their debt in every state of the next period, when volatility increases, the lowest realization(s) of the idiosyncratic productivity shock becomes crucial. It is due to the fact that as the dispersion of the shock distribution increases, the left tail of the distribution goes to further left yielding lower outcomes than low volatility case. In this case, firms are more likely to fail repayment, as their income would not be enough the cover the debt. Therefore expecting an increase in the firm's likelihood of reneging from its promise of payment, the intermediary tighten the borrowing constraints for both contracts, but even tighter for cash flow-based contracts as their borrowing limit is a direct function of productivity. This steer more firms to sign asset based contracts and as we see asset based contracts constitute larger area in Panel (B).

6 Quantitative Monetary Policy Analysis

In this section, I analyze the response of the model economy to a one-time unexpected contractionary monetary policy shock. The quantitative model is designed to validate the proposed asset price channel on the monetary policy transmission while staying consistent with the empirical responses presented in Section 2. The layout of this section as follows. Section 6.1 presents the computed the aggregate impulse responses of key variables to a contractionary monetary policy shock. Section 6.2 depicts the heterogeneous sensitivity of monetary policy by focusing on their debt contracts. The results are in line with the empirical evidences from Section 2, as firms with asset based debt contracts are more responsive to monetary policy. To show the relevance of proposed asset price channel, Section 6.3 presents the results of an alternative scenario in which there is no capital adjustment and thus price of capital is not time varying. Consistent with the suggested mechanism, when the capital channel is shut down, the responsiveness of asset based borrowers are substantially reduced compared to cash flow based borrowers. Finally, Section 6.4 discusses the aggregate implications of the debt contract heterogeneity and argues that strength of financial accelerator mechanism depends on the share of asset based borrowers in the economy.

6.1 Aggregate Responses to Monetary Policy

The aggregate responses of some selected variables to a contractionary monetary policy shock are shown in Figure 4. First row presents the responses of nominal interest rate, rate of inflation and the implied changes in the real interest rate. In response to a contractionary, one time innovation to the Taylor rule, nominal interest rate increases. Second figure shows that the innovation lowers inflation by cooling down the economy. As shown by the third figure on the first row, an increase in the nominal interest rate pass through real interest rate. Since, due to staggered pricing mechanism, prices cannot adapt immediately to the nominal changes.

Second row in Figure 4 reports the effects of a contractionary monetary policy shock on consumption, investment, and output. Higher real interest rate cools down the economy, as it depresses consumption and investment, and thus output and inflation.[29] Moreover, model's impulse responses are in line with the literature. Response of consumption is milder than output, due to the consumption smoothing motive of households and investment appears as the most volatile element. Furthermore, the magnitude of model's impulse responses are consistent with the peak impulse responses to monetary policy shocks estimated in Christiano et al. (2005) and those computed with the heterogeneous quantitative models in Kaplan et al. (2018) and Ottonello and Winberry (2020).

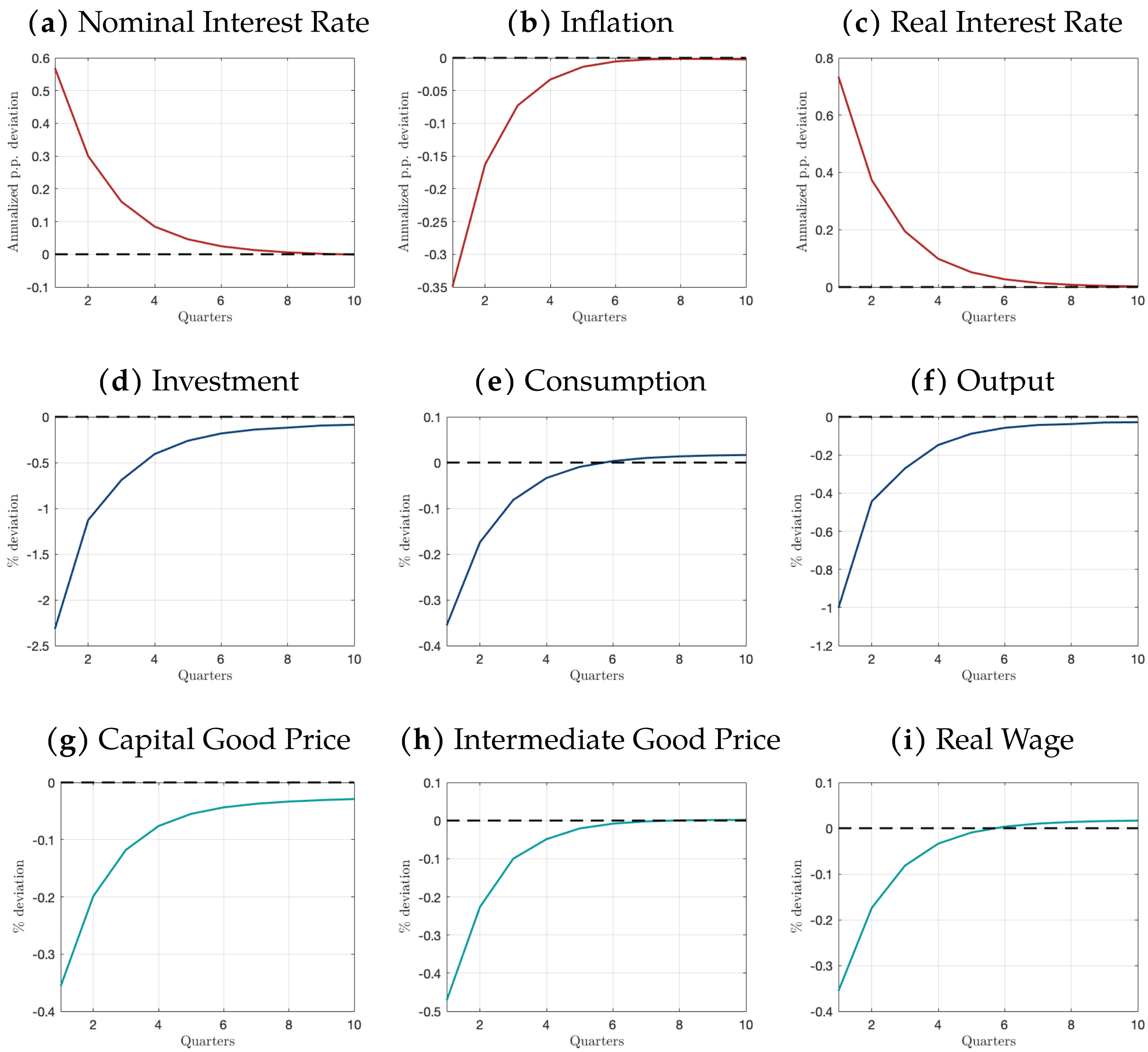
The third row depicts the impulse responses of prices in the economy. First figure shows the impulse response of capital price. Note that a contractionary monetary policy shock mitigates investment demand. In the presence of capital adjustment costs, this implies that the marginal cost of capital declines. As can be seen from the second and third figures, lower aggregate demand for goods (whether it comes from consumption and investment) reduces other prices in the economy such as intermediate good prices and real wages.

Here it is helpful to discuss the lack of hump shaped responses as opposed to the estimations in the typical New Keynesian literature (Christiano et al., 2005; Smets and Wouters, 2007). Such hump shapes in investment and consumption would require some impedance mechanisms. For instance, habit formation is widely used in the literature to produce hump shaped response of consumption. Further, one could produce hump shaped investment response by formulating costly adjustment as a function of investment rather than capital. The main reason behind excluding these extensions is that the quantitative section of this paper focuses on the role of capital price movements on the borrowing constraints and investment. If these extensions had been included, the underlying mechanisms would had been entangled with collateral channel of monetary policy transmission, and it would be very difficult to isolate the collateral channel.

In the next section, I decompose the total effect of the monetary shock on aggregate investment and borrowing. To do so, through the lens of methodology developed in Section 2, I compute the impulse responses of these aggregate variables among asset based and cash flow based borrowing firms.

[29]Here note that in Kaplan et al. (2018), major part of the response to monetary policy shock originates from indirect channels. However, since heterogeneous household is beyond the scope of this paper, the model relies on the conventional intertemporal substitution channel.

Figure 4
Aggregate Impulse Responses



Note. This figure shows the average impulse response functions for the spread following a 25 bps increase in 3-month T-bill rate. The responses are classified into asset-based and cash flow-based borrowers and estimated with the local projection specification given by (5). Monetary policy shock is interacted with indicator variable based on the firm borrowing status. The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

6.2 Heterogeneous Responses to Monetary Policy

This section presents the estimation results on firms' heterogeneous responses to the monetary policy shock experiment in the model. In order to observe the model's internal dynamics while keeping the comparability to the empirical pattern of Section 2, I estimate variants of empirical specification (5) on the simulated data. Regressions yield β_1^h and β_2^h which are the impulse response to a contractionary monetary shock. More details about the simulated data and estimation procedure can be found in Appendix **??**. To prevent the contamination from the firm initial distribution assumption, I only take into account the firms surviving at least 28 quarters.[30] Similar to (5), firm level controls include firm size (k), age and leverage (b), while the macro controls are excluded here and instead time fixed effect is employed.[31]

I compare the model output and the data by focusing on the interaction coefficient of indicator variable $\mathcal{I}_{t-1}^{Asset}$ and the monetary shock ϵ_t^m. Dependent variables of interest are firm level investment and borrowing. The estimation horizon is 8 quarters.[32] I present the model impulse responses as the point estimates of the interaction coefficient β_x^h along with their 90% error bands.

Investment and Borrowing Response The relative impulse responses for investment and borrowing, captured by the coefficient β_x^h are reported in Figure 5, in Panel (A) and Panel (B), respectively.

Panel (A) depicts that after a contractionary monetary policy shock, asset based borrowers decrease their investment relatively more than cash flow based borrowers. Panel (B) shows that a similar pattern holds for firm borrowing. The differential impulse response is significant which means asset based borrowers cut back on borrowing by considerably more compared to cash flow based borrowers.

