Monetary Policy and Credit Flows*

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Abstract

The paper assesses the impact of monetary policy shocks on credit reallocation and evaluates the importance of theoretical monetary policy transmission mechanisms. Compustat data covering 1974 through 2017 is used to compute quarterly measures of credit flows of borrowing firms. I find that expansionary monetary policy is associated with positive long-term credit creation and credit destruction (i.e. credit reallocation). This impact is larger for financially constrained firms and those that are perceived as relatively risky to the lender. This is predicted by the balance sheet channel of monetary policy and mechanisms that reduce lenders' risk perceptions and increase the tendency to search for yield.

Key words: Credit Reallocation, Credit Constraints, Monetary Policy Transmission

JEL codes: E32, E44, E51, G21, G31, G32

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1 Introduction

In neoclassical macroeconomic models without financial frictions, credit markets are an afterthought; banks act as inconsequential intermediaries between owners and ultimate users of capital (Jorgenson, 1963; Tobin, 1969). In such models, credit markets are assumed to be fully efficient and capital flows to its most productive use. Monetary policy impacts real economic activity through the "cost-of-capital" channel alone e (Bernanke, 2007). In reality, credit markets are not frictionless and can severely affect economic activity. Modern models incorporate financial frictions and have expanded monetary policy channels beyond those influencing market interest rates and bank capital.[1] That is, monetary policy impacts borrowing firms' costs of external financing[2] and lending institutions' tolerance and perception of risk.[3]

While there is a large body of literature investigating the effect of monetary policy on credit market outcomes,[4] a less explored aspect is policy's impact on the reallocation of credit among borrowing firms. Existing theory implies that the composition of credit will adjust following a macroeconomic shock.[5] Because outstanding credit fluctuates and gets reshuffled to others, assessment of credit market conditions through inspection of aggregate net credit changes alone is incomplete and potentially misleading. For instance, if credit extended to one firm increases by 5%, but as the result of a 5% decrease in credit to another, then the net credit change is zero. Yet, credit has been reshuffled between these two firms. Such reallocation may have important implications for future capital formation and economic growth (Herrera, Kolar, and Minetti, 2014; Bianco and Herrera, 2020). Thus, an assessment of monetary policy's impact on credit markets ought to account for this reallocation.

The objective of this paper is to explore the effect of monetary policy shocks on the flow of credit. Following Herrera, Kolar, and Minetti (2011) –hereafter HKM–, I use Compustat North America data to compute credit flows for borrowing firms. Use of this data has several advantages. First, credit extended by nonbank financial institutions like private equity firms, investment banks, or insurance companies is included in the data.[6] Second, Compustat data contains firm-level income statement and balance sheet information, which can be used to obtain relevant financial characteristics of the borrowing firm. This will aid in evaluating the importance of distinct monetary policy transmission mechanisms. For instance, credit

[1] See Bernanke and Blinder (1988) and Kashyap and Stein (1994).

[2] See Bernanke and Gertler (1989), Bernanke and Gertler (1995), Kiyotaki and Moore (1997), and Bernanke, Gertler, and Gilchrist (1999).

[3] See Borio and Zhu (2012), Adrian and Shin (2010), Bruno and Shin (2015), Gambacorta (2009), and Dell'Ariccia, Laeven, and Suarez (2017).

[4] See Ramey (2016) for an overview of recent studies.

[5] See, for instance, models of homogeneous firms with heterogeneity investment project profitability (Matsuyama, 2007) or heterogeneity in firm quality (Bernanke, Gertler, and Gilchrist, 1994).

[6] In 2007, the size of nonbank lending was estimated to be 29.2 trillion U.S. dollars. As of 2015, the size increased to 34.2 trillion U.S. dollar (Financial Stability Board, 2017).

flows may be larger and more fluid for firms that are highly dependent on external financing. Therefore, the reallocation of credit among these firms may be of a larger consequence for economic activity than those capable of generating cash flow internally. An additional benefit of Compustat data is that a firm's total debt is classified into the short- and long-term components.[7] Typically, short-term debt is used to provide cash flow for current expenses rather than to finance long-term investment projects. However, short-term, non-intermediated debt can be a relevant source of bridge financing for long-term projects (Kahl, Shivdasani, and Wang, 2015). Further, as Guedes and Opler (1996) document, borrowing (i.e. debt issuance) at both very short and long maturities are common features of large, highly rated firms, which account for a large portion of the U.S. output.

Nevertheless, there are disadvantages to using Compustat data. First, the data cannot distinguish between the type of borrowing, other than whether it is short- or long-term credit. Second, Compustat only includes information on publicly traded firms, which tend to be large and developed. With Compustat, credit movement among small, non-publicly traded firms is ultimately excluded. Over the period analyzed, Compustat contains an average of 45 percent of the U.S. non-financial sector credit, as reported by the Bank for International Settlements.[8] Compustat's coverage has increased over time, rising to an average of 64 percent since the first quarter of 2000. Even though a substantial portion of credit is absent from Compustat, this data provides a good testing ground for exploring the impact of monetary policy on credit flows.

The topic of credit reallocation was first addressed by Dell'Ariccia and Garibaldi (2005) using bank lending data. They find that credit expansion and contraction tend to co-move, specifically among banks of comparable size, loan type, and location. HKM draw similar conclusions by analyzing firm borrowing, rather than bank lending. They find that credit reallocation among borrowing firms is intense, volatile, procyclical, and highly concentrated among firms of comparable size, location, and industry. A connected study by Craig and Haubrich (2013) investigates the substantial bank consolidation in the 1990s and analyzes bank loan creation, destruction, and reallocation in and out of recessions using data from bank balance sheets. They observe that loan creation is higher during expansions and that loan destruction is higher during recessions.

These studies either do not consider the impact of monetary policy on the reallocation of credit or do so only in a tangential manner. In this paper, I show that monetary policy's impact on the flow of credit is large, and that the impact depends on specific firm characteristics and the length of debt maturity. Following expansionary monetary policy, credit tends to flow to borrowers that are generally considered

[7] Short-term debt includes bank acceptances, commercial paper, the current portion of long-term debt, etc. Long-term debt includes loans, bonds, lines of credit, etc. maturing in more than one year.

[8] http://www.bis.org/statistics/totcredit.htm

financially constrained or perceived as relatively risky to the lender. This is consistent with parts of the balance sheet and risk-taking channels of monetary policy. Moreover, following expansionary monetary policy, credit creation rises relatively more for firms of high investment intensity. This aside suggests that expansionary monetary policy may have a positive effect on growth in the U.S. economy.

This paper is organized as follows. Section 2 describes the construction of credit flows, as well as trends in credit flow and monetary policy measures. Section 3 summarizes the theoretical background for the expected response of credit flows to monetary policy and documents heterogeneity in credit flows. Section 4 outlines the empirical framework and discusses the impact of monetary policy's influence on credit flows, Section 5 discusses monetary policy's influence on investment intensity, and Section 6 concludes.

2 Data Construction and Description

2.1 Credit Flows

Following HKM, I create inter-firm credit flow measures from balance sheet data of publicly traded firms as reported in Compustat North America. These measures are computed from individual growth rates of debt of individual firms.[9] If a newly public firm enters the dataset with debt, this ought to be observed as an increase in debt. However, if a public firm that was previously excluded from Compustat enters the dataset, this should not be observed as an increase in debt. To remedy this, following HKM and Ramey and Shapiro (1998), I exclude firms for which the end-of-period gross capital to net capital ratio exceeds 120%. If a firm exits the dataset due to a merger, acquisition, liquidation, or bankruptcy, I observe this as a contraction of credit. Firms who exit the dataset for other reasons are excluded. Firms in finance, insurance, and real estate industry groups are also excluded because these firms tend to be suppliers of credit, and this study regards the impact of monetary policy on the less-studied demanders of credit.

In this paper, I employ quarterly data spanning the period between the first quarter of 1974 and the first quarter of 2017.[10] The use of quarterly data, instead of annual, as in HKM, allows for clearer identification of monetary policy shocks. Furthermore, the lengthy period covered by Compustat allows for the use of structural vector autoregression (SVAR) tools, such as historical decomposition, when studying the impact of monetary policy (see Kilian and Lütkepohl (2017)).

The quarterly rate of debt growth, g_{it}, for firm i in quarter t is given by

[9] As in HKM, I exclude accounts payable as this typically is not used to finance individual projects.
[10] HKM analyze a period between 1954 and 2007.

$$g_{it} = \frac{debt_{it} - debt_{it-1}}{(debt_{it} + debt_{it-1})/2}. \tag{1}$$

This transformation yields a symmetric and bounded growth rate around zero for continuing, entering, and exiting firms. A value of -2 represents the contraction of debt due to a firm's exit, and 2 represents the expansion of credit of a firm entering the dataset.

Throughout this period, the average growth rate of debt of all firms is -0.0168 and most growth rates are near zero, as shown in the first panel of Figure 1. The histogram in the second panel of this figure splits firms by the dollar amount of total credit, where firms with debt above the median are referred to as top firms and those with debt below the median are referred to as bottom firms. Top firms tend to have larger growth rates of debt than bottom firms. In fact, the average growth rates of debt for top and bottom firms are 0.0189 and -0.0668, respectively. Figure 1 also highlights that most entering and exiting firms, represented by a growth rate of 2 and -2, respectively, are bottom firms.

With these growth rate, I compute aggregate credit creation for a set of firms s in quarter t (POS_{st}) as the debt-weighted sum of the rates for firms with expanding credit and firms entering the market.

$$POS_{st} = \sum_{g_{it}>0, i \in s_t} g_{it} \left(\frac{debt_{it}}{debt_{st}} \right) \tag{2}$$

Aggregate credit destruction (NEG_{st}) is computed using the absolute values of the growth rates for firms with contracting credit and firms exiting the market. It is defined as

$$NEG_{st} = \sum_{g_{it}<0, i \in s_t} |g_{it}| \left(\frac{debt_{it}}{debt_{st}} \right). \tag{3}$$

The first panel of Figure 2 plots credit creation and credit destruction for publicly traded firms from the first quarter of 1974 through the first quarter of 2017. These credit flow measures follow dissimilar patterns. Credit creation is highest in the late 1980s, a period when credit destruction is near its average. In the late 2000s, credit destruction falls from 6.2 in the second quarter of 2006 to 2.3 percent in the fourth quarter of 2007 once the Great Recession officially begins. Over the same period, credit creation increases from 6.6 percent to 9.4 percent.

I compute gross credit reallocation as the sum of credit creation and credit destruction ($SUM_{st} = POS_{st} + NEG_{st}$) and net credit change by subtracting credit destruction from credit creation ($NET_{st} = POS_{st} - NEG_{st}$), shown in the second panel of Figure 2. Analysis of net credit changes alone may provide an incomplete depiction of the market because it masks the reallocation of credit. For instance, though

credit reallocation is high in the late-1990s and early-2000s; these are periods of slightly higher than average net credit changes.

I measure excess credit reallocation as the credit reallocation in excess of what is required to accommodate net credit changes ($EXC_{st} = SUM_{st} - |NET_{st}|$). Large movements in credit reallocation can occur due to large increases in either credit creation or credit destruction. For example, suppose credit creation increases 5%, but credit destruction is unchanged. In this scenario, credit reallocation is 5%, but no credit was truly reallocated from one borrower to another as excess credit reallocation equals zero. In other words, the change in NET and SUM are equivalent. In a more fluid credit market, excess credit reallocation rises with simultaneously expanding and contracting credit. As the second panel of Figure 2 shows, excess credit reallocation is consistently non-zero, with an upward trend until the late 1990s. Starting in the mid-2000s, excess credit reallocation has trended downward.