Compositional Changes Following a similar approach to the Section 2, it is worth controlling a potential concern about firm's grouping that is about endogenous changes in group composition. Specifically, a firm may change its contract type when it faces a con-

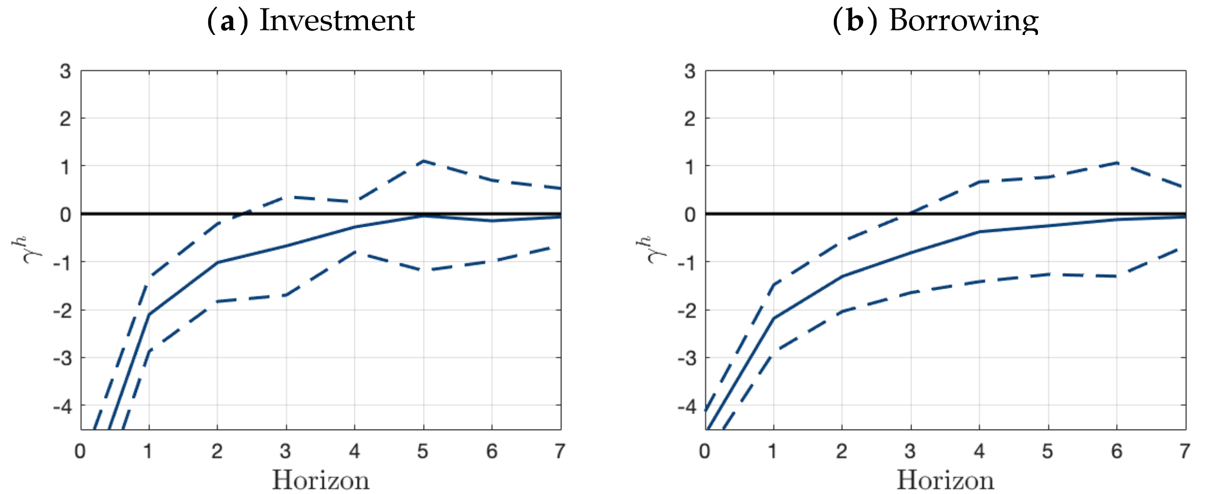
[30] Excluding the earlier periods of firms is a common practice in the literature (Ottonello and Winberry, 2020). Model's results are robust to the cutoff choice.

[31] Here note that (5) also includes current assets ratio and Tobin's Q as firm level controls, but excluded here since these two variables are beyond the scope of the model.

[32] The horizon of the impulse responses on the simulated data is shorter than the actual data. It is because model does not feature aggregate impedance mechanisms to generate sluggish response of variables. Therefore, the impact of the shock survive at shorter horizons compared to the data and thus running the regressions at longer horizons is unnecessary.

Figure 5

Differential Impulse Responses: Investment and Borrowing



Note. This figure shows the average impulse response functions for the spread following a 25 bps increase in 3-month T-bill rate. The responses are classified into asset-based and cash flow-based borrowers and estimated with the local projection specification given by (5). Monetary policy shock is interacted with indicator variable based on the firm borrowing status. The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

tractionary monetary policy shock. The relevance of switching response is twofold. First, if there are too many switchers in the wake of a monetary shock, then it doesn't make sense to investigate the response of borrowing and investment between these subgroups. Second, if there are now switchers at all, then modeling the economy with heterogeneous firms is unnecessary and it would be enough to set an exogenous fraction of asset based and cash flow based borrowers in order to observe their behavioral differences.

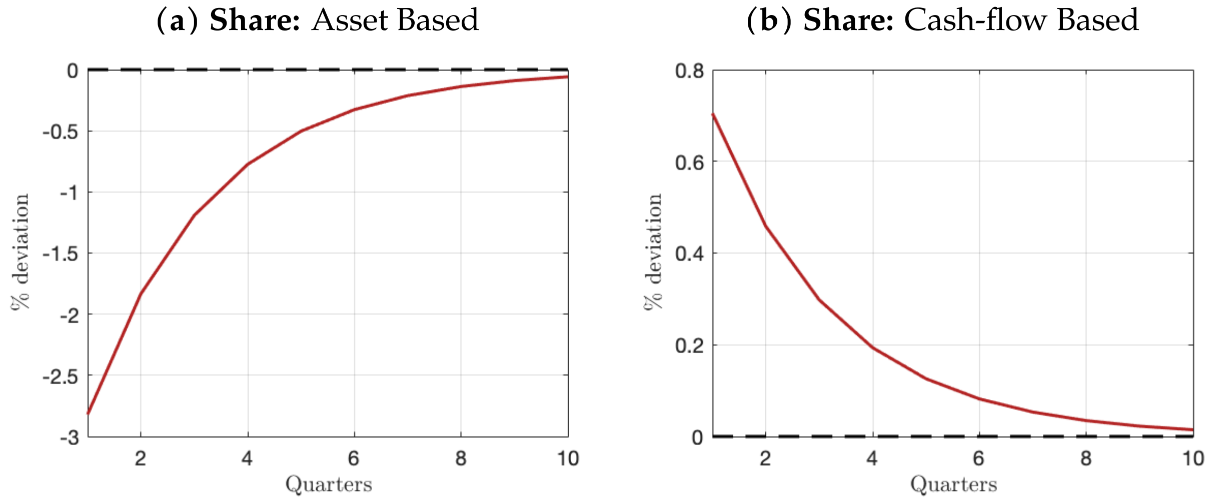
Figure 6 shows that indeed, firms respond to a contractionary monetary policy shock by switching from asset based contracts to cash flow based contracts. Therefore, it is evident that quantitative model needs heterogeneous firm structure. This finding about switching supports the main idea of paper that is asset based borrowers affected more than cash flow based borrowers. The magnitudes of compositional changes explain another aspect. If there had not been limited commitment, then we would have seen a much larger switch, but through the limited commitment mechanism, asset based borrowers only switch to cash flow based debt contracts if they are able to do so. Here note that as the model does not include portfolio adjustment costs to generate dampened dynamics, the responses are larger than their empirical counterparts (3% in quantitative model vs 1.2% in the data).

As a bottom line, Figure 5 shows that asset based borrowers are affected from an un-

Figure 6

Impulse Responses: Shares

Asset-based vs. Cash flow-based



Note. This figure shows the average impulse response functions for the spread following a 25 bps increase in 3-month T-bill rate. The responses are classified into asset-based and cash flow-based borrowers and estimated with the local projection specification given by (5). Monetary policy shock is interacted with indicator variable based on the firm borrowing status. The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

expected interest rate increase more than cash flow based borrowers. The compositional change also favors the cash flow based debt contracts. These responses resemble with their empirical counterparts and suggest that quantitative model well captures the empirical patterns.

At this point, it is worth repeating the main mechanism in mind. The firms issuing new debt with asset based contract have to rely on their capital stock to serve as collateral. Therefore, by reducing the capital price, contractionary monetary policy shocks tighten the borrowing constraint for these firms and force them to cut back borrowing and investment. Whereas the firms with cash flow based debt contracts do not have capital price in their borrowing constraint formulations, therefore are not affected from the decreasing values of capital price. I assess the relevance of this capital price channel in the next section by switching it off and compare the differential responses.

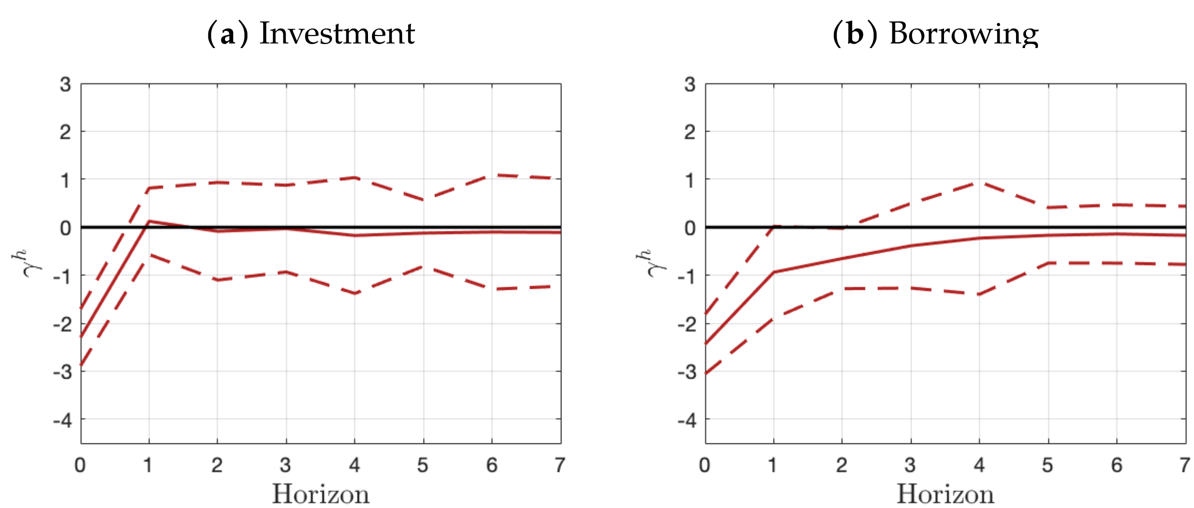
6.3 Heterogeneous Responses to Monetary Policy in the Absence of Capital Price Movements

In this section, I demonstrate why asset based borrowers exhibit relatively more sensitivity to a contractionary monetary shock. The results emphasize that a conventional framework with borrowing constraints (Kiyotaki and Moore, 1997; Bernanke et al., 1999; Khan and Thomas, 2013) cannot capture the crucial features of the findings presented in Section 2. Indeed, since the paper's hypothesis is the capital price responsiveness, incorporating two types of debt (one focused on the collateral value while the other cash flow) is necessary to be able to capture the empirical patterns.

In order to show the impact of capital price movements on the monetary policy transmission, I compare the impulse responses with and without capital price movements. To shut off the capital price movements, in (18) I set the convex adjustment cost parameter $\phi = \text{Inf}$, which yields flexible capital adjustment and time-invariant capital price, $q = 1$. Therefore, collateral constraint of asset based borrowers are now not affected by extra response of capital price to a monetary shock.

Figure 7

Impulse Responses without Capital Price Movements: Investment and Borrowing



Note. This figure shows the average impulse response functions for the spread following a 25 bps increase in 3-month T-bill rate. The responses are classified into asset-based and cash flow-based borrowers and estimated with the local projection specification given by (5). Monetary policy shock is interacted with indicator variable based on the firm borrowing status. The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

There are two possible scenarios. First, to the extent that another factor (rather than asset price channel) is the fundamental driver of the heterogeneous responses of investment and borrowing in Section 2, there should be no difference between the results obtained in this section and Section 6.2. Second, if the asset price channel is the key feature behind observing the heterogeneous responses, then the differential responses should be close to zero and insignificant. Figure 7 shows that it is the latter scenario that prevails. Indeed, when I shut down the asset price channel, differential responses of investment and borrowing are dampened. Here note that the ideal response would be the elimination of differential responses. However, in the model, capital price is strongly tied to investment demand and supply, therefore any change in the capital price mechanism also affects cash flow based borrowers through the indirect channel. Therefore, to eliminate differential responses require loosening the connection between capital price and investment, and possibly alternative borrowing mechanisms. Although these are interesting extensions to incorporate, they are beyond the scope of this quantitative model of which main purpose is to demonstrate that capital price channel is the the main driver of the heterogeneous responses to monetary policy.

As a bottom line, this experiment supports the idea that change in asset prices is the key trait associated with a larger response of asset based borrowers. This is in line with the main mechanism that borrowing constraints tighten for financially constrained firms whose borrowing is secured against the value of their collateral.

6.4 Aggregate Implications

In the previous parts of this section, I have shown that by incorporating coexistence of asset based and cash flow based borrowing contracts to an otherwise conventional heterogeneous firm New Keynesian framework, I rationalize the empirical findings of Section 2. That is, firms with asset based borrowing contracts exhibit larger response of investment and borrowing following an unexpected change in interest rates. In the following, I discuss the implications of two types of debt contracts from the macro perspective by focusing on the financial accelerator mechanism.

Implications for Financial Accelerator A broad literature have investigated the roles of firm balance sheets and their interplay with financial frictions in amplifying the effects of monetary policy. The key trait in these papers is that the response of asset prices trigger a reinforcing channel on the monetary policy transmission. However, this mechanism relies on borrowing constraints (Kiyotaki and Moore, 1997) or equity values (Bernanke et al., 1999) have to be a function of liquidation value of physical assets. The introduction of cash flow based borrowing constraints to an otherwise conventional macrofinance model exhibits that asset price feedback through firms' borrowing constraints is weakened.

As the traditional collateral value channel of financial accelerator mechanism is valid only for asset based borrowers, since in the cash flow based contracts borrowing limits depend on the cash flow which is not directly tied to the liquidation value of capital. One can state that strength of financial accelerator depends on the share of asset based borrowers. Given that majority of firms borrow using cash flow based debt contracts, the effectiveness of financial accelerator mechanism may be overstated in the macrofinance models with traditional collateral constraints.

Implications for Misallocation As empirical results in Section 2 shows mostly younger and smaller firms use asset based contracts. Therefore, the empirical results and the quantitative model imply that asset-based borrowers with high marginal products of capital does not have enough room to borrow more, since they lack enough collateral. Therefore, financial frictions prevent firms with high marginal products of capital to access external funds and thus cause misallocation. Higher misallocation impairs capital accumulation and leading to less output and aggregate productivity than optimal. Similarly, using a model with size dependent collateral constraints Gopinath, Kalemli-Özcan, Karabarbounis, and Villegas-Sanchez (2017) show that the underlying reason of declining total factor productivity is the misallocation of capital. Gopinath et al. (2017) also shows that -based on firm level data- capital flows toward firms with higher net worth are not necessarily more productive.

Implications for Quantitative Easing Programs Quantitative easing (QE) involves purchasing securities from the open market to reduce longer term interest rates. These securities include government and corporate bonds. The overall increase in demand for these bonds tends to drive up their price. The higher bond prices feed through to higher asset prices in general. Higher asset prices in the economy means higher collateral which translates into looser borrowing constraints for asset-based borrowers. Given that asset-based borrowing firms most of the time affected more from the aggregate fluctuations, QE programs directly lift up the financial situation of these fragile firms.

7 Conclusion

In this paper I investigate the role of debt contracts and their interactions with financial frictions on the transmission of monetary policy to firm-level investment. On the empirical side, by employing loan level credit information, firm-level balance sheet data, and stock return data, first I show that firms with more pledgeable assets, and high stock beta tend to sign asset based debt agreements, while more profitable firms with high Jensen's alpha usually opt for cash flow based debt contracts. Second I show that following a contractionary monetary policy shock, firms with asset based borrowing contracts cut their investment and borrowing significantly less than firms with cash flow based debt contracts. To interpret the results about why firms choose one contract over the the other, and to understand the channels driving the heterogeneous sensitivity to monetary policy shocks, I setup a heterogeneous firm macrofinance model. Model is able to explain the cross sectional heterogeneity on firm's contract type choice through state contingent borrowing limits. The quantitative results suggests that the traditional collateral channel through asset prices causes this heterogeneous sensitivity as the cash flow based borrowers are less vulnerable. Results suggest that severity of financial frictions depends on the debt contract type, and also shapes the monetary policy transmission.

The results of this paper is of crucial interest to monetary policy makers as these results contribute to the understanding about how monetary policy transmits to firm investment and borrowing. Furthermore, long-term economic growth requires a regular rate of business openings and closings because it promotes the emergence of new, productive ideas. However, my results show that, while cooling down the economy via increasing rates, through the financial accelerator mechanism, contractionary policy will asymmetrically harm the asset based borrowing firms which are already fragile. Given that asset-based borrowers are mostly young and small firms, this would be detrimental to business dynamism. My results imply that there is a room for fiscal policy intervention to asset-based borrowing firms, while conducting the monetary policy to fulfill its mandate of keeping inflation steady.

References

Albuquerque, R. and H. A. Hopenhayn (2004). Optimal lending contracts and firm dynamics. *The Review of Economic Studies 71*(2), 285–315.

Altınkılıç, O. and R. S. Hansen (2000). Are there economies of scale in underwriting fees? evidence of rising external financing costs. *The Review of Financial Studies 13*(1), 191–218.

Anderson, G. and A. Cesa-Bianchi (2020). Crossing the credit channel: credit spreads and firm heterogeneity.

Bahaj, S., G. Pinter, A. Foulis, and P. Surico (2019). Employment and the collateral channel of monetary policy.

Bazdresch, S. (2013). The role of non-convex costs in firms' investment and financial dynamics. *Journal of Economic Dynamics and Control 37*(5), 929–950.

Begenau, J. and J. Salomao (2019). Firm financing over the business cycle. *The Review of Financial Studies 32*(4), 1235–1274.

Benmelech, E. and N. K. Bergman (2009). Collateral pricing. *Journal of financial Economics 91*(3), 339–360.

Benmelech, E. and N. K. Bergman (2011). Bankruptcy and the collateral channel. *The Journal of Finance 66*(2), 337–378.

Bernanke, B. S., M. G. Gertler, and S. Gilchrist (1999). The financial accelerator in a quantitative business cycle framework. *The Handbook of Macroeconomics 1*, 1342–1385.

Bernanke, B. S. and K. N. Kuttner (2005). What explains the stock market's reaction to federal reserve policy? *The Journal of finance 60*(3), 1221–1257.

Biais, B., T. Mariotti, G. Plantin, and J.-C. Rochet (2007). Dynamic security design: Convergence to continuous time and asset pricing implications. *The Review of Economic Studies 74*(2), 345–390.

Billett, M. T., T.-H. D. King, and D. C. Mauer (2007). Growth opportunities and the choice of leverage, debt maturity, and covenants. *the Journal of Finance 62*(2), 697–730.

Cao, D., G. Lorenzoni, and K. Walentin (2019). Financial frictions, investment, and tobin'sq. *Journal of Monetary Economics 103*, 105–122.

Chaney, T., D. Sraer, and D. Thesmar (2012). The collateral channel: How real estate shocks affect corporate investment. *American Economic Review 102*(6), 2381–2409.

Chava, S. and M. R. Roberts (2008). How does financing impact investment? the role of debt covenants. *The journal of finance 63*(5), 2085–2121.

Chodorow-Reich, G. and A. Falato (2017). The loan covenant channel: How bank health transmits to the real economy. Technical report, National Bureau of Economic Research.

Christiano, L. J., M. Eichenbaum, and C. L. Evans (2005). Nominal rigidities and the dynamic effects of a shock to monetary policy. *Journal of political Economy 113*(1), 1–45.

Cloyne, J., C. Ferreira, M. Froemel, and P. Surico (2018). Monetary policy, corporate finance and investment. Technical report, National Bureau of Economic Research.

Cochrane, J. H. and M. Piazzesi (2002). The fed and interest rates-a high-frequency identification. *American economic review 92*(2), 90–95.

Cook, T. and T. Hahn (1989). The effect of changes in the federal funds rate target on market interest rates in the 1970s. *Journal of monetary economics 24*(3), 331–351.

Cooley, T., R. Marimon, and V. Quadrini (2004). Aggregate consequences of limited contract enforceability. *Journal of political Economy 112*(4), 817–847.

Cooper, R. W. and J. C. Haltiwanger (2006). On the nature of capital adjustment costs. *The Review of Economic Studies 73*(3), 611–633.

Crouzet, N. and N. R. Mehrotra (2020). Small and large firms over the business cycle. *American Economic Review 110*(11), 3549–3601.

DeMarzo, P. M., M. J. Fishman, Z. He, and N. Wang (2012). Dynamic agency and the q theory of investment. *The Journal of Finance 67*(6), 2295–2340.

Dinlersoz, E., S. Kalemli-Ozcan, H. Hyatt, and V. Penciakova (2018). Leverage over the life cycle and implications for firm growth and shock responsiveness. Technical report, National Bureau of Economic Research.

Drechsel, T. (2018). Earnings-based borrowing constraints and macroeconomic fluctuations. Technical report, Job Market Papers.

Farre-Mensa, J. and A. Ljungqvist (2016). Do measures of financial constraints measure financial constraints? *The review of financial studies 29*(2), 271–308.

Gertler, M. and S. Gilchrist (1994). Monetary policy, business cycles, and the behavior of small manufacturing firms. *The Quarterly Journal of Economics 109*(2), 309–340.

Gertler, M. and P. Karadi (2015). Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics 7*(1), 44–76.

Giglio, S. and T. Severo (2012). Intangible capital, relative asset shortages and bubbles. *Journal of Monetary Economics 59*(3), 303–317.

Gopinath, G., Ş. Kalemli-Özcan, L. Karabarbounis, and C. Villegas-Sanchez (2017). Capital allocation and productivity in south europe. *The Quarterly Journal of Economics 132*(4), 1915–1967.

Gorodnichenko, Y. and M. Weber (2016). Are sticky prices costly? evidence from the stock market. *American Economic Review 106*(1), 165–99.

Greenwald, D. (2019). Firm debt covenants and the macroeconomy: The interest coverage channel. *Manuscript, July*.

Gürkaynak, R. S., B. Sack, and E. Swanson (2005). The sensitivity of long-term interest rates to economic news: Evidence and implications for macroeconomic models. *American economic review 95*(1), 425–436.

Holmstrom, B. and J. Tirole (1997). Financial intermediation, loanable funds, and the real sector. *the Quarterly Journal of economics 112*(3), 663–691.