Table 1 provides further detail on these five measures by decade. In line with the findings of HKM, credit reallocation is consistently large and far exceeds what is needed to accommodate net credit changes, particularly in the 1990s and 2000s. This table also shows that credit creation and credit destruction are quite volatile. Until the 2010s, the volatility of credit creation exceeded that of credit destruction. In the 2010s, credit destruction's volatility exceeds the volatility of credit creation. It is important to note that the magnitudes of these flows are not directly comparable with those of HKM because I use quarterly rather than annual measures. Further, reliable quarterly data is only available from Compustat starting in the early 1970s.[11]

2.2 Monetary Policy Measure, Short-Term Debt, and Long-Term Debt

Throughout much of the period analyzed, the federal funds rate is an appropriate measure of monetary policy when analyzing the effect on credit flows as described above. From late 2008 through 2015, this rate was unmoved and bounded at a range between 0 and 0.25 percentage points (i.e. the zero lower bound) when the Federal Reserve resorted to measures of unconventional monetary policy. Wu and Xia (2016) approximate these actions using the shadow rate term structure model and construct a monetary policy measure that contains information of unconventional monetary policy during the zero lower bound. This measure is the federal funds rate during normal times and the model's shadow rate during the zero lower bound (i.e. the Wu-Xia shadow rate). Figure 3 plots the effective federal funds rate along with the shadow rate around the

[11] See the Appendix for a description of credit flows using annual growth rates that more closely resemble the measures in HKM.

zero lower bound.[12] Using this newly constructed measure, they find that unconventional monetary policy has a non-trivial impact on economic activity once the zero lower bound is reached. Consequently, this measure is often used in the literature employing SVARs over the zero lower bound (see Anderson, Malin, Nakamura, Simester, and Steinsson (2017); Mumtaz and Surico (2018); Bianco and Herrera (2020)). In my analysis, I similarly employ the effective federal funds rate as the measure of monetary policy, but I replace it with the Wu-Xia shadow rate during the zero lower bound period.

Figure 4 plots long- and short-term credit flow measures,[13] respectively, along with this monetary policy rate. Long-term credit creation after the Great Recession and during rounds of quantitative easing is substantially lower than prior to the official start of the recession. By 2017, this measure remains below the average over the entire period. Long-term credit destruction is relatively flat prior to and following this easing of monetary policy. Short-term credit creation is highest in the 1980s when the monetary policy rate is high. This is a period of moderate short-term credit destruction. While short-term credit destruction increases during the Great Recession as the monetary policy rate declines, during the subsequent rounds of quantitative easing, this measure remains nearly unchanged. Short-term credit creation also remains near its long-term average. Because credit flow and monetary policy measures are endogenous, a SVAR approach is utilized to measure the effect of monetary policy shocks on such credit flows.

3 The Role of Monetary Policy and the Flow of Credit

In this section, I discuss relevant channels of monetary policy and how credit flows ought to respond to an expansionary monetary policy shock. A traditional mechanism through which monetary policy is transmitted to real economic activity is through the supply of loans. That is, during times of expansionary monetary policy, banks have more reserves, prompting lending and subsequent capital formation. Accordingly, following expansionary monetary policy, credit creation is expected to increase. Following analysis on job reallocation by Davis and Haltiwanger (2001), I consider this an "aggregate channel," as it mainly impacts the total amount of credit in the economy. This contrasts with "allocative channels," which alter the flow of credit to correct the mismatch between actual and desired credit positions of lenders and borrowers. The reshuffling of credit that takes place through the allocative channel hinges on the existence of firm heterogeneity.

[12] Similar models that aim to capture monetary policy during the zero lower bound include Krippner (2012) and Bauer and Rudebusch (2016). See the Appendix for a comparison of these measures during the zero lower bound.

[13] That is, short- and long-term credit creation, credit destruction, net credit change, credit reallocation, and excess credit reallocation.

3.1 Theoretical Underpinnings

3.1.1 The Balance Sheet Channel

There are three aspects of the balance sheet channel to consider – the cost of external financing, collateral constraints, and cash flows. The two former aspects follow Bernanke, Gertler, and Gilchrist (1994), among others. If a firm's borrowing is constrained by the collateral they pledge, they pay an external finance premium above the market interest rate.[14] Expansionary monetary policy lowers external financing costs by impacting market interest rates and asset values. Rising asset values ease collateral constraints, thereby lowering external finance premia.

Following expansionary monetary policy, net credit ought to increase as external financing becomes less costly. This results from an increase in credit creation, particularly for collateral constrained firms. However, theory appears to be silent regarding policy's impact on credit destruction. It may increase as monetary policy enables firms to better meet interest and principal debt payments or induces lenders to forgive debt. Alternatively, credit may fall as loan defaults become less probable. When the change in net credit is positive, an increase in credit creation cannot be offset by a similar or larger increase in credit destruction. Credit reallocation increases with a rise in both credit creation and credit destruction. When expansionary monetary policy increases credit creation, the sign of policy's impact on excess credit reallocation will correspond to that of credit destruction.

The third aspect of the balance sheet channel is "floating rate mechanism", which is related to firms' cash flows (Mishkin, 1996; Ippolito, Ozdagli, and Perez-Orive, 2018). Interest expense on variable rate loans positively co-moves with the monetary policy rate, especially for firms heavily reliant on bank loans. Traditional monetary easing leads to lower variable rate interest expenses on loans whose rate is tied to short-term rates via the yield premium. These policies lower the overall need for external financing to meet interest obligations. In other words, following expansionary monetary policy, credit creation ought to decrease for high debt service firms. Credit destruction may increase or decrease for the same reasons as discussed previously. While the impact of monetary policy on net credit and credit reallocation depends on the impact on credit destruction, excess credit reallocation ought to decrease.

3.1.2 The Investment Channel

Aside from the balance sheet channel, theory predicts that expansionary monetary policy impacts financially constrained firms through the investment channel (Ottonello and Winberry, 2018). Borrowing firms face

[14] In Bernanke, Gertler, and Gilchrist (1994), the external finance premium is the agency premium that arises endogenously in model (i.e. the shadow value of relaxing the borrower's collateral constraint).

upward sloping marginal cost curves for investment. The slopes of these curve are increasing with the degree to which the firm is financially constrained. Expansionary monetary policy that shifts the marginal benefit curve to the right will lead to larger increases in investment for non-financially constrained firms. The magnitude of this effect, in aggregate, depends on the distribution of the degree to which firms in the economy are financially constrained. An implication of this channel is that, when investment spending is financed through external financing, credit ought to flow relatively more to non-financially constrained firms to accommodate the investment.

Ottonello and Winberry (2018) find support for this channel by analyzing the differential impact of monetary policy shocks on investment, dependent upon a firm's financial constraints.[15] They find that monetary policy shocks impact investment relatively more for non-financially constrained firms at short horizons, thus supporting the channel. This is corroborated by Jeenas (2018) at short horizons using the leverage ratio and liquid asset holdings as proxies for financial constraints. However, he finds that financially constrained firms are relatively *more* responsive to monetary policy shocks at medium- and long-term horizons, which is not consistent with the channel.[16]

Through this channel, following an expansionary monetary policy shock, I expect credit creation to increase for financially constrained and non-financially constrained firms that seek external financing for new investment projects. I expect the magnitude to be larger for non-financially constrained firms because they have flatter marginal cost curves for investment. While the impact of the shock on credit destruction is unclear in this model, I expect the net credit change to be positive as the stock of investment projects rises. Like credit destruction, the shock's impacts on credit reallocation and excess credit reallocation are unclear.

3.1.3 The Risk-Taking Channel

Monetary policy may also impact economic activity through the risk-taking channel.[17] A lender's credit risk tolerance and the ease by which they price credit risk are sensitive to monetary policy. For example, during the 2000s, interest rates in the U.S. were considered by many as "too low for too long" (Taylor, 2009). Even Federal Reserve officials expressed concern over the dangers of keeping policy rates unnecessarily low in the aftermath of the financial crisis (Bullard, 2015). Extended periods of excessively low interest rates may cause asset bubbles and financial sector instability as banks engage in excessive risk-taking.

In times of expansionary monetary policy, lenders may engage in "searching for yield" in which the

[15] They measure the firm's investment as the quarter-to-quarter log difference in book value of fixed assets and measure a firm's financial constraints by the leverage ratio and S&P credit rating.

[16] Jeenas (2018) also finds that, following monetary policy tightening, inventories and sales contract relatively more for firms with high leverage and low liquid asset holdings.

[17] See Borio and Zhu (2012), Adrian and Shin (2010), Bruno and Shin (2015), Gambacorta (2009), and Dell'Ariccia, Laeven, and Suarez (2017).

allocation of loans in a lender's portfolio shifts towards high risk, high return loans (Rajan, 2006). Nominal return targets are slow to adjust downward when market interest rates fall. To achieve previous returns, lenders are incented to reallocate the risk composition toward riskier borrowers. This implies that credit creation increases in aggregate and credit destruction increases as lenders reshuffle credit to reallocate their risk compositions. Credit destruction may also decrease as loan default is less likely. When both measures increase, credit reallocation and excess credit reallocation also increase. Through this mechanism, net credit should rise if the increase in credit creation is not offset by a sufficiently large increase in credit destruction.

The second component of the risk-taking channel is the risk perception mechanism (Borio and Zhu, 2012). This is related to the balance sheet channel, although the mechanism operates through fundamental changes in lenders' risk perceptions, rather than the easing of collateral constraints and lowering external financing costs. Expansionary monetary policy inflates asset prices and decreases volatility, which tend to lower lenders' perceptions of credit risk (Gambacorta, 2009). In other words, following monetary easing, the marginal borrower, who may not have met previous lending standards, appears creditworthy, even if their relative riskiness is unchanged.

This mechanism implies that credit creation and net credit increase in response to an expansionary monetary policy shock. The response of credit destruction to the shock is unclear. Credit reallocation will rise if the increase in credit creation is larger in magnitude than the decrease in credit destruction. The sign of the shock's impact on excess reallocation ought to correspond to that of credit destruction.

The final mechanism of this channel is described by Dell'Ariccia, Laeven, and Suarez (2017) as the "risk-shifting" channel. Bank liabilities, like wholesale funding and bank deposits, become less costly when monetary policy lowers market interest rates. This increases lenders' margins and induces lenders to shift their allocation of loans away from high risk lending. As opposed to searching for yield mechanism, this implies that expansionary monetary policy will lead to increases in credit creation for relatively less risky borrowers. To accommodate shifting loan portfolios, credit destruction is likely to increase,[18] specifically for risky firms. Like the other risk-taking mechanisms, I expect an increase in net credit change and credit creation for certain types of firms, but the impacts on credit destruction, credit reallocation, and excess credit reallocation are ambiguous.

[18]Recall that credit destruction may rise because of loan repayment or debt forgiveness or decrease because of fewer defaults. Through this channel, the impact of the former is more likely, although the net impact on credit destruction is ambiguous.

3.2 Measuring Heterogeneity

To examine the importance of these channels in the transmission of monetary policy shocks to credit flows, I must first effectively group firms by relevant characteristics. For the balance sheet and investment channels, firms ought to be classified by their degree of financial constraints. For the floating rate mechanism, they should be classified by debt service. For the risk-taking channel, firms ought to be grouped by lenders' risk perceptions of the borrowing firms. Since information on these perceptions is not available, I group firms by characteristics that may reflect perceived risk: probability of default, leverage, asset size, financial dependence, age, and liquid asset holdings.

While these groups certainly have similar characteristics, the categories do highlight distinct aspects of firms. Table 2 shows the number of quarter-firm observations present in each group of firms used in this study. To illustrate the heterogeneity, of the more than 140,000 observations of high default probability firms across time, the majority of these are low leverage, high liquidity, small, and non-financially dependent firms. Not all of these are necessarily characteristics of financially constrained or risky firms. Next, I briefly discuss the methods used to measure borrower heterogeneity and describe asymmetries in credit flows for these groups.

3.2.1 Probability of Default

Researchers have attempted to quantify firms' financial constraints in equity and debt markets in recent years.[19] These measures are typically created by analyzing firms' annual reports (Kaplan and Zingales, 1997), structural modeling (Whited and Wu, 2006), whether a firm has a credit rating (Almeida, Campello, and Weisbach, 2004), or whether they pay a dividend (Fazzari, Hubbard, and Petersen, 1988; Almeida and Campello, 2007). Farre-Mensa and Ljungqvist (2016) find that firms classified as financially constrained by such measures, to a greater extent, are young firms in the growth phase of their life cycle, rather than truly financially constrained firms. Further, they find that firms close to default behave as if they are truly financially constrained.[20] Therefore, I group firms by their default probability. This not only identifies firms that are more highly constrained in credit markets, which is relevant for the balance sheet and investment channels, but also those that are relatively risky borrowers, which is relevant to the risk-taking channel.