Jarociński, M. and P. Karadi (2020). Deconstructing monetary policy surprises—the role of information shocks. *American Economic Journal: Macroeconomics 12*(2), 1–43.

Jeenas, P. (2018). Firm balance sheet liquidity, monetary policy shocks, and investment dynamics. In *Technical Report*. Working paper.

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American economic review 95*(1), 161–182.

Kahan, M. and B. Tuckman (1993). Private vs. public lending: Evidence from covenants.

Kaplan, G., B. Moll, and G. L. Violante (2018). Monetary policy according to hank. *American Economic Review 108*(3), 697–743.

Karabarbounis, L. and B. Neiman (2014). The global decline of the labor share. *The Quarterly journal of economics 129*(1), 61–103.

Kermani, A. and Y. Ma (2020). Two tales of debt. Technical report, National Bureau of Economic Research.

Khan, A., T. Senga, and J. K. Thomas (2016). Default risk and aggregate fluctuations in an economy with production heterogeneity. *Working Paper*.

Khan, A. and J. K. Thomas (2013). Credit shocks and aggregate fluctuations in an economy with production heterogeneity. *Journal of Political Economy 121*(6), 1055–1107.

Kiyotaki, N. and J. Moore (1997). Credit cycles. *Journal of political economy 105*(2), 211–248.

Kuttner, K. N. (2001). Monetary policy surprises and interest rates: Evidence from the fed funds futures market. *Journal of monetary economics 47*(3), 523–544.

Lian, C. and Y. Ma (2021). Anatomy of corporate borrowing constraints. *The Quarterly Journal of Economics 136*(1), 229–291.

Miranda-Agrippino, S. and G. Ricco (2018). The transmission of monetary policy shocks.

Mongey, S. and J. Williams (2017). Firm dispersion and business cycles: Estimating aggregate shocks using panel data. *Manuscript, New York University*.

Nakamura, E. and J. Steinsson (2018). High-frequency identification of monetary non-neutrality: the information effect. *The Quarterly Journal of Economics 133*(3), 1283–1330.

Nini, G., D. C. Smith, and A. Sufi (2009). Creditor control rights and firm investment policy. *Journal of Financial Economics 92*(3), 400–420.

Nini, G., D. C. Smith, and A. Sufi (2012). Creditor control rights, corporate governance, and firm value. *The Review of Financial Studies 25*(6), 1713–1761.

Ottonello, P. and T. Winberry (2020). Financial heterogeneity and the investment channel of monetary policy. *Econometrica 88*(6), 2473–2502.

Pulvino, T. C. (1998). Do asset fire sales exist? an empirical investigation of commercial aircraft transactions. *The Journal of Finance 53*(3), 939–978.

Rajan, R. G. and L. Zingales (1998). Financial dependence and growth. *American Economic Review*, 559–586.

Roberts, M. R. and A. Sufi (2009a). Control rights and capital structure: An empirical investigation. *The Journal of Finance 64*(4), 1657–1695.

Roberts, M. R. and A. Sufi (2009b). Renegotiation of financial contracts: Evidence from private credit agreements. *Journal of Financial Economics 93*(2), 159–184.

Smets, F. and R. Wouters (2007). Shocks and frictions in us business cycles: A bayesian dsge approach. *American economic review 97*(3), 586–606.

Stiglitz, J. E. and A. Weiss (1981). Credit rationing in markets with imperfect information. *The American economic review 71*(3), 393–410.

Verde, M. (1999). Loan preserve: The value of covenants, fitch ibca loan products special report.

Winberry, T. (2021). Lumpy investment, business cycles, and stimulus policy. *American Economic Review 111*(1), 364–96.

Online Appendix
"Debt Contracts, Investment, and Monetary Policy"
by Özgen Öztürk

A Data Appendix

In this section, I elaborate the steps taken in data process. Section A.1, A.2, and A.3 discusses the selection/construction of the variables of interest from Compustat, DealScan, and CRSP datasets, respectively. Section A.4 details the merging procedure of the datasets: Compustat, DealScan, and CRSP. Data appendix continues with the discussion of macro variables, as Section A.5 presents each macro time series utilized in the analyses, and Section A.6 elaborates the sources of the identified monetary policy shocks. Figure A.1 shows the comprehensive picture of the finalized data set.

A.1 Firm-level Data

This subsection describes the firm-level, quarterly Compustat variables used in the empirical exercises of the paper. The variable definitions and their implied role in the analyses along with the sample selection procedure closely follow standard practices in the literature (Cloyne et al., 2018; Jeenas, 2018; Ottonello and Winberry, 2020). Briefly, if a variable is defined as a ratio, it is directly used as they are in Compustat. However, if the variable is in levels, then it is deflated by the aggregate GVA deflator. Some Compustat variables are reported from the source as cumulative within the firm's fiscal year. To convert these variables to quarterly series, I take the first difference of these variables within each fiscal year. Furthermore, if there is only one missing observation in the data series, I estimate it by linear interpolation, however, if there is more than one missing variable in the consecutive periods, then no data imputation is involved. All Compustat variables are deseasonalized by regressing them on quarter-dummies, and using the residuals in the actual exercises. Table A.1 briefly presents the variable definitions and corresponding Compustat variable codes, but below I present further details about these variables.

Investment. Following the literature which works with Compustat data (Mongey and Williams, 2017; Jeenas, 2018; Ottonello and Winberry, 2020), I employ perpetual inventory method to calculate the investment variable which is defined as $\Delta \log(k_{j,t+1})$. Due to being sparsely populated, level of gross plant, property, and equipment (`PPEGTQ`) cannot be used directly. Instead for each firm, I track the earliest observation of PPEGTQ in Compustat and record it as the first value of $k_{j,t+1}$. Then, by consecutively adding the changes of net plant, property, and equipment (PPENTQ) in each period, I obtain the series $k_{j,t+1}$. Note that the variable is PPENTQ is well populated and reported (from the source) as the net of depreciation. However, if a firm has only one missing observation of PPENTQ, I estimate that missing observation by linear interpolation. If there are more than one missing observation in the consecutive periods, I do not impute the values

Leverage. I measure leverage as the ratio of total debt (DLCQ and DLTTQ) to total assets (ATQ).

Size. I define size as the log of total real assets (ATQ), deflated by the aggregate GVA deflator.

Liquidity. I measure liquidty as the ratio of cash and short-term investments (CHEQ) to total assets (ATQ).

Cash flow. I define cash flow as EBITDA OIBDPQ deflated by the aggregate GVA deflator.

Dividend. I calculate dividend DVQ by taking the first difference of DVY within the firm's own fiscal year. Then deflate resulting DVQ by the aggregate GVA deflator.

Cash receipts. Following Lian and Ma (2021), cash receipt is defined as the ratio of the sum of cash flows from operations (OANCFQ) plus interest and related expenses (XINTQ) to the firm size (ATQ). Here, I calculate the cash flows from operation (OANCFQ), by taking the first difference of OANCFY within the firm's own fiscal year.

Tobin's Q. Following Cloyne et al. (2018), I define Tobin's Q as the ratio of total assets at market value to the total assets. Here market value is calculated as the sum of total assets (ATQ), market value of common shares outstanding (PRCCQxCSHOQ), and deferred taxes and investment tax credit (TXDITCQ) less common equity (CEQQ)[33].

[33] CSHOQ is recorded (at the source) as the actual number of shares and PRCCQ is the acutal level of share price, and therefore both variables are adjusted for stock splits. See Section A.3 for further details about the retroactive adjustment procedure.

Collateral. Following Dinlersoz et al. (2018) and Cloyne et al. (2018), collateral is defined as the ratio of the sum of net property, plant and equipment (PPENTQ), inventory (INVTQ), and receiables (RECTQ) to the total assets (ATQ).

Asset pledgeability. Following Dinlersoz et al. (2018), I define asset pledgeability as the ratio of collateralizable assets to the total assets.

Profitability. Following Dinlersoz et al. (2018), I define profitability as the ratio of net income (NIQ) to the total assets (ATQ).

Table A.1
COMPUSTAT VARIABLE DEFINITIONS

Variable	COMPUSTAT
Total Assets (Book Value)	ATQ
Long-term Debt (Book Value)	DLTTQ
Total Debt (Book Value)	DLCQ + DLTTQ
Leverage (Book Value)	(DLCQ + DLTTQ) / ATQ
Liquidity Ratio (Book Value)	CHEQ / ATQ
EBITDA	OIBDPQ
Interest and Related Expenses	XINTQ
Rent Expense	XRENT
Dividends	D.DVY (within year)
Acquisitions	AQCY / ATQ
Tobin's Q	(ATQ + PRCCQ x CSHOQ - CEQQ +TXDITCQ) / ATQ
Collateral (Book Value, Annual)	PPENT + INVT + RECT
Operating Cash Flow	D.OANCFY (within year)
Cash Receipts	(OANCFQ + XINTQ) / AT

Sample Selection. Before cleansing the data with the given sample selection procedure, following Ottonello and Winberry (2020), I winsorize observations at the top and bottom 0.5% of the distribution to prevent outliers contaminating the results. Then, I impose a set of sample restrictions:

1. Firms not incorporated in the United States are excluded.

2. Firms in the finance, insurance, real estate (FIRE) and public sectors are excluded.

3. Firm-quarter observations with below conditions are dropped.

- Negative capital or assets
- Acquisitions (constructed based on aqcy, item 94) larger than 5% of assets.
- Investment rate is in the top and bottom 0.5% of the distribution.
- Investment spell is shorter than 40 quarters.
- Net current assets as a share of total assets higher than 10 or below -10.
- Leverage higher than 10 or negative.
- Quarterly real sales growth above 1 or below -1.
- Negative sales or liquidity

WorldScope Following Cloyne et al. (2018), I construct firm age in two steps. First, I use the incorporation date from WorldScope (`INCORPDAT`), and second I check the firm's first appeareance in Compustat. Firm age is calculated by taking the earlier one between WorldScope variable and Compustat first appearance.

Furthermore, the regional dummy used in the analyses in Section B.2 is constructed by using the corresponding ZIP code variable in WorldScope.

A.2 Loan-level Data

DealScan is a detailed loan-level database. The unit observation is loan facility. Although the dataset presents information on many other aspects of the loan, in this paper I use the following variables: contract type, start date, end date, covenant type, amount, spread, and maturity. Since, this paper focuses on the firm-quarter observations, before merging DealScan with Compustat, there has to be two aggregation layers involved in the dataset. First layer is package level. Lenders may choose to bundle the loan facilities into one package or create new packages depending on the characteristics of the loan facilities. Therefore, for a given quarter, a firm may have multiple packages and each of these packages may include multiple loan facilities. Following Chava and Roberts (2008), covenant info is aggregated to firm level as follows. As covenants -most of the time- apply to all loan facilities in a package, life of the package starts with the loan with the earliest start date within the package and ends with the ending date of the most recent loan. Related, each of the loan packages firm have could be tied to a different covenant. Following Chava and Roberts (2008) and Nini et al. (2012) it is assumed that for a given quarter, tightness of these covenants are similar. Therefore, while parallel packages may have different debt covenants, such as debt-to-EBITDA, net worth, or interest payment, since the most pertinent to the analysis is the debt-to-EBITDA covenants, among multiple covenants I consider "Max. Debt-to-EBITDA" covenant.

DealScan is a wide format database. Therefore, each row in the dataset denotes a loan facility with information such as start/end date, amount, spread, maturity etc. cross section with different origination dates. Following Chava and Roberts (2008), I transform the dataset into long format with quarterly frequency (not annual). It is because firms are subject to due diligence 4 times a year and have to show their compliance with financial covenants by reporting their balance sheet/income statement details. Therefore, the it is logical to assume that restrictions apply at a quarterly frequency.

Classification. First step of categorization is the determining whether a loan is asset based or cash flow based (or neither). To do so:

- A loan is classified as asset based if
  - Backed by specific physical and other separable assets including equipment, inventory, receivable etc.
  - Specify a *"borrowing base"*,
  - Explicit statements in the notes
- A loan is classified as cash flow based
  - Backed by borrowers' **"all assets"** or **"cash and cash equivalents"**
  - Explicit statement about a lien on the entire corporate entity,
  - Entails financial covenants based on cash flow, mostly **"Max. Debt-to-EBITDA"**,

Second step is determining whether the active borrowing constraint is asset based or cash flow based for a given quarter. Following the corporate finance literature, the key feature is that terms of asset based contracts being loan specific, while the terms of cash flow based contracts are usually blanket liens. Namely, the borrowing constraint is defined as asset based ***iff*** all the packages include asset based contracts exclusively. However, it is enough to have only one cash flow-based contract to define the borrowing constraint as cash flow-based.

Sample Selection. Since the variable about financial covenants was sparsely populated before 1997, sample period starts with 1997 Q1. The ending of the sample period is restricted by the Chava-Roberts link file which is 2017 Q3.

A.3 Security-level Data

The Center for Research in Security Prices (CRSP) is the detailed security level dataset which is widely used in the literature. I use the variables S&P Domestic long term issuer Credit rating (SPLTICRM), stock price variable (PRC), Cumulative Factor to Adjust Prices (CFACPR), and S&P return (SPRTRN). Price variables of interest in CRSP (PRC) and Compustat (PRCCQ) are historically recorded at the source and require further treatment as they have not been retroactively adjusted for splits[34]. But fortunately, both Compustat and CRSP have dedicated split adjustment factor variables. In Compustat, this factor variable is ADJEX and in CRSP it is CFACPR. By using these variables, I retroactively adjust the stock returns for stock splits as follows. In order to retroactively adjust the historical prices for the stock split, I divide PRC by CFACPR. For instance if a stock is priced at 86.92 before the split, and 44.01 after the split, after the adjustment it becomes 43.46 and 44.01, before and after the split.

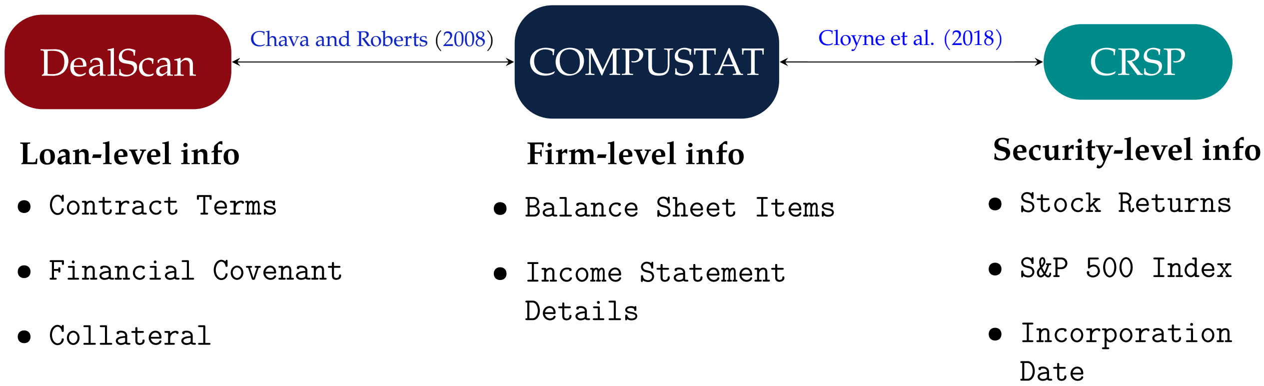
A.4 Dataset Construction

In this subsection I elaborate the merging procedure of Compustat, DealScan, and CRSP. Figure A.1 depicts the final body of the constructed dataset, along with the information about which items come from which dataset. The final version of the merged data set covers more than 60,000 firm-quarter observations for more than 1,000 distinct firms from 1997 to 2018.

Merging Compustat - DealScan. Following Chava and Roberts (2008), I merge Compustat and DealScan by utilizing the identifier link provided publicly by Michael Roberts and is available on Michael Roberts' personal website. Unfortunately, the link file is updated infrequently, and the version used in this paper is April 2018 version. Merging procedure is inner join, namely I drop firms from Compustat that do not appear at in Dealscan data and similarly drop loan observations that if the firm cannot be found in Compustat.

[34]From time to time, a company's share price can increase too much, and becomes unaffordable for some investors. This situation is detrimental to the stock's liquidity. In this case, a firm can undertake a stock split decision to increase the number of shares outstanding by spliting existing shares. This operation does not alter the underlying value of the company. Common split ratios are 2-for-1 and 3-for-1, which means that after the stock split operation an investor who owns the stock will have two or three shares, respectively, for every share held before the split.

Figure A.1
Dataset Construction



Merging Compustat - CRSP. I merge Compustat - CRSP datasets to carry out the analysis in Section B.1. I merge Compustat with CRSP by employing the Compustat/CRSP link-table available in WRDS. The link table maps the firm identifier in CRSP (`CUSIP`) to the firm identifier of Compustat (`GVKEY`).

A.5 Macro Time Series Data

Macro data is obtained from the Federal Reserve Bank of St. Louis (FRED). I closely follow the definitions and interpretations of Cloyne et al. (2018), which builds upon Gertler and Karadi (2015). The GVA deflator series is `B358RG3Q086SBEA`, the Price Index for Gross Value Added (GDP: Business: Nonfarm (chain-type price index)). Aggregate business investment is `PNFI`, Private Nonresidential Fixed Investment. CPI is `CPALTT01USM661S`, Consumer Price Index: Total All Items for the United States. One-year risk free rate is `GS1`, Market Yield on U.S. Treasury Securities at 1-Year Constant Maturity, Quoted on an Investment Basis. Three-months risk free rate is `DGS3MO`, Market Yield on U.S. Treasury Securities at 3-Month Constant Maturity, Quoted on an Investment Basis. Industrial production is `INDPRO`, Industrial Production: Total Index. GDP is `GDPC1`, Real Gross Domestic Product. Unemployment rate is `UNRATE`, Unemployment Rate. Volatility index is `VIXCLS`, CBOE Volatility Index: VIX.

A.6 Monetary Policy Shocks

For the baseline exercises, I use the exact FOMC meeting dates, time stamp of press release from FOMC, and daily shocks in percentage points from Gorodnichenko and Weber

(2016). The data is publicly available and can be downloaded from Michael Weber's personal website. Sample period is from Feb 5, 1997 to Dec 16, 2009.

For robustness check, I use Policy News Shock from Nakamura and Steinsson (2018). Corresponding data, along with the dates are publicly available and can be downloaded from Emi Nakamura and Jon Steinsson's personal websites.

B Additional Empirical Exercises

B.1 CAPM Regression

In order to measure the profitability (Jensen's Alpha) and return volatility (Beta), I estimate the below single factor CAPM model.

$$r_{j,t-\tau} - r_{f,t-\tau} = \alpha_j^{\tau} + \beta_j^{\tau} \left(r_{m,t-\tau} - r_{f,t-\tau}\right) + e_{j,t-\tau} \tag{B.1}$$

$\tau = 0, 1, \ldots, \mathrm{T}$ represents the active time horizon. Following both the literature and real life practices, rolling regressions are estimated using a window of 36 months (*i.e.* $\mathrm{T} = 36$). $r_{j,t}$ is the stock return of firm j, $r_{m,t}$ is the $S\&P$ 500 Index and $r_{f,t}$ is the risk free rate. To carry out the analyses I merge Center for Research in Security Prices (CRSP) and Compustat databases via a Compustat/CRSP link-table, which maps the identifier in CRSP (`PERMNO`) to the identifier in Compustat (`GVKEY`). Here note that B.1 does not represent a panel data regression, but instead a separate time series regression is estimated for each firm j. This process yields time series for α_j (**Jensen's alpha**) and β_j (**Stock Beta**) coefficients for each firm j.

B.2 Robustness of the Baseline Results

In order to show the robustness of the baseline results, I carry out additional set of empirical exercises presented below.

Spread. Anderson and Cesa-Bianchi (2020) stresses the role of credit spread on the firm level investment. The mechanism in their setup is that firms having higher credit spread response cut their investment and borrowing more, therefore responds more to a monetary policy surprise. Therefore, the baseline results in Figure 1, could be driven by spread responses regardless of the underlying borrowing method. To address this concern, I run the same setup as in (1), with the dependent variable being the spread (Dealscan variable *AllInDrawn*).