Corporate default risk is constructed as in Merton (1974), whereby

$$DD_{it} = Distance - to - default_{it} = \frac{log(\frac{E_{it}+F_{it}}{F_{it}}) + r_{it} - 0.5\sigma_{it}^2}{\sigma_{it}} \tag{4}$$

[19] See Farre-Mensa and Ljungqvist (2016) for a survey of the literature regarding the measurement of financial constraints.

[20] They also find that private firms behave as if they are financially constrained. Compustat only contains income statement and balance sheet data for publicly traded firms, therefore, I do not group firms by whether they are publicly traded.

where

$$E_{it} = \frac{|prccq| \times cshoq}{10^3} \tag{5}$$

$$F_{it} = dlcq + \frac{1}{2} dlttq \tag{6}$$

$$\sigma_{it} = [\frac{E}{E+F} \times \sigma_{E,it}] + [\frac{F}{E+F} \times (0.05 + 0.25 \times \sigma_{E,it})] \tag{7}$$

and $\sigma_{E,it}$ is the rolling one-year standard deviation of *prccq* (stock price), r_{it} is the year-over-year stock return, *dlttq* is long-term debt, *dlcq* is short-term debt, and *cshoq* is common shares outstanding. Following Farre-Mensa and Ljungqvist (2016), firms with a probability of default exceeding 25 percent from the cumulative standard normal distribution function are high default probability firms and all others are low default probability firms.

Table 3 provides descriptive statistics of credit flows, subset by maturity and default probability grouping. The short-term credit flows of these two groups tend to be comparable to one another, on average. However, the table also highlights that most long-term credit flows tend to be significantly higher for high default probability firms. For instance, the average credit creation for high default probability firms is 8.53 percent, and this is significantly larger than the average of 5.63 percent for low default probability firms. The average long-term credit destruction for these groups are not statistically different from one another, yet the net credit change and credit reallocation are significantly higher for high default probability firms at 4.38 and 12.67 percent, respectively. Excess credit reallocation is significantly higher for *low* default probability firms, indicating that credit markets for low default probability firms are relatively more fluid.

The credit flow measures are also substantially more volatile for high default probability firms, shown in the second panel of the table. It is important to note that credit measures are constructed by *growth rates* and even if these rates are higher, the dollar amount of credit created or destroyed by high default probability firms is lower than the total credit flows of low default probability firms. Indeed, over this period, the average share of credit for all high default probability firms is 6.8 percent. Further, the default probability threshold is static and depending on overall conditions, the number of firms considered to be high or low default probability fluctuates. In the third quarter of 2008, at the height of the Great Recession, over 28 percent of firms were classified as high default probability firms as compared to just above 4 percent at its low in the fourth quarter of 1978. Still, the results presented in this study are robust to a dynamic

threshold, whereby firms are grouped into top and bottom terciles based on the probability of default.

3.2.2 Leverage

A commonly used financial constraints measure is the leverage ratio (see Gertler and Gilchrist (1994); Chari, Christiano, and Kehoe (2007); Kudlyak and Sanchez (2017)). Highly leveraged firms are also likely to have relatively high variable interest expense, making this measure useful in analyzing the importance of the floating rate mechanism. I utilize the leverage ratio (total debt as a percentage of total assets), and I classify a firm as "high leverage" if its leverage ratio falls in the top tercile of firms in a quarter. "Low leverage" firms are those with a leverage ratio falling in the bottom tercile in a quarter.

From Table 3, short- and long-term creation and credit destruction are significantly larger for low leverage firms. These measures are weighted sums of debt growth rates. Accordingly, low leverage firms may hold little or no debt, thereby having little or zero weight on the group credit flow measures. Therefore, growth rates of a small number of low leverage firms are utilized in creating group credit flows.[21] This table also shows that the credit measures at both maturities tend to be more volatile for low leverage firms.

3.2.3 Asset Size

A firm's asset size is likely to coincide with the degree to which they are financially constrained. This is shown empirically by Gertler and Gilchrist (1994), who find that, during periods of tight credit, small manufacturing firms are more adversely impacted by credit conditions than large firms. The topic is re-examined by Kudlyak and Sanchez (2017), who find that credit contracted relatively more for *large* firms during the late 2000s recession. Some recent studies that also analyze heterogeneity in monetary policy's impact on large and small firms include Crouzet and Mehrotra (2020) and Lian and Ma (2018). I classify firms with asset values in a quarter in the top tercile as "large" and in the bottom tercile as "small".

Table 3 shows the averages and volatility of the credit flow measures for these two groups. Credit creation and credit destruction are higher for small firms, noting again that the aggregate dollar amount of total credit is likely higher, on average, for large firms. Also, short- and long-term net credit change, credit reallocation and excess credit reallocation are larger for small firms.

3.2.4 Financial Dependence

In general, obtaining external financing is costlier than generating cash flow internally through operations. Therefore, firms that are highly dependent on external financing are more likely to be impacted by fluctuating

[21] In Compustat, 4.22 percent of quarter-firm observations report holdings of no debt.

credit market conditions. Through the balance sheet channel and investment channel, if financially dependent firms are also financially constrained (Rajan and Zingales, 1998; Kudlyak and Sanchez, 2017), then they are susceptible to shocks in the same manner. A widely used measure of financial dependence comes from Rajan and Zingales (1998) in their influential study of the link between financial dependence and economic growth. This measure is the ratio of capital spending less cash flow from operations to capital spending. I classify financially dependent firms as those with the ratio is in the top tercile at a point in time, while those in the bottom tercile as non-financially dependent.

In Table 3, I show that short- and long-term credit destruction is higher for non-financially dependent firms. Short-term credit creation is larger for non-financially dependent firms, but long-term credit creation is similar between these groups. The averages of short- and long-term credit reallocation and excess credit reallocation are significantly larger for non-financially dependent firms. While the average credit flows tend to be larger for non-financially dependent firms, the short-term credit flows of financially dependent firms are more volatile than that of non-financially dependent firms.

3.2.5 Age

A borrower's financial constraints may depend negatively on the stage in the firm's life cycle. That is, young firms are more likely to be financially constrained (Hadlock and Pierce, 2010).[22] Yet, a more recent study by Dinlersoz, Kalemli-Ozcan, Hyatt, and Penciakova (2018) shows that age is likely *not* related to a firm's financial constraints. Young firms are more reliant on equity financing, particularly among private firms; as they age, they tend to deleverage and finance through long-term debt to repay existing, more costly financial obligations. Still, Cloyne, Ferreira, Froemel, and Surico (2018) find that monetary policy's impact on the net credit of borrowers is highly dependent upon age in that only changes in small firms' collateral values positively co-move with net credit growth. They infer that young firms are financially constrained and monetary policy either eases or tightens the constraint. In this paper, firms with age in the top tercile at a point in time are classified as "old", and those in the bottom tercile are "young".[23]

Table 3 shows that credit creation is larger, on average, for young firms, though credit destruction is larger for old firms. Specifically, long-term credit creation for young firms at 8.30 percent, compared to 5.41 percent for old firms. The long-term credit destruction is significantly larger for old firms, although they are similar in magnitude. These result in a significantly larger long-term net credit change and credit reallocation for young firms. This implies that young firms, as a group, are more reliant on long-term financing. Recall

[22] Hadlock and Pierce (2010) proposes a financial constraints index that loads negatively on a firm's age and total assets and positively on squared total assets.

[23] Age is the number of years since the firm enters Compustat.

that this study analyzes credit flows derived from the balance sheets of publicly traded firms. Therefore, this result is not inconsistent with Dinlersoz, Kalemli-Ozcan, Hyatt, and Penciakova (2018), who find that *private* firms tend to switch to long-term financing as they age.

3.2.6 Liquid Asset Holdings

Lastly, firms may hold low levels of liquid assets, such as cash, because they are financially constrained, and, presumably, are heavily reliant on short-term debt to sustain operations (Jeenas, 2018).[24] Hence, they are markedly exposed to short-term interest rate movements generated by monetary policy shocks. I classify firms with the ratio of cash and short-term investments to total assets in a quarter in the bottom tercile as "low liquidity" and in the top tercile as "high liquidity". This characteristic is relevant for assessing the impact of the balance sheet channel and investment channel in the conduct of monetary policy.

There are stark differences in credit flows of high and low liquidity firms, as shown in Table 3. The average short-term credit creation is similar between these groups, but they are each more than 3 percentage points higher than the average short-term credit creation for all firms. This implies that both high and low liquidity firms tend to be active in obtaining short-term credit. Short-term credit destruction is higher for low liquidity firms, at 8.57 percent, compared to high liquidity firms, at 6.29 percent. For long-term credit, all credit flow measures of high liquidity firms are significantly higher than low liquidity firms.

4 Monetary Policy Shocks and Credit Flows

4.1 Empirical Strategy

To analyze monetary policy's impact on credit flows, I utilize a SVAR, represented as

$$A_0 Y_t = a + \sum_{j=1}^{n} A_j Y_{t-j} + u_t. \tag{8}$$

The vector, Y_t, includes a block of macroeconomic variables (real GDP, unemployment, consumer prices), the monetary policy rate (the effective federal funds rate supplemented by the shadow rate of Wu and Xia (2016) during the zero lower bound period), and a block of credit flow measures (credit destruction and credit creation), with this ordering. The A matrices are matrices of coefficients, a is a vector of constants, and u_t is a vector of structural innovations.

This methodology is comparable to Craig and Haubrich (2013), who specify a VAR with a block of

[24] Jeenas (2018) measures a borrower's holdings of liquid assets by the ratio of cash and short-term investments to total assets.

macroeconomic variables, the federal funds rate, and a block of loan flows. However, the specification used in this paper differs in two aspects. First, to account for the "price puzzle", whereby consumer prices respond unexpectedly to a monetary policy shock, I follow Estrella (2015). I impose a zero restriction on the coefficient of the first quarter lag of the monetary policy rate on consumer prices. For full identification, the A_0^{-1} matrix is assumed to be lower triangular. Through these restrictions, monetary policy does not directly impact the current or the following period's consumer prices.[25] The method utilized by Estrella (2015) is motivated by theoretical analogs of identities for aggregate supply, aggregate demand, and a monetary policy rule. Because I impose the restriction on the lagged coefficient matrix, ordinary least squares equation by equation does not produce efficient estimates of the VAR parameters. Hence, I estimate the VAR via iterated seemingly unrelated regression, which is equivalent to full information maximum likelihood (Hamilton, 1994).

Second, I order credit destruction before credit creation in Y_t by an assumption that credit creation responds contemporaneously to credit destruction, but not vice versa. This assumption is motivated by the likely ability of borrowers to respond quickly to a credit destruction shock, whereas adjustment of credit destruction to a credit creation shock would take time to implement. That is, firms can quickly draw upon existing credit, but the impact of the shock on credit destruction through the maturation or repayment of existing credit is likely to take longer to materialize. Yet, the results are robust to ordering credit creation before credit destruction.

To study the effect of monetary policy on credit flows of groups of firms, I include an additional block of group credit destruction and credit creation in Y_t. This VAR is estimated separately for total, short-, and long-term credit by rotating credit creation and credit destruction as the final block in Y_t. The results are summarized below.

4.2 The Effect of Monetary Policy Shocks for Publicly Traded Firms

To start, Figure 5 shows the impulse responses of Y_t to a one-time, unexpected decrease of 100 basis points in the monetary policy rate.[26] In response to the shock, real GDP increases with a lag, remaining persistently high, while unemployment falls and remains persistently low. Consumer prices fall beyond the first quarter, although the statistical significance is eliminated at a 10 percent level. Further, the response of consumer prices to this shock relative to a VAR without the restriction as in Estrella (2015), is muted.