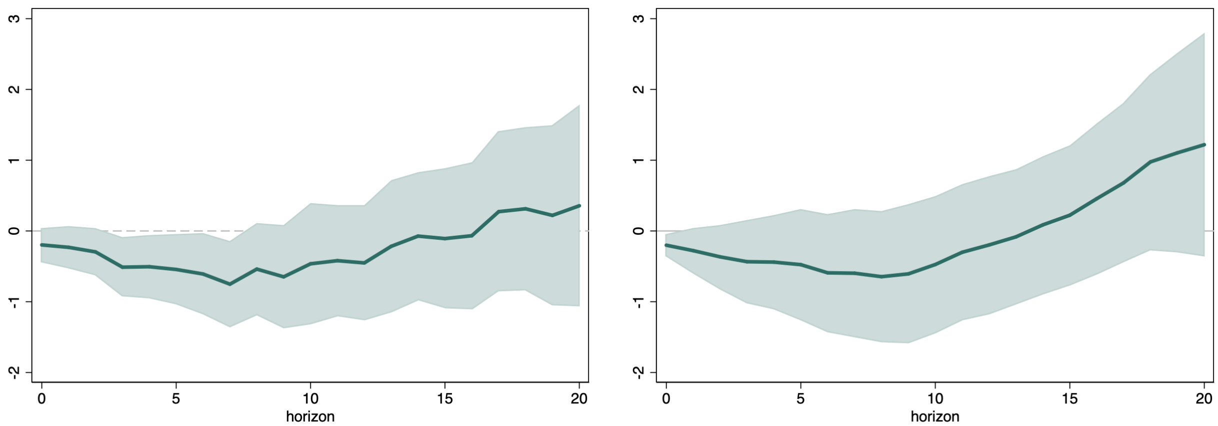
Figure B.1 reports the results obtained. The point estimates among subgroups are almost identical, therefore the baseline results in Figure 1 cannot be driven by the response of credit spread.

Figure B.1

Impulse Responses: Spread

Asset-based vs. Cash flow-based

(a) **Spread:** Asset Based (b) **Spread:** Cash-flow Based



Note. This figure shows the average impulse response functions for the spread following a 25 bps increase in 3-month T-bill rate. The responses are classified into asset-based and cash flow-based borrowers and estimated with the local projection specification given by (5) with the dependent variable being the spread (Dealscan variable *AllInDrawn*). Monetary policy shock is interacted with indicator variable based on the firm borrowing status. The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

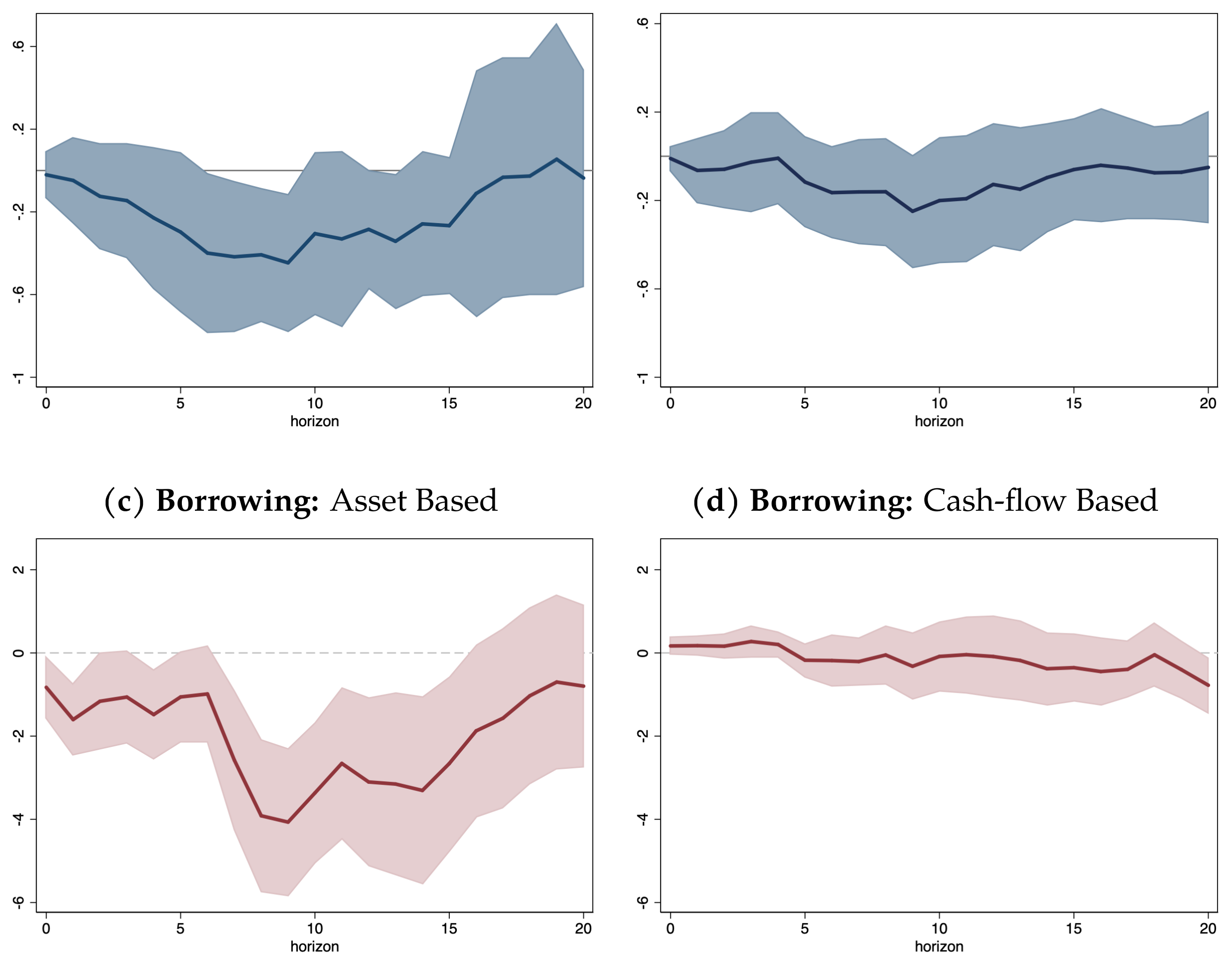
Regional heterogeneity. As documented by Chaney, Sraer, and Thesmar (2012), the value of real estate has considerable impact on firm-level activity through the collateral channel. Further, Bahaj, Pinter, Foulis, and Surico (2019) show that regional heterogeneity plays role in the response of property prices to monetary policy. These two studies suggest that the results depicted in Section 2.4 may simply reflect that some firms reside in areas where real estate prices are more responsive to monetary policy than others. To address this concern, I run a variant of (5) and include regional dummies as shown below

$$y_{j,t+h} - y_{j,t-1} = \alpha_j^h + \gamma_{l,s}^h + \beta_1^h \left(\epsilon_t^m \mathcal{I}_{j,t-1}^{Asset}\right) + \beta_2^h \left(\epsilon_t^m \mathcal{I}_{j,t-1}^{Cash}\right) + \sum_{p=1}^{P_Z} \Gamma_p \mathbf{Z}_{j,t-p} + \sum_{p=1}^{P_X} \Gamma_p \mathbf{X}_{t-p} + e_{j,t+h}. \tag{B.2}$$

$\gamma_{l,s}^{h}$ is the regional dummy equals 1 for firms that operate in the region l in the quarter-year s and 0 otherwise. Figure B.2 depicts that estimated responses are similar to Figure 1 and still statistically significant.

Figure B.2

IMPULSE RESPONSES: REGIONAL HETEROGENEITY
ASSET-BASED VS. CASH FLOW-BASED



(a) **Investment:** Asset Based (b) **Investment:** Cash-flow Based (c) **Borrowing:** Asset Based (d) **Borrowing:** Cash-flow Based

NOTE. This figure shows the average impulse response functions for the investment rate and net debt issuance following a 25 bps increase in 3-month T-bill rate. The responses are classified into asset-based and cash flow-based borrowers and estimated with the local projection specification given by (B.2). Monetary policy shock is interacted with indicator variable based on the firm borrowing status. The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

External finance dependence. As originally proposed by Rajan and Zingales (1998), in order to fund their investment expenditures, some firms could be inherently more dependent on the financial sector. This dependence could arise from the sector's frequent investment requirements or simply from the strong link between banks and the firm. Following Rajan and Zingales (1998), I construct a proxy for the external finance dependence as presented below.[35]

$$ExFin = \frac{\text{Capital Expenditures} - \text{Cash Flow from Operations}}{\text{Capital Expenditures}} \tag{B.3}$$

To address this concern, I switch to the " double-sorting" strategy and interact the coefficient of borrowing method with the external finance dependence coefficient. That is, I estimate the following specification

$$\begin{gathered} y_{j,t+h} - y_{j,t-1} = \alpha_j^h + \sum_{x \in \{\chi\}} \beta_x^h \left(\epsilon_t^m \mathcal{I}_{j,t-1}^x \right) + \\ \sum_{p=1}^{P_Z} \Gamma_p \mathbf{Z}_{j,t-p} + \sum_{p=1}^{P_X} \Gamma_p \mathbf{X}_{t-p} + e_{j,t+h}. \end{gathered} \tag{B.4}$$

Figure B.3 and B.4 presents the results for firms of which their external finance dependence is below and above median, respectively. Even after double sorting, the results remain unchanged.

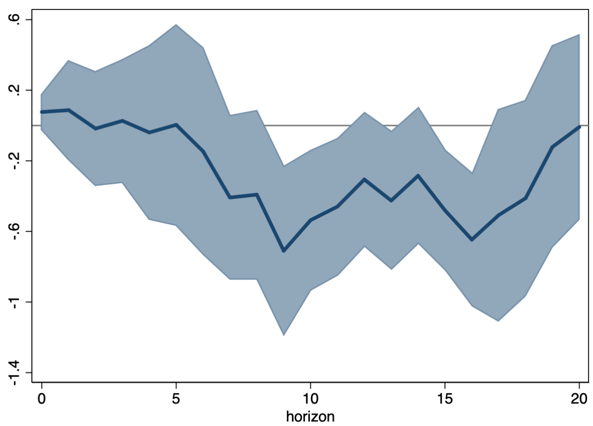
[35] Here Rajan and Zingales (1998) stresses that as being large and publicly traded, most Compustat firms face the least frictions in accessing finance. Thus the amount of external finance used by these Compustat firms is likely to be a good proxy of their demand for external finance.

Figure B.3

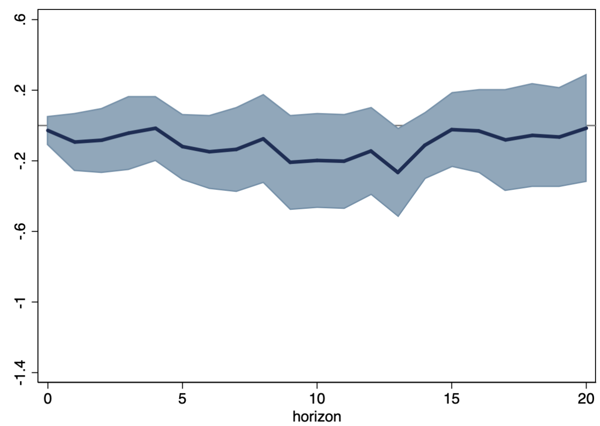
Impulse Responses: ***Low*** External Finance Dependence

Asset-based vs. Cash flow-based

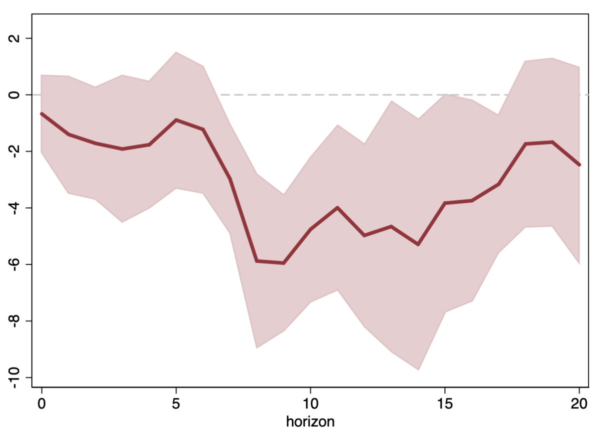
(**a**) **Investment:** Asset Based



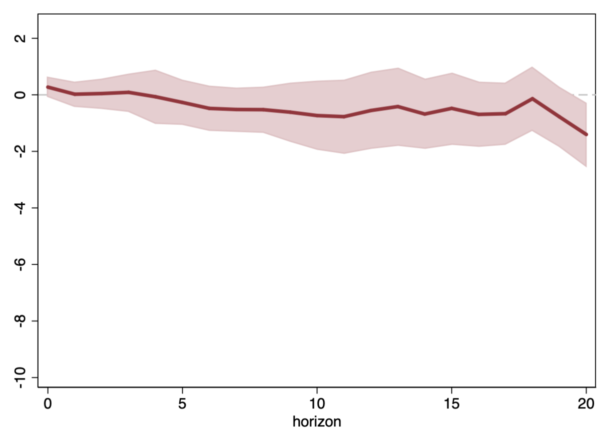
(**b**) **Investment:** Cash-flow Based



(**c**) **Borrowing:** Asset Based



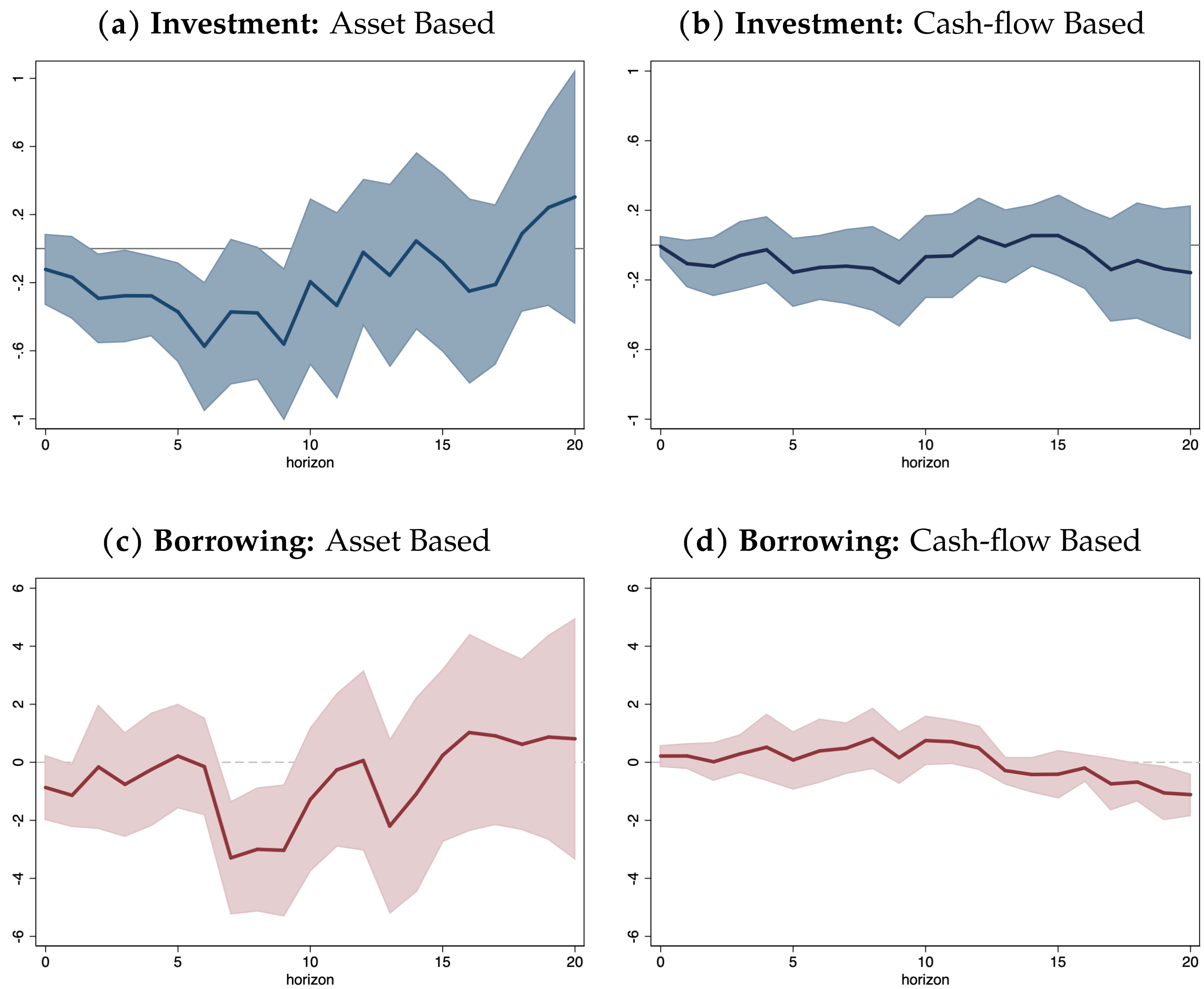
(**d**) **Borrowing:** Cash-flow Based



Note. This figure shows the average impulse response functions for the investment rate and net debt issuance following a 25 bps increase in 3-month T-bill rate. The responses are classified into 4 groups: asset-based/low dependence, asset-based/high dependence, and cash flow-based/low dependence, cash flow-based/high dependence. The impulse responses are estimated with the local projection specification given by (B.3). Monetary policy shock is interacted with indicator variable based on the firm borrowing status. The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

Figure B.4

IMPULSE RESPONSES: ***HIGH*** EXTERNAL FINANCE DEPENDENCE
ASSET-BASED VS. CASH FLOW-BASED



(a) **Investment:** Asset Based — (b) **Investment:** Cash-flow Based — (c) **Borrowing:** Asset Based — (d) **Borrowing:** Cash-flow Based

NOTE. This figure shows the average impulse response functions for the investment rate and net debt issuance following a 25 bps increase in 3-month T-bill rate. The responses are classified into 4 groups: asset-based/low dependence, asset-based/high dependence, and cash flow-based/low dependence, cash flow-based/high dependence. The impulse responses are estimated with the local projection specification given by (B.3). Monetary policy shock is interacted with indicator variable based on the firm borrowing status. The shaded areas display 90 percent confidence intervals based on two-way clustered standard errors at firm and quarter.

C Model Appendix

C.1 Discussion of Key Assumptions

The following discusses the implications of and rationale behind some of the key modeling assumptions made.

No spread difference between contract types. I employ a simplifying assumption that there is no difference in their spreads between asset based and cash flow based contracts.[36] Empirically, it is obvious that such a spread exits between corporate borrowing rate and risk free policy rates, however from the modeling perspective, as long as there is no spread difference between asset based and cash flow based contracts, model's implications would not have changed, if I had included spread over risk-free rate.

To be able to assume no spread difference between asset based and cash flow based contract types, three conditions must be satisfied. First, empirically the difference between the *level* of spreads has to be small enough. As can be seen from Table 1, at the mean the difference between these two borrowing types is only 0.37 pp, and thus we can accept that this condition is satisfied. Second, the loan maturities have to be close to each other. Otherwise these contracts would have been exposed to different duration risk. Table 1 depicts that at the median maturity of both types exactly equal each other (60 months). Third, the *response* of spread to a common monetary policy shock must be similar. Figure B.1 shows that indeed in terms of point estimates the responses are similar and both asset based and cash flow based borrowers experience similar fluctuations in relevant borrowin rates. Since these three conditions are satisfied, I could assume no spread difference among contract types.

Exogenous exit of firms. A common curse in the macrofinance models is that in the model economy, firms accumulate capital and thus become financially unconstrained very quickly. However, the focus of the paper is to understand how debt contracts and financial constraints shape the monetary policy transmission to firm level borrowing and investment decisions. Therefore, in order to prevent firms from accumulating enough capital that firms do not face a binding borrowing limit forever. This is forestalled by imposing stochastic exogenous exit in the model. Since exiting firms are replaced by en-

[36] By introducing endogenous default mechanism, one can introduce endogenous spread in two aspects: *i*) between the borrowing rate and risk free rates, *ii*) between the borrowing rates of asset based and cash flow based contract holders. Although interesting, this extension is irrelevant to the core mechanism of the paper (*i.e.* asset price channel of monetary policy transmission).

trants which are small by definition, it takes time for new entrants to reach their optimal scale due to the existence of financial frictions.

Non-negative dividends. It is common in the macro finance literature to assume that firms do not raise equity to fund their investment expenditures. First, this assumption is convenient in the sense that it allows for a leaner computational process. Second, the assumption is also backed by empirical studies such that new equity issuance occurs very infrequently and it is lumpy due to its costly nature (Altınkılıç and Hansen, 2000; Bazdresch, 2013).

Pass-through financial intermediary. Following the literature (Jeenas, 2018; Ottonello and Winberry, 2020), I model the financial intermediary as pass-through. It is because the purpose of this paper to explain/interpret firm behavior regarding their debt contract choice and its interaction with a monetary policy surprise. Therefore mechanisms like relationship lending (*i.e.* lenders behave differently to the borrowers they already know) or search friction in the credit markets (*i.e.* borrowers search for a suitable source of funding among lenders and there is nonzero probability of failure to do so) are abstracted from this model. Although interesting, the concept of financial intermediary with such self interests is beyond the scope of this paper.

Aggregate capital adjustment cost. The main point of the quantitative section is to illustrate the main mechanism behind why asset based borrowers are more responsive to monetary policy shocks. As discussed rigorously above it is the collateral channel through asset price fluctations. Therefore, to induce time varying capital price within the model economy, I incorporate separate aggregate capital producer firms subject to convex capital adjustment costs. In a nutshell, by this method, model is able to include financial accelerator mechanism (Bernanke et al., 1999).