[25] Alternative approaches to account for the price puzzle are including commodity prices in the VAR to capture internal information on inflation expectations (For instance, see Christiano, Eichenbaum, and Evans (1999) and Craig and Haubrich (2013)), utilizing a factor-augmented VAR (Bernanke, Boivin, and Eliasz, 2005) to account for monetary policymakers' internal information relevant for monetary policy, or including an omitted variable, the output gap, in a misspecified VAR (Giordani, 2004).

[26] The error bands are the 68 percent mean-bias-corrected residual-based wild bootstrap interval with 10,000 repetitions.

While credit creation significantly falls on impact (-0.11 percentage points), the response is positive and significant six quarters following the shock. This persists through twelve quarters, peaking nearly 0.15 percentage points at eight quarters. The response of credit destruction is significant on impact and the subsequent quarter, rising 0.15 cumulative percentage points. The response is also significant in the seventh through tenth quarter following the shock, rising about 0.05 percentage points each quarter. These impulse responses are plotted along with credit reallocation, net credit change, and excess credit reallocation in the first panel of Figure 6. Credit reallocation increases significantly at quarters six through twelve following the shock, peaking at 0.20 percentage points after eight quarters. The net credit change falls on impact from the increase in credit destruction and decrease in credit creation, and significantly increases in the seventh through tenth quarter following the shock when credit destruction and credit creation are rising.

The second and third panels of Figure 6 plot the responses of long- and short-term credit flows to an expansionary monetary policy shock. Long-term credit creation also exhibits positive and significant increases in response to the shock at short- and medium-term horizons, but the response persists further. The pattern of the responses of long-term credit creation and credit destruction mimic that of total credit although the magnitudes of responses for long-term credit are also larger. At medium and longer horizons, the responses of credit reallocation, net credit change, and excess credit reallocation are positive and significant. The response of net credit change and excess credit reallocation are also significant and negative on impact. Contrary to the responses of long-term credit flows, short-term credit destruction *falls* significantly at medium-term horizons. The impact of the shock on credit creation is not statistically significant at any horizon.

4.3 Heterogeneity in Responses of Credit Flows to Monetary Policy Shocks

Table 4 provides the four-, eight-, and twelve-quarter cumulative impulse responses of long- and short-term credit flows to an expansionary monetary policy shock for the subsets of firms described in Section 3.2. At these horizons, long-term credit destruction significantly increases for low default probability firms, high leverage firms, young firms, and low liquidity firms at all horizons. There are also significant increases at certain horizons for small firms and financially dependent firms and a small, but significant *decrease* for high liquidity firms at the twelve quarter horizon. Long-term credit destruction significantly rises as much as 1.14 percentage points for high leverage firms at the twelve quarter horizon. This magnitude is sizable considering that the average is 3.34 percentage points for such firms over the entire period.

Following the monetary policy shock, long-term credit creation increases significantly for several subsets of firms. The most notable increases occur for high default probability firms, significantly rising at eight and twelve quarter horizons and by as much as 3.06 percentage points. These increases are relatively large

compared to the increases that low default probability firms experience, rising only as much as 0.55 percentage points after twelve quarters. Old firms' long-term credit creation rises 0.55 and 1.33 percentage points at eight and twelve quarters following the shock, respectively, while there are no significant increases in the long-term credit of young firms. The responses of long-term credit creation for small firms, low leverage firms, and low liquidity firms are also significant at certain quarters while there are no significant increases in the long-term credit creation of large firms, high leverage, or high liquidity firms.

The responses result in significant increases in the credit reallocation for several groups of firms. The largest of these occurs for young firms. After eight quarters following the shock, the cumulative increase in long-term credit reallocation is 2.08 percentage points for this group. While the increases in credit reallocation are larger for other groups, they are not statistically significant. This is mainly due to large and significant increases in other groups' either credit creation or credit destruction alone.

The second panel of Table 4 shows that the responses of short-term credit flows to the shock are dissimilar to those for long-term credit. Young firms are the only group for which credit creation increases significantly following the shock, rising 2.68 percentage points after four quarters. Credit creation significantly falls by as much as -4.32 percentage points for several groups following the shock. Short-term credit destruction commonly decreases following the shock, especially for old firms and low default probability firms and, to a lesser extent, for high and low leverage firms, financially constrained and non-financially constrained firms, and high and low liquidity firms.

4.4 Implications for Credit Channels of Monetary Policy

The results highlight that monetary policy operates through the aggregate channel by increasing credit creation, specifically for long-term credit. By decomposing the responses of credit reallocation into the contributions from credit creation and credit destruction, I shed light on the allocative impact of monetary policy through the aforementioned channels.

4.4.1 Publicly Traded Firms

The result that expansionary monetary policy shocks brings about increases in credit creation is consistent with aspects of the balance sheet channel, investment channel, and risk-taking channel. The balance sheet channel predicts that collateral constrained firms ought to experience increases in credit creation as monetary policy eases these constraints and lowers the cost of external financing. By the investment channel, credit creation rises as expansionary monetary policy shifts firms' marginal benefit cost curves for investment to the right. Through the risk-taking channel, credit creation rises for risky firms as lenders search for yields or

their perceptions of risk are distorted following expansionary monetary policy. Conversely, credit creation may rise for less risky firms, via the risk-shifting mechanism, as lenders' margins widen.

An alternative aspect of monetary policy regards the floating rate mechanism, which predicts that expansionary monetary policy prompts declines in credit creation for firms with high debt service (i.e. high leverage). These firms experience increases in cash flows as interest rates fall, thus limiting their need for external financing. Because neither short- nor long-term credit creation significantly falls for high leverage firms in response to the shock, I find no support for this mechanism.

Expansionary monetary policy's impact on credit destruction is ambiguous. Deleveraging and debt forgiveness bring about increases in credit destruction. Also, reshuffling of credit between borrowers causes credit destruction to rise for those by which credit is contracted. Conversely, credit destruction falls if expansionary monetary policy aids in preventing loan defaults. Here, I show that the impact on firms' credit destruction depends on debt maturity. Following an expansionary monetary policy shock, long-term credit destruction tends to rise and short-term credit destruction tends to fall.

Next, I analyze the impulse responses of credit flows of the groups of firms described in Section 3.2 to provide clearer evidence for these channels, if it exists.

4.4.2 Probability of Default Grouping

In response to an expansionary monetary easing shock, the balance sheet channel predicts that credit creation should increase for financially constrained firms, and, as Farre-Mensa and Ljungqvist (2016) find, high default probability firms behave as if they are financially constrained. By the investment channel though, credit creation should rise relatively more for non-financially constrained firms, such as those with *low* default probabilities as they have flatter marginal cost curves for investment. Following an expansionary monetary policy shocks, credit creation should rise for risky firms, such as those with high default probabilities, by the searching for yield and risk perception mechanisms. Finally, the risk-shifting mechanism predicts that lenders allocate their portfolios to accommodate *less* risky firms, such as those with low default probabilities, in response to expansionary monetary policy.

As Table 4 reveals, key predictions from certain channels are consistent with these results. First, long-term credit creation increases significantly, at eight and twelve quarter horizons, following the expansionary monetary policy shock. While long-term credit creation also rises for low default probability firms, the responses are comparatively small. Second, the channels predict that monetary policy plays an allocative role by reshuffling credit between high and low default probability firms. Because long-term credit destruction also rises, at each horizon, for low default probability firms, this suggests that credit may be reshuffled from

low default probability firms to high default probability firms. As short-term credit destruction falls for low default probability firms, there are no corresponding increases in short-term credit creation for high default probability firms.

These results support the aspect of monetary policy that eases collateral constraints, that cause lenders to search for yield, and alters lenders' perception of risk. This hinges upon the notion that high default probability firms are likely to be financially constrained and are perceived as relatively risky to the lender.

4.4.3 Leverage Grouping

As with high default probability firms, highly leveraged firms' credit creation ought to rise when expansionary monetary policy eases collateral constraints and lowers external financing costs. Via the investment channel (Ottonello and Winberry, 2018), highly leveraged firms' credit creation rises relatively less than low leverage firms following expansionary monetary policy. This occurs because highly leveraged, financially constrained firms have steeper marginal cost curves for investment, and their need for external financing rises relatively less in response to monetary easing. Also, expansionary monetary policy positively impacts firms' cash flows as variable interest expenses fall (Mishkin, 1996; Ippolito, Ozdagli, and Perez-Orive, 2018). Because firms' need for external financing declines, credit creation also falls, especially for highly leverage firms.

What do the results suggest about the channels of monetary policy? From Table 4, the responses of only low leverage firms' short- and long-term credit creation is significant at the four and twelve quarter horizons, respectively. However, the floating rate mechanism predicts that credit creation ought to fall for *high* leverage firms, so these results do not support this prediction. If high leverage firms are also financially constrained, then, expansionary monetary policy eases financial constraints and credit ought to increase for highly leveraged firms following the shock. There are no significant increases in the long-term credit creation of this group at any horizon, therefore providing no support for this mechanism when classifying firms by their leverage ratios. By the risk-taking channel, funds will be channeled from risky firms to less risky firms, or vice versa. There are significant increases in the credit destruction of long-term credit for high leverage firms. This suggests that expansionary monetary policy leads to a contraction of credit from risky firms, in line with the risk-shifting mechanism. However, I find little evidence that funds are reshuffled toward low leverage firms apart from the twelve quarter horizon when credit creation slightly rises (0.12 percentage points) for low leverage firms.

4.4.4 Asset Size Grouping

Following the expansionary monetary policy shock, long-term credit creation for small firms significantly increases 0.80 percentage points after four quarters. If small firms are financially constrained, then this is consistent with the balance sheet channel regarding monetary policy's impact on easing these firms' financial constraints for long-term debt. This result is also consistent with the searching for yield and risk perception mechanisms at this maturity. By such mechanisms, credit creation ought to increase proportionately more for small firms following an expansionary monetary policy shock if these firms are perceived as riskier. There are no statistically significant increases in credit creation for *large* firms, which are less likely to be financially constrained and less likely to be perceived as risky. Therefore, these results do not provide support for the risk-shifting mechanism or the investment channel.

4.4.5 Financial Dependence Grouping

There are no statistically significant increases in credit creation for financially dependent firms following an expansionary monetary easing shock. This suggests that monetary easing does not operate through the easing of collateral constraints when classifying firms by their need for external financing. It is likely that the financial dependence ratio does not effectively group firms by their degree of financial constraints, as examined by Farre-Mensa and Ljungqvist (2016).

4.4.6 Age Grouping

From Table 4, short-term credit creation rises significantly for young firms four quarters after the shock (2.68 percentage points), but there are no significant increases in old firms' short-term credit creation following the shock. This evidence supports that monetary policy operates through the easing of financial constraints for young firms in short-term credit at short horizons because young firms are more likely to be financially constrained. There are not significant increases in the long-term credit creation of young firms in response to the shock, but there are for old firms at eight and twelve quarter horizons. This result is not inconsistent with this mechanism. The results support the searching for yield and risk perception mechanism, especially for short-term credit, because young firms tend to be perceived as relatively risky. Recall that, by the investment channel, credit creation ought to increase for both firms, but rise proportionally more for old firms that have flatter marginal cost curves for investment. These results show a significant increase in the long-term credit creation of old firms; this alone is consistent with this channel. However, I do not find significant increases in the long-term credit creation of young firms.

4.4.7 Liquid Asset Holdings Grouping

Firms that hold low levels of liquid assets may have two characteristics - being financially constrained and being reliant on variable interest rate debt (Jeenas, 2018). By the latter characteristic, monetary easing ought to increase cash flows as variable interest expenses fall, thereby limiting their need for external finance via the floating rate mechanism. The result is a larger decline in credit creation for low liquidity firms than high liquidity firms. By the former characteristic, to be consistent with the mechanism of the balance sheet channel concerning collateral constraints and the cost of external finance, credit creation ought to rise substantially for low liquidity firms as monetary policy eases their constraints and lowers their financing costs. Conversely, the investment channel implies that credit creation ought to rise relatively more for high liquidity firms.

Table 4 shows that long-term credit creation rises significantly for low liquidity firms twelve quarters following the shock, but the magnitude is small (0.19 percentage points). High liquidity firms' long-term credit creation does not change significantly at any horizon. At the twelve quarter horizon, this is consistent with expansionary monetary policy's impact on easing only low liquidity firms' financial constraints. The results in the table also show that expansionary monetary policy promotes the reallocation of long-term credit of low liquidity firms more than that of high liquidity firms as credit reallocation rises 0.21 and 1.03 percentage points at eight and twelve quarter horizons, respectively, for the group. This occurs because credit destruction rises significantly at all horizons for low liquidity firms. Aside from the balance sheet channel, if lenders perceive low liquidity firms as being risky, then this is consistent with part of the risk-shifting mechanism. That is, lenders choose to contract lending to risky firms. However, because credit creation does not rise significantly for high liquidity firms, this does not support the channel's prediction that credit will be reshuffled from low to high liquidity firms.

4.5 Historical Decompositions

As these results show, expansionary monetary policy influences credit flows through easing collateral constraints, lowering external finance premia, and altering lender portfolio allocation decisions. To pinpoint the magnitude and evolution of these aspects, here, I construct historical decompositions for the groups of firms analyzed. Historical decompositions show how much of the fluctuations in the endogenous variables in the system, such as credit creation and credit destruction, are caused by the individual structural innovations, such as the monetary policy innovations.

Consider the SVAR in (8). If Y_t is covariance stationary, then its value in t is a function of all previous

structural innovations, which also pre-date the initial period. Because the effects of old innovations are small, an innocuous approximation of Y_t is

$$Y_t \approx \widehat{Y}_t = b + \sum_{s=0}^{t-1} \theta_s u_{t-s}. \tag{9}$$

The structural MA coefficient matrices, (θ_0, θ_1, ... ,θ_{T-1}), are responses of each element in Y_t to a single u_t shock at the horizon $h = 1, 2, ..., H$. So,

$$\frac{\partial Y_{t=h}}{\partial u_t'} = \theta_h \tag{10}$$

where θ_h is a $(K \times K)$ matrix. K is the number of variables and, therefore, the number of structural innovation series in the VAR. Each element of the θ_h is a $(H \times H)$ impulse response matrix.

Figure 7 plots the cumulative contributions of monetary policy innovations to credit reallocation for the groups of firms analyzed in this study. This shows that the contributions of the innovations are large and volatile for several groups, especially in the 1970s and 1980s. This is notable considering that, in aggregate, this was a period of low and stable credit destruction, but larger and more volatile credit creation. Among groups of firms across time, the contributions of the monetary policy innovations do not tend to follow similar patterns. For instance, the contributions of the monetary policy innovations are largest in the late 1970s and early 1980s for low leverage firms and high liquidity firms. The contribution for financially dependent firms is also large during this time, but also more volatile.

Following this time, the contributions are small and rather stable until the Great Recession. For several groups, the contribution of monetary policy innovations to credit reallocation dips after the onset of the recession. This is most pronounced for financially dependent firms and young firms. It is also observed that, following the dip, the contributions tend to increase by the official end of the recession as the Federal Reserve embarked on several rounds of quantitative easing during the zero lower bound. This topic is addressed in greater detail by Bianco and Herrera (2020), who analyze the effect of unconventional monetary policy on credit flows during the zero lower bound.

5 Monetary Policy's Influence on Investment Intensity

So far, this paper has focused on the response of credit flows to monetary policy shocks. Yet, ultimately the question of interest for policymakers and academics likely regards whether monetary policy aids or hinders the reallocation of credit from less profitable to more profitable firms and investment projects. Because

Compustat does not provide detail on individual investment projects, I am not able to determine if credit is used to finance such projects. To capture the extent to which firms' credit reallocation rises along the spectrum of firms based on the *intensity* of investment, following Rajan and Zingales (1998), I utilize the ratio of capital expenditures to net property, plant, and equipment.[27] High investment intensity firms are those that have ample profitable investment opportunities, thus when credit flows to such firms, this is likely to lead to economic growth.

Table 5 shows the average and standard deviation of this ratio for subsets of firms across time.[28] From this table, it is unclear if investment intensity tends to be higher for risky and financially constrained firms. Investment intensity is smallest, on average, for large firms, but is largest for high liquidity firms. These are both features of non-financially constrained and less risky firms, but these groups have significantly different investment intensity. Still, as the table shows, investment intensity is significantly larger for high default probability firms, small firms, financially dependent firms, and young firms compared to low default probability firms, large firms, non-financially dependent firms, and old firms. This suggests that investment intensity tends to be larger for firms that are financially constrained and perceived as relatively risky by those measures, and that monetary policy brings out credit reallocation of such firms.

Recall that, in response to an expansionary monetary easing shock, long-term credit creation rises substantially for high default probability firms. As Table 5 shows, the average investment intensity of these firms is high, reaching as high as 0.377 in the 1990s. This suggests that expansionary monetary policy may have had a positive impact on capital formation and productivity. Further, expansionary monetary policy brings about significant long-term credit creation of small firms and old firms. Investment intensity tends to be large for the former group, but small for the latter group, so the overall effect is unclear. Figure 8 shows the impulse responses of total credit creation and destruction for high investment intensity firms (top tercile) and low investment intensity firms (bottom tercile) to an expansionary monetary policy shock. This shows that the responses of the credit flow measures significantly increase at medium term horizons. However, the responses of both credit creation and destruction are larger for high investment intensity firms. Credit creation rises nearly 0.20 percentage points after eight quarters for high investment intensity firms while is rises just over 0.14 percentage points for low investment intensity firms. These result in relatively larger increases in gross and excess credit reallocation following an expansionary monetary policy shock. This suggests that expansionary monetary policy may have a positive impact on future economic growth by

[27] In analyzing credit reallocation and future capital formation and productivity, Herrera, Kolar, and Minetti (2014) utilize an index of investment efficiency to test the impact of interstate financial deregulation on states' capital productivity growth through the reallocation of credit. Bianco and Herrera (2020) utilize a measure of credit efficiency to show that unconventional monetary policy in the late 2000s and early 2010s brought about credit reallocation of firms of high credit efficiency.

[28] The top and bottom 2.5 percent of indexes are trimmed in the calculation of these statistics.

aiding in the intensity of investment.

6 Conclusion

In this paper, I show that expansionary monetary policy leads to substantial reallocation of credit, especially of long-term credit. In aggregate, this stems from significant increases in long-term credit creation and credit destruction at multiple horizons following an expansionary monetary policy shock. Among groups of firms, the positive effect on long-term credit creation is largest for high default probability firms. While smaller in magnitude, there is also a significant increase in the long-term credit creation of small firms compared to large firms. These results are consistent with the easing of collateral constraints that ensue by expansionary monetary policy, as purported by the balance sheet channel. This result is also implied by the searching for yield and risk perception mechanisms of the risk-taking channel if these firms are perceived by the lender as being relatively risky borrowers. This result is also consistent with these mechanisms of monetary policy. For short-term credit, among firms, the only significantly increase in credit creation arises for young firms following an expansionary monetary policy shock. There is also a significant increase in the long-term credit creation of old firms following an expansionary monetary policy shock. While this result is predicted from the investment channel, there is no significant, yet small, increase in the long-term credit creation of young firms as predicted by the channel. I also do not find support for the floating rate mechanism or risk-shifting mechanism of monetary policy as pertinent to monetary policy. That is, expansionary monetary policy does not cause credit creation to fall for highly leveraged firms or cause credit to be reallocated from risky firms to less risky firms.

I find that, historically, the contribution of monetary policy innovations to credit reallocation is large and volatile, especially in the late 1970s, early 1980s, and late 2000s. Among groups of firms, during the Great Recession and the subsequent rounds of quantitative easing, as the result of the innovations, credit reallocation tended to rise notably for low leverage firms and high liquidity firms. During the round of quantitative easing in the late 2000s and early 2010s, the contributions of monetary policy innovations to credit reallocation were rather stable and consistent among groups.

These results have important implications for capital formation. I show that long-term credit creation significantly increases for high default probability firms following an expansionary monetary easing shock. On average, these firms have considerably high investment intensity. I also find that investment intensity tends to be larger, in general, for firms that are likely to be perceived as risky and those that are financially constrained. In response to an expansionary monetary policy shock, I also show that the increase in credit

creation of high investment intensity firms is significant and larger than that of low investment intensity firm. This suggests that monetary policy has an overall positive impact on capital formation through impacting credit flows.

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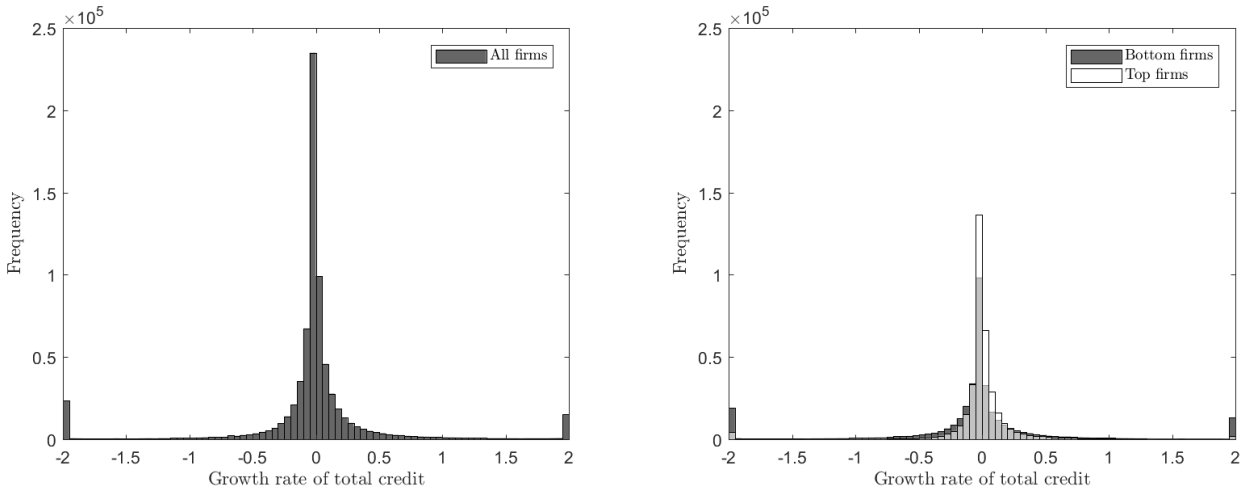
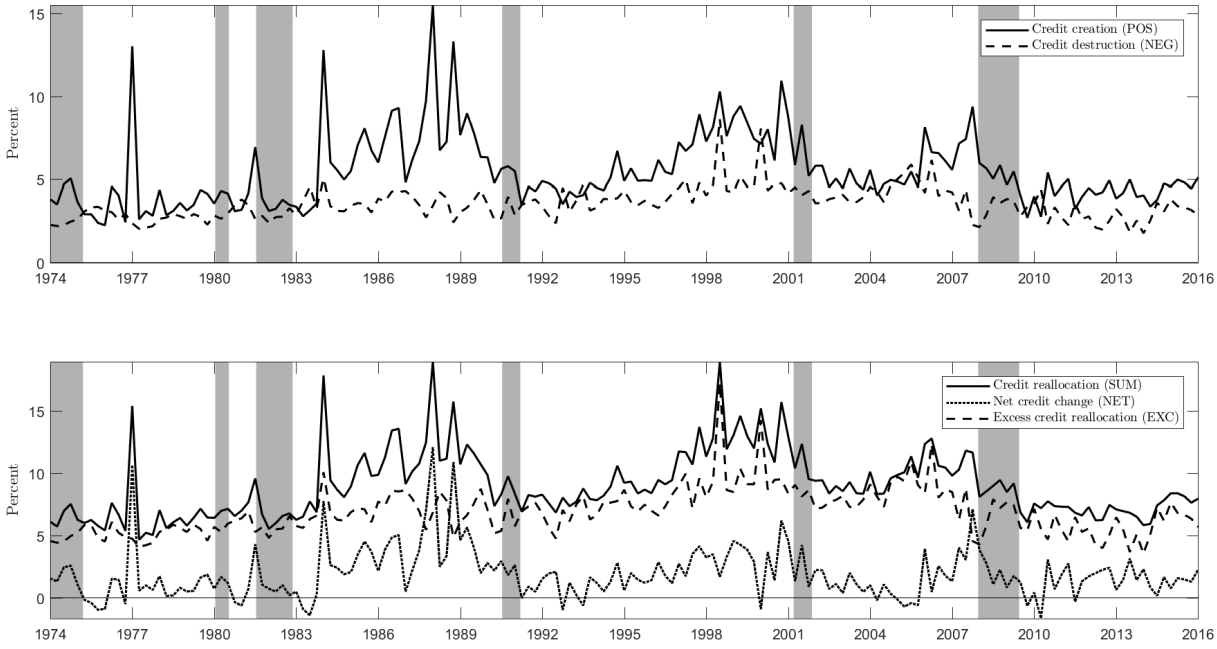
7 Figures

Figure 1: Growth Rates of Total Credit



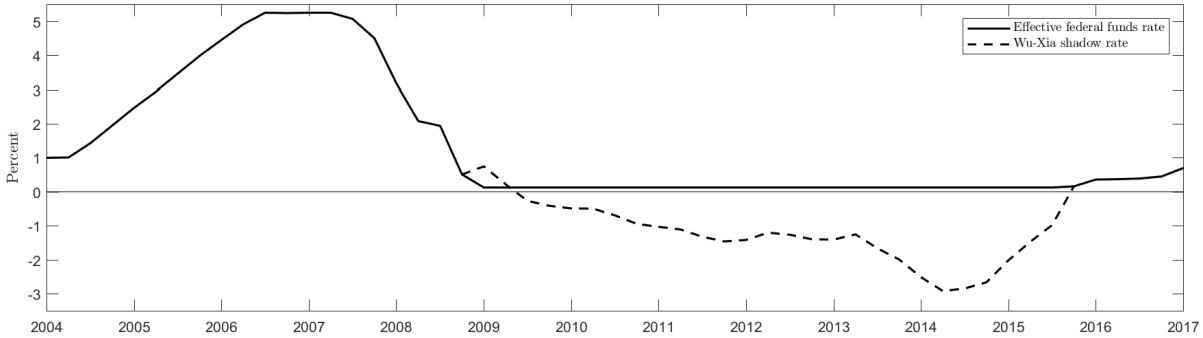
Note: The growth rate of total credit is $g_{it} = \frac{debt_{it} - debt_{it-1}}{(debt_{it} + debt_{it-1})/2}$, which is bounded between -2 and 2. Top firms refer to firms by which total credit is above the median at a point in time and bottom firms refers to firms by which total credit is below the median at a point in time.

Figure 2: Total Credit Measures of Publicly Traded Firms



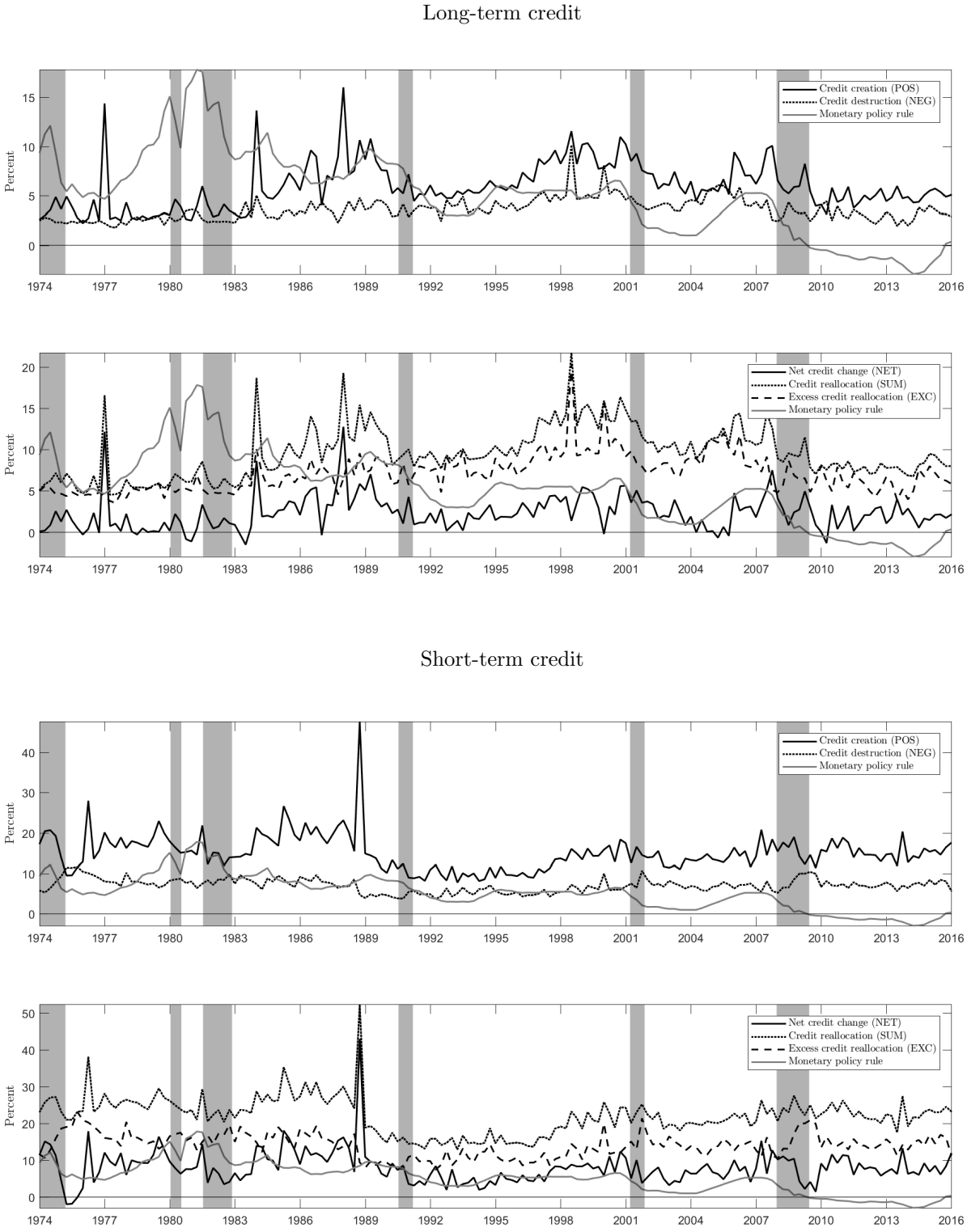
Note: POS refers to credit creation, NEG is credit destruction, NET is net credit change ($NET_{st} = POS_{st} - NEG_{st}$), SUM is credit reallocation ($SUM_{st} = POS_{st} + NEG_{st}$), and EXC is excess credit reallocation ($EXC_{st} = SUM_{st} - |NET_{st}|$) for total credit for all firms. Shaded bars indicate NBER recessions.

Figure 3: The Shadow Rate and Effective Federal Funds Rate



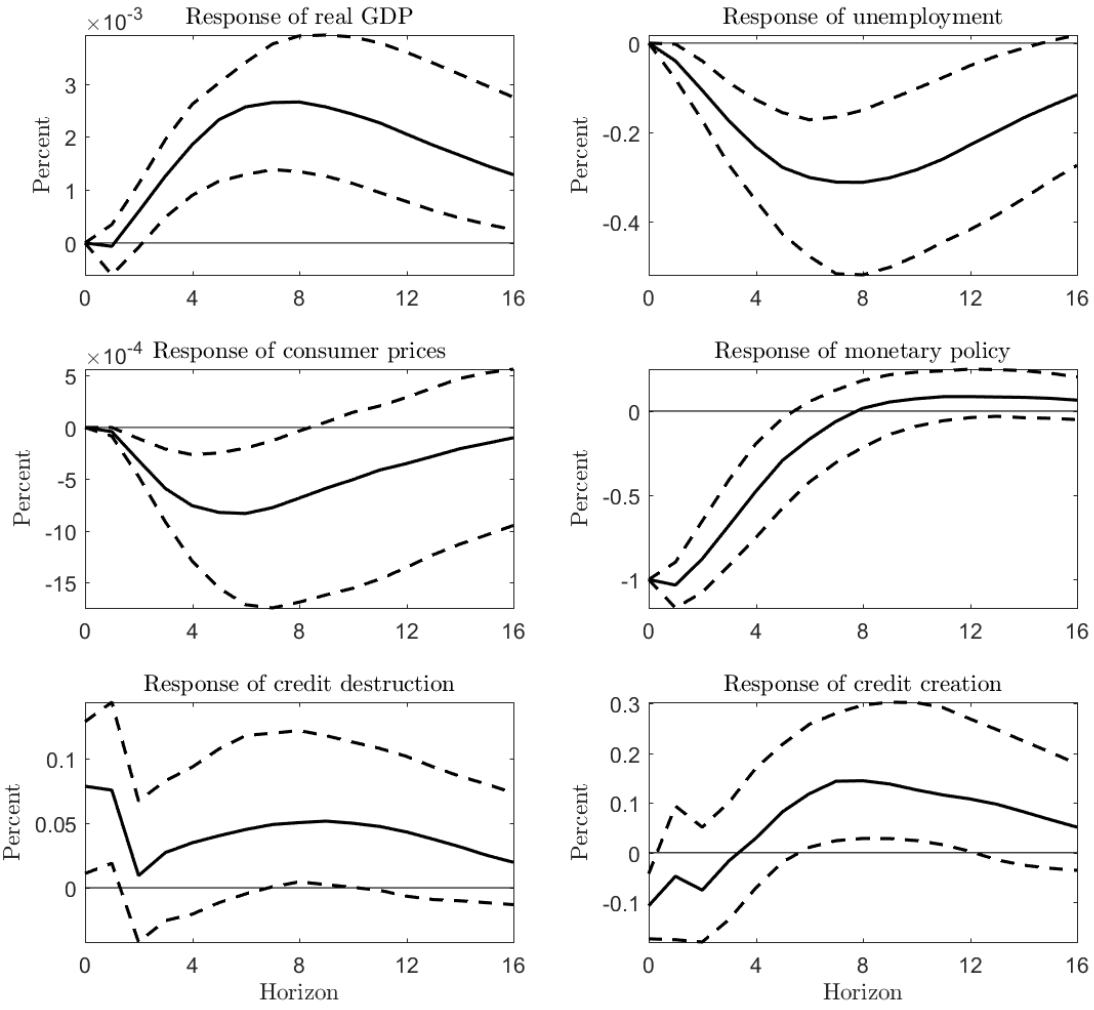
Note: The effective federal funds rate comes from the Federal Reserve Board's H.15 release and the Wu Xia shadow rate comes from the Federal Reserve Bank of Atlanta.

Figure 4: The Monetary Policy Rate and Credit Flow Measures



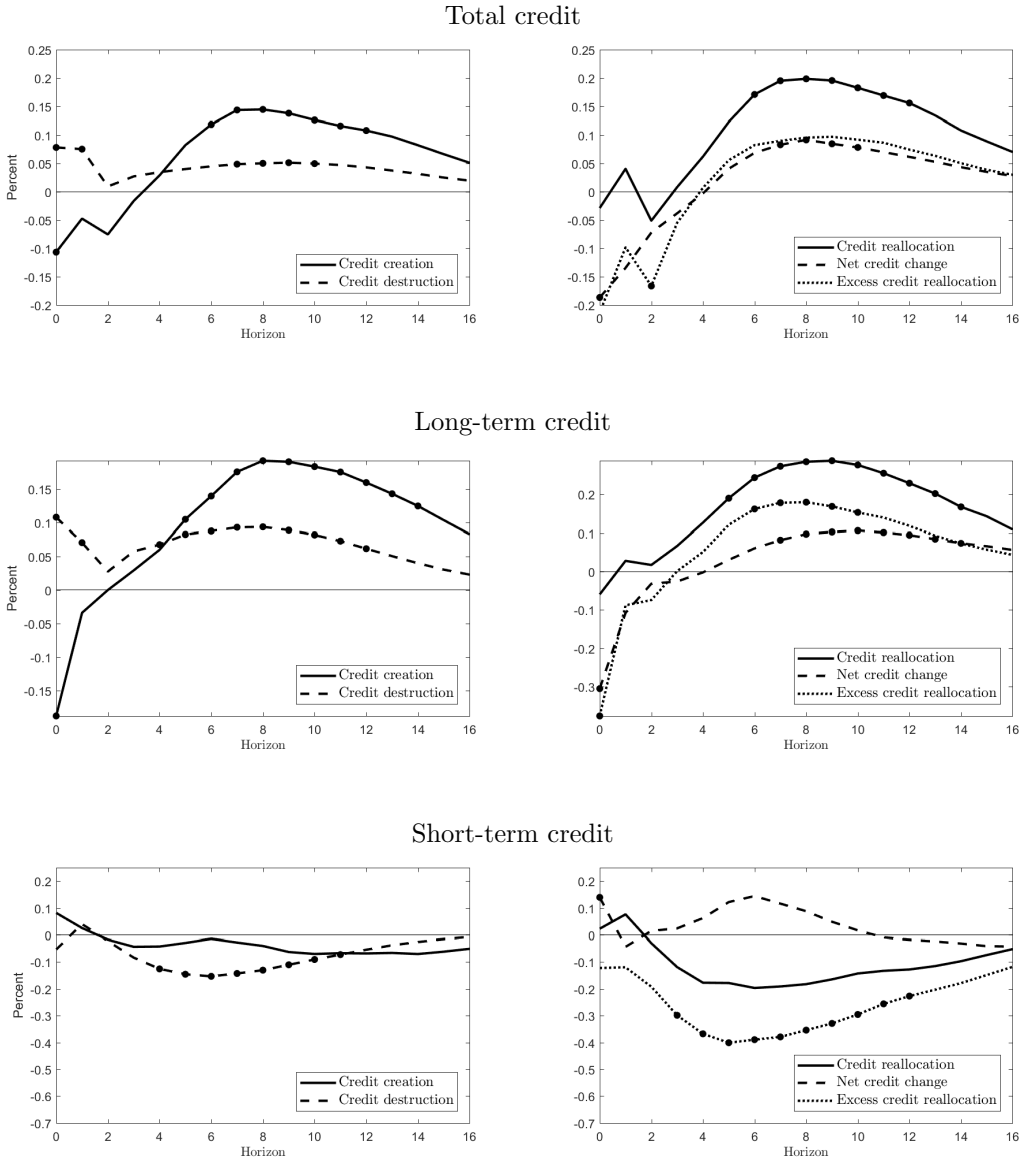
Note: This monetary policy rate is the effective federal funds rate during normal times, but the Wu-Xia shadow rate during the zero lower bound period. Shaded bars indicate NBER recessions.

Figure 5: Impulse Responses to an Expansionary Monetary Policy Shock



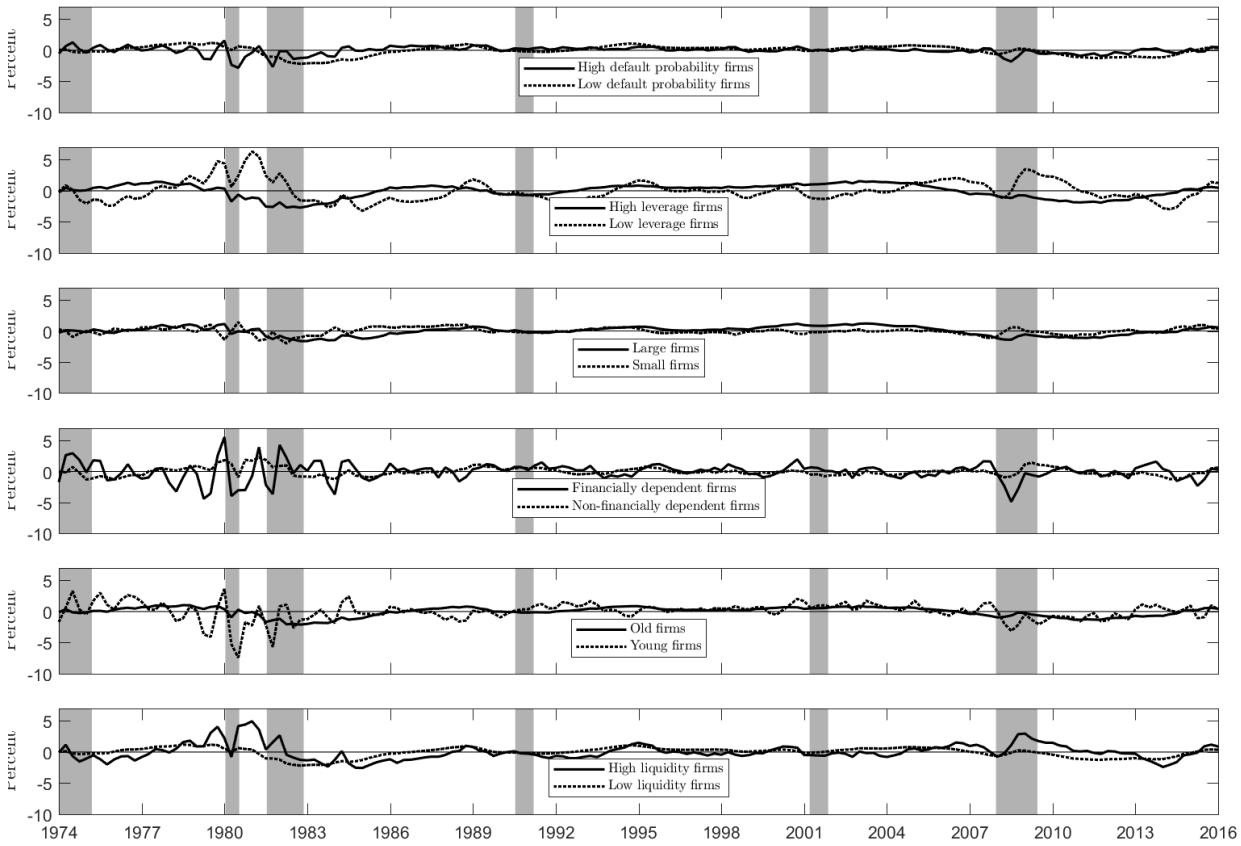
Note: These graphs plot quarterly impulse responses to a -100 basis point monetary policy shock. The impulse responses are derived from a VAR that includes a block of macroeconomic variables, the monetary policy rate, and two credit flow measures. It includes a constant and two lags, chosen by BIC. The bands represent the 68 percent mean-bias-corrected residual-based wild bootstrap interval with 10,000 repetitions.

Figure 6: Impulse Responses of Credit Flows to an Expansionary Monetary Policy Shock



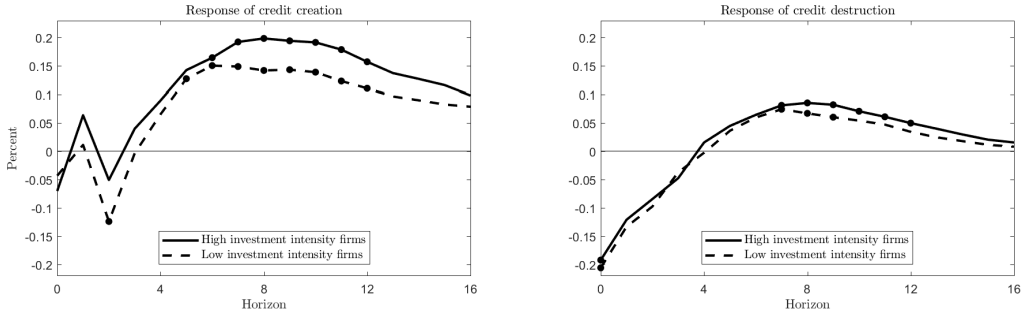
Note: These graphs plot quarterly impulse responses to a -100 basis point monetary policy shock. The impulse responses are derived from a VAR that includes a block of macroeconomic variables, the monetary policy rate, and two credit flow measures. It includes a constant and two lags, chosen by BIC. The dots indicate 68 percent statistical significance using the mean-bias-corrected residual-based wild bootstrap method with 10,000 repetitions.

Figure 7: Historical Contribution of Monetary Policy Shocks to Credit Reallocation



Note: These graphs shows the cumulative historical contribution of monetary policy shocks to credit flow measures. These results are derived from a VAR that includes a block of macroeconomic variables, the monetary policy rate, two aggregate credit flow measures, and two group credit flow measures. The VAR includes a constant and two lags, chosen by BIC. Firms with a probability of default exceeding 25 percent at a point in time are high default probability firms, and all others are low default probability firms. High leverage firms are those with a leverage ratio in the top tercile of firms in each quarter, and low leverage firms are those with the ratio in the bottom tercile. Large firms are those with an asset value in the top tercile of firms in each quarter, and small firms are those in the bottom tercile. Financially dependent firms are those by which the ratio of capital spending less operating cash flow as a percentage of capital spending is in the top tercile of firms in each quarter, and non-financially dependent firms are those by which the ratio is in the bottom tercile. Young firms are those by which the number of years listed in Compustat is in the bottom tercile, and old firms are those in the top tercile. High liquidity firms are those by which the ratio of cash and short-term investments to total assets is in the top tercile of firms in each quarter, and low liquidity firms are those by which the ratio is in the bottom tercile. Shaded bars indicate NBER recessions.

Figure 8: Impulse Responses to an Expansionary Monetary Policy Shock



Note: These graphs plot quarterly impulse responses to a -100 basis point monetary policy shock. The impulse responses are derived from a VAR that includes a block of macroeconomic variables, the monetary policy rate, aggregate credit flow measures, and credit flow measures for high and low investment intensity firms. It includes a constant and two lags, chosen by BIC. The bands represent the 68 percent mean-bias-corrected residual-based wild bootstrap interval with 10,000 repetitions.

8 Tables

Table 1: Descriptive Statistics of Quarterly Credit Flow Measures

	Average					Coefficient of variation				
	NEG	POS	NET	SUM	EXC	NEG	POS	NET	SUM	EXC
1974:Q1–1979:Q4	2.66	3.87	1.22	6.53	5.07	14.52	54.21	183.30	31.16	11.73
1980:Q1–1989:Q4	3.44	6.25	2.81	9.69	6.72	18.20	47.74	104.03	32.71	17.98
1990:Q1–1999:Q4	3.92	5.88	1.96	9.80	7.76	25.87	29.19	67.05	25.46	25.88
2000:Q1–2009:Q4	4.17	5.89	1.73	10.06	8.15	24.84	27.57	107.43	19.85	22.60
2010:Q1–2017:Q1	2.93	4.29	1.36	7.22	5.71	21.36	15.10	76.24	10.18	19.02

Note: This table reports averages and coefficients of variation of total credit flow measures for publicly traded firms. NEG is credit destruction, POS refers to credit creation, NET is net credit change ($NET_{st} = POS_{st} - NEG_{st}$), SUM is credit reallocation ($SUM_{st} = POS_{st} + NEG_{st}$), and EXC is excess credit reallocation ($EXC_{st} = SUM_{st} - |NET_{st}|$).

Table 2: Frequency of Quarter-Firm Observations

	Low default probability	High default probability	Low leverage	High leverage	Small	Large	Non-financially dependent	Financially dependent	Young	Old	Low liquidity	High liquidity
Low default probability	613,193	0										
High default probability	0	141,151										
Low leverage	124,265	122,191	292,601	0								
High leverage	240,634	5,513	0	292,482								
Small	184,755	50,828	137,543	78,717	294,158	0						
Large	229,920	31,911	41,231	131,746	0	294,034						
Non-financially dependent	162,874	46,316	84,244	67,389	75,224	72,273	241,115	0				
Financially dependent	154,853	34,027	73,968	85,412	86,962	67,712	0	240,996				
Young	142,445	41,565	118,161	90,218	141,228	48,745	65,476	104,620	323,172	0		
Old	237,831	41,776	69,437	99,847	47,514	162,399	91,682	54,844	0	287,907		
Low liquidity	235,558	13,836	32,151	149,686	70,983	129,730	69,972	80,593	82,604	114,017	292,464	0
High liquidity	149,618	91,977	187,108	40,939	138,592	46,503	82,156	76,346	121,846	62,763	0	292,352

Note: This table shows the number of quarter-firm observations per group over the period 1974:Q1–2017:Q1. Firms with a probability of default exceeding 25 percent at a point in time are high default probability firms, and all others are low default probability firms. High leverage firms are those with a leverage ratio in the top tercile of firms in each quarter, and low leverage firms are those with the ratio in the bottom tercile. Large firms are those with an asset value in the top tercile of firms in each quarter, and small firms are those in the bottom tercile. Financially dependent firms are those by which the ratio of capital spending less operating cash flow as a percentage of capital spending is in the top tercile of firms in each quarter, and non-financially dependent firms are those by which the ratio is in the bottom tercile. Young firms are those by which the number of years listed in Compustat is in the bottom tercile, and old firms are those in the top tercile. High liquidity firms are those by which the ratio of cash and short-term investments to total assets is in the top tercile of firms in each quarter, and low liquidity firms are those by which the ratio is in the bottom tercile.

Table 3: Descriptive Statistics of Credit Measures by Subset

	Average									
	Short-term credit					Long-term credit				
	NEG	POS	NET	SUM	EXC	NEG	POS	NET	SUM	EXC
High default probability	7.88	15.97	8.09	23.85	13.72	4.14	8.53	4.38	12.67	6.69
Low default probability	7.13	15.10	7.96	22.23	14.21	3.72	5.63	1.90	9.35	7.27
	[0.0877]	[0.2331]	[0.8804]	[0.0599]	[0.4306]	[0.1709]	[0.0000]	[0.0008]	[0.0000]	[0.0201]
High leverage	6.22	15.14	8.92	21.36	12.44	3.34	6.18	2.84	9.52	6.60
Low leverage	11.61	19.99	8.38	31.60	21.09	7.22	7.10	-0.12	14.32	10.45
	[0.0000]	[0.0000]	[0.5989]	[0.0000]	[0.0000]	[0.0000]	[0.0274]	[0.0000]	[0.0000]	[0.0000]
Large	6.88	14.74	7.86	21.62	13.69	3.50	5.77	2.27	9.26	6.90
Small	12.75	24.24	11.49	36.99	25.37	8.34	16.24	7.90	24.58	16.55
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Financially dependent	7.23	16.10	8.87	23.33	13.02	3.56	6.95	3.39	10.51	6.12
Non-financially dependent	8.99	18.41	9.41	27.40	16.39	4.95	7.18	2.24	12.13	8.23
	[0.0004]	[0.0203]	[0.6461]	[0.0001]	[0.0000]	[0.0000]	[0.6521]	[0.0682]	[0.0035]	[0.0000]
Old	6.80	14.88	8.08	21.67	13.50	2.97	5.41	2.44	8.37	5.84
Young	5.47	16.67	11.21	22.14	10.89	2.62	8.30	5.68	10.92	5.19
	[0.0000]	[0.0258]	[0.0002]	[0.5704]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0001]
High liquidity	6.29	18.06	11.77	24.36	12.31	3.87	9.33	5.46	13.20	7.43
Low liquidity	8.57	18.73	10.16	27.29	16.99	3.24	4.95	1.71	8.18	6.18
	[0.0000]	[0.5022]	[0.0769]	[0.0121]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]

	Coefficient of variation									
	Short-term credit					Long-term credit				
	NEG	POS	NET	SUM	EXC	NEG	POS	NET	SUM	EXC
High default probability	69.42	59.05	132.63	46.46	54.66	91.79	99.77	223.74	69.46	46.19
Low default probability	25.67	33.11	63.07	25.28	25.05	33.87	37.30	93.68	31.76	32.19
High leverage	31.35	41.81	69.28	32.91	31.43	39.52	49.84	98.24	40.34	39.70
Low leverage	45.05	56.18	139.38	41.3	39.97	66.07	69.30	-5066.67	52.72	49.67
Large	24.42	30.73	58.52	23.40	23.52	33.71	42.46	93.83	34.56	33.91
Small	27.37	21.04	54.4	16.55	26.09	26.62	32.82	70.89	24.17	25.74
Financially dependent	76.07	63.79	134.72	48.65	53.07	55.90	78.13	173.45	54.04	48.69
Non-financially dependent	49.94	51.22	118.60	35.33	42.46	66.26	70.61	266.96	50.21	50.91
Old	29.56	41.06	76.11	30.92	28.44	30.64	44.73	91.8	34.53	30.31
Young	44.61	56.51	86.53	44.04	43.99	30.92	66.51	99.65	50.27	29.87
High liquidity	61.53	63.62	88.02	56.08	59.46	43.15	52.09	88.10	41.29	44.15
Low liquidity	26.25	33.74	62.50	25.80	25.25	36.42	43.43	121.64	33.99	33.17

Note: This table reports averages, p-values of a two-sided t-test for mean equivalence in brackets, and coefficients of variation for subsets of firms. Firms with a probability of default exceeding 25 percent at a point in time are high default probability firms, and all others are low default probability firms. High leverage firms are those with a leverage ratio in the top tercile of firms in each quarter, and low leverage firms are those with the ratio in the bottom tercile. Large firms are those with an asset value in the top tercile of firms in each quarter, and small firms are those in the bottom tercile. Financially dependent firms are those by which the ratio of capital spending less operating cash flow as a percentage of capital spending is in the top tercile of firms in each quarter, and non-financially dependent firms are those by which the ratio is in the bottom tercile. Young firms are those by which the number of years listed in Compustat is in the bottom tercile, and old firms are those in the top tercile. High liquidity firms are those by which the ratio of cash and short-term investments to total assets is in the top tercile of firms in each quarter, and low liquidity firms are those by which the ratio is in the bottom tercile.

Table 4: Cumulative Impulse Responses of Credit Flows to an Expansionary Monetary Policy Shock

Long-term credit

	After four quarters					After eight quarters					After twelve quarters				
	NEG	POS	NET	SUM	EXC	NEG	POS	NET	SUM	EXC	NEG	POS	NET	SUM	EXC
High default probability	0.76	0.19	-0.58	0.99	-1.67	0.67	**1.74**	**0.91**	2.39	-1.88	0.40	**3.06**	**2.62**	3.42	-2.44
Low default probability	**0.27**	-0.32	**-0.59**	-0.04	-0.71	**0.64**	**0.01**	-0.64	**0.64**	-0.19	**0.94**	**0.55**	**-0.41**	**1.48**	0.40
High leverage	**0.28**	-0.20	-0.50	0.08	-0.62	**0.75**	0.24	-0.51	**0.98**	-0.02	**1.14**	0.88	-0.28	1.99	0.67
Low leverage	0.23	-0.39	-0.54	-0.21	-1.91	0.52	-0.36	-0.72	0.09	-2.10	0.77	**0.12**	-0.53	0.80	-1.72
Large	0.48	-0.79	**-1.30**	-0.35	-1.93	0.70	-0.58	-1.33	0.03	-2.02	0.80	-0.46	-1.32	0.22	-2.14
Small	0.40	**0.80**	**0.39**	**1.11**	-0.34	0.45	1.66	1.24	**2.03**	-0.40	**0.75**	1.67	0.95	2.35	-0.60
Financially dependent	0.23	0.22	0.04	0.44	**-0.99**	0.40	0.46	0.11	0.84	-1.14	**0.71**	0.79	0.13	1.50	-0.88
Non-financially dependent	-0.36	-0.07	0.34	-0.42	-1.79	-0.15	0.09	0.33	-0.10	-1.96	0.13	0.68	0.61	0.76	-1.57
Old	0.21	-0.01	-0.19	0.20	-0.32	0.45	**0.55**	**0.16**	**1.01**	0.06	0.60	**1.33**	**0.79**	1.93	0.36
Young	**0.06**	1.17	1.12	**1.22**	-0.10	**0.36**	1.74	1.38	**2.08**	0.40	**0.62**	2.01	1.41	2.60	0.73
High liquidity	-0.41	0.15	0.53	-0.22	**-1.38**	-0.37	0.31	0.69	0.02	-1.60	**-0.10**	0.74	0.80	0.71	-1.24
Low liquidity	**0.22**	-0.46	**-0.71**	-0.24	-0.97	**0.54**	**-0.35**	-0.94	**0.21**	**-0.79**	**0.84**	**0.19**	**-0.71**	**1.03**	**-0.22**

Short-term credit

	After four quarters					After eight quarters					After twelve quarters				
	NEG	POS	NET	SUM	EXC	NEG	POS	NET	SUM	EXC	NEG	POS	NET	SUM	EXC
High default probability	0.99	-0.13	-1.09	0.91	-1.38	0.83	-0.83	-1.59	0.08	**-3.32**	0.48	-1.57	-2.06	-0.96	**-5.32**
Low default probability	**-0.29**	1.45	**1.73**	1.17	**-1.04**	**-1.04**	1.61	2.68	0.54	**-2.82**	**-1.52**	1.25	2.72	**-0.32**	**-4.33**
High leverage	**-0.17**	1.05	1.30	0.90	**-0.96**	-0.74	1.26	2.06	0.56	**-2.50**	-1.13	0.68	1.88	-0.38	-4.06
Low leverage	**-0.84**	**-4.22**	-3.50	**-4.93**	**-8.76**	-1.32	-4.64	-3.48	-5.76	-10.48	-1.59	-3.97	**-2.56**	-5.44	-11.13
Large	-0.13	0.98	0.98	0.84	-2.32	-0.37	4.46	4.82	4.04	-3.20	-0.57	6.10	6.58	5.43	-3.84
Small	-0.37	-0.09	0.30	-0.45	-1.80	-0.03	0.28	0.43	0.23	-1.83	0.46	0.46	0.12	0.73	-1.90
Financially dependent	-0.56	-1.74	-1.28	-2.18	**-5.01**	**-1.90**	-3.54	-1.58	-5.35	**-9.14**	-2.65	-4.19	-1.44	-6.74	-11.39
Non-financially dependent	**-1.26**	1.52	2.62	**0.14**	**-3.34**	-2.16	0.91	2.91	-1.42	**-6.07**	-2.09	0.89	3.04	-1.40	-6.80
Old	**-0.44**	-0.07	0.36	-0.54	**-1.66**	**-1.35**	-0.40	0.94	**-1.78**	**-3.86**	**-1.98**	**-1.29**	0.72	**-3.34**	**-6.02**
Young	-0.08	**2.68**	**2.73**	**2.69**	-0.48	-0.14	4.07	4.12	4.06	-0.71	-0.09	4.05	3.96	4.12	-1.17
High liquidity	**-0.48**	**-4.32**	**-3.93**	**-4.69**	**-8.74**	-1.08	-6.41	-5.50	-7.42	**-12.93**	-1.16	-6.86	-5.90	-7.95	-13.98
Low liquidity	-0.13	1.36	1.47	1.27	**-0.59**	**-0.84**	1.80	2.63	0.99	**-2.46**	**-1.40**	1.32	2.68	**-0.03**	**-4.40**

Note: This table shows the cumulative percentage point response of credit flows to a -100 basis point monetary policy shock. The impulse responses are derived from a VAR that includes a block of macroeconomic variables, the shadow federal funds rate, and two credit flow measures. It includes a constant and two lags, as chosen by BIC. Bold responses are those that fall within the 68 percent mean-bias-corrected residual-based wild bootstrap interval with 10,000 repetitions. Firms with a probability of default exceeding 25 percent at a point in time are high default probability firms, and all others are low default probability firms. High leverage firms are those with a leverage ratio in the top tercile of firms in each quarter, and low leverage firms are those with the ratio in the bottom tercile. Large firms are those with an asset value in the top tercile of firms in each quarter, and small firms are those in the bottom tercile. Financially dependent firms are those by which the ratio of capital spending less operating cash flow