C.2 Recursive Problem of Contracts

For both contracts, net worth is defined as

$$nw = \max_{l} p_t z(k)^{\theta} l^{\nu} - w_t l + q_t(1-\delta)k - b - \Phi, \tag{C.1}$$

where Φ is the operating cost.

Asset-based Borrowers. Conditional on surviving the exit shock, the recursive problem of the heterogeneous production firm under asset-based contract is:

$$v_t(z, nw; \chi) = \max_{k', b'; \chi'} \quad nw - q_t k' + \mathcal{Q}_t b' + \mathbb{E}_t[\Lambda_{t+1}(\pi_d \hat{nw}_{t+1}(z', k', b') + (1 - \pi_d) v_{t+1}(z', \hat{nw}_{t+1}(z', k', b'); \chi'))] \quad \text{(C.2)}$$

subject to the non-negativity constraint on dividends

$$nw - qk' + \mathcal{Q}b' \geq 0,$$

and the terms of the asset based debt contract, $\chi_{t+1}^{Asset} \{z', \hat{nw}_{t+1}(z', k', b'); q\}$

$$v_{t+1}^{Asset}(z', \hat{nw}_{t+1}(z', k', b')) \geq v_{t+1}^{Asset}(z', \hat{nw}_{t+1}(z', (1 - \Theta)k', 0)) \quad \text{(C.3)}$$

Cash flow-based Borrowers. Conditional on surviving the exit shock, the recursive problem of the heterogeneous production firm under cash flow-based contract is:

$$v_t(z, nw; \chi) = \max_{k', b'; \chi'} \quad nw - q_t k' + \mathcal{Q}_t b' + \mathbb{E}_t[\Lambda_{t+1}(\pi_d \hat{nw}_{t+1}(z', k', b') + (1 - \pi_d) v_{t+1}(z', \hat{nw}_{t+1}(z', k', b'); \chi'))] \quad \text{(C.4)}$$

subject to the non-negativity constraint on dividends

$$nw - qk' + \mathcal{Q}b' \geq 0,$$

and the terms of the cash flow-based debt contract, $\chi_{t+1}^{Cash} \{z', \hat{nw}_{t+1}(z', k', b'); \pi\}$

$$v_{t+1}^{Cash}(z', \hat{nw}_{t+1}(z', k', b')) \geq v_{t+1}^{Cash}(z', \hat{nw}_{t+1}(z', k', 0)) - W_{t+1}(z', \hat{nw}_{t+1}(z', k', b')) \quad \text{(C.5)}$$

where

$$W_{t+1}(z', \hat{nw}_{t+1}(z', k', b')) = \varphi[\overbrace{p_{t+1} z' (k')^{\theta} (l')^{\nu} - w_{t+1} l'}^{\approx \pi}] \quad \text{for all } z'.$$

C.3 Equilibrium Definition

A recursive equilibrium in this economy, given prices $\left\{\rho, r^D, r^B, w, p, q\right\}$, the borrowing constraint rules, operating cost, initial distribution $\mu_0(z, nw)$ of firms over idiosyncratic states, set of value functions $\left\{V(a,\eta), V(z,nw), V^{Asset}(z,nw), V^{Cash}(z,nw), V_I(B,D)\right\}$ and allocations $\{c, l, a', \eta'(z', nw'), B', D', k', b', l'\}$ such that:

1) Production firms. Given the borrowing constraint rules and operating cost $\{\Phi\}$ and prices $\{p, q, \mathscr{Q}, w\}$; allocation $\{k', b', l\}$ and the value function $\{v(z, nw)\}$ solves production firm's problem governed by (8) and (9) , by satisfying the optimal choice of debt contracts governed by (10), (11).

2) Financial Intermediary. (14) holds and financial intermediary earns zero profits. Also, intermediary's lending operations are solely funded through deposits it receive, *i.e.* $B' = D'$;

3) Household. Given prices $\{r, w, \rho\}$, value function $\{V(a,\eta)\}$ and allocation $\{c, l, a', \eta'(z, k', b')\}$ solves the household's problem governed by (22), (23). And it satisfies (24) and the intratemporal optimality condition $w = \psi c$;

4) Stationary distribution. Stationary distribution of firms

$$\mu(z, nw) = \mu'(z, nw) \tag{C.6}$$

5) Labor market clearing. Labor market clears.

$$l = \int_{\mathbf{S}} l\mu(z, nw)\, d(z, nw) \tag{C.7}$$

6) Equity market clearing. The equity market clears.

$$\eta(z, k', b') = 1 \quad \text{for each firm } (z, k', b') \in \mathbf{S} \tag{C.8}$$

7) Debt market clearing. The debt market clears.

$$B' = \int_{\mathbf{S}} b'\mu(z, nw)\, d(z, nw) \tag{C.9}$$

8) Deposit market clearing. The deposit market clears.

$$D' = a' \tag{C.10}$$

9) Goods market clearing. The goods market clear by Walras Law.

$$\begin{aligned} C + &\int_{\mathbf{S}} k' \mu\left(z, nw\right) d(z, nw) + \int_{\mathbf{S}} \Phi \mu\left(z, nw\right) d(z, nw) \\ &= \int_{\mathbf{S}} z k^{\theta} l^{\nu} \mu\left(z, nw\right) d(z, nw) + (1-\delta) \int_{\mathbf{S}} k \mu\left(z, nw\right) d(z, nw) \end{aligned} \tag{C.11}$$

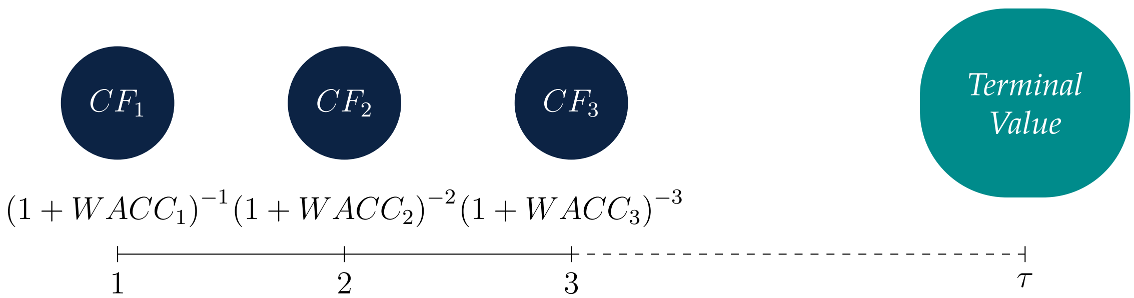
D Discussion About Debt Contracts

D.1 Valuation Methods

There are two main approaches in business valuation: absolute valuation and relative valuation. Absolute valuation, also called as intrinsic valuation, employs discounted cash flow (DCF) analysis to evaluate a firm's financial worth. DCF method determines a firm's intrinsic value by using its projected cash flows. Figure D.1 depicts a diagram summarizing the DCF analysis. However, using the absolute value analysis poses some challenges such as accurately forecasting cash flows, predicting accurate growth rates, and evaluating appropriate discount rates. First, forecasting the exact cash flow values is nearly impossible given the idiosyncratic and aggregate disturbances firm faces. Second, not only cash flow values but also an appropriate discount rate (i.e. weighted average cost of capital) needs to be forecasted with complete certainty. Third, as can be seen from Figure D.1, the largest chunk that needs to be forecasted is the terminal value. More elaborately, all of the DCF analysis assume that each firm reaches a stable path in their lifecycle in which exhibits a constant growth rate, cash flow and discount rate. The analyst also has to assume the length of time period until its terminal value. Although there are methods to estimate these values from firm's balance sheet and income statement, these estimations are still far from being absolute. Therefore, it is difficult for borrower and lender to agree on any of these estimations given the very sensitive nature of the analysis. The caveats of this approach makes it controversial in real life practices.

Given the contractibility issues of absolute valuation, borrowers and lenders employ a much more practical approach. Relative valuation is a business valuation approach in which a firm's value is assessed by using some measures of the firm's competitors or industry peers. In order to evaluate the firm of interest, analysts and investors compare the ratios such as value-to-EBITDA, price-to-earnings, market capitalization etc. to other similar firms. Nevertheless, absolute valuation via DCF method is also used by analysts to support the relative valuation. Therefore one can think of these two approaches as complements rather than substitutes.

Figure D.1
DCF Analysis



Note. This figure summarizes the discounted cash flow analysis. $WACC_t$ stands for weighted average cost of capital in period t. Terminal value is defined as $TV = \frac{CF}{WACC-g}$ where CF is the constant cash flow value, WACC is the constant weighted average cost of capital, and g is the constant growth rate of the firm.

Sectoral Heterogeneity. Some sectors exhibit strong preference in one of the debt contract types. Lian and Ma (2021) indicates that firms in the airline industry constitute good example as they predominantly employ asset-based borrowing due to having substantial amounts of standardized, transferable assets such as aircrafts and hangars. Having higher amounts of pledgeable assets makes asset based borrowing ideal for the firms in airline sector. By presenting impact of aircraft collateral and fire sale mechanism in this industry, Pulvino (1998),Benmelech and Bergman (2009) and Benmelech and Bergman (2011) also emphasize the dominance of asset based borrowing in airline sector.

On the other extreme, firms operating in services and technology (*e.g.* software) sectors mostly rely on cash flow based lending. In these sectors, firms mostly operate using intangible capital rather than tangible capital. Therefore these firms do not have enough tangible assets to pledge as collateral, so they rely on cash flow-based lending. One caveat for this group is that if these firms are low on productivity, then they cannot generate enough cash flows, leading to tighter borrowing constraints (Giglio and Severo, 2012).

Loan vs Bond. Kahan and Tuckman (1993) states that compared to terms of corporate bond issuance, loan agreements more aggressively dictate terms and thus impose strict limits to the firm's actions (mostly borrowing). Verde (1999) compares firms' choice of debt instruments and finds that borrowing via bonds generally comes with looser restrictions. Furthermore, Billett, King, and Mauer (2007) suggests that only 5% of bond indentures dictates restriction on firm. However, even though bonds do not contain such limits on firm's actions, they are still bounded by the loan covenants as a loan covenant limits firm's total debt, regardless the underlying source of the debt (*i.e.* bond issuance or loans).

The underlying reasons behind why firms borrow via loans and comply with the stricter covenants: (*i*) loans are faster way to borrow, (*ii*) bond issuance are subject to considerable amount of transaction costs, (*iii*) credit rating agencies charge significant amount to grade the issued bonds (sometimes this cost is high enough that some firms opt for issuing ungraded bonds which are significantly cheaper than their graded counterparts), *iv*) if a firm is rated as "below investment grade" then the premium they are obliged to pay is relatively larger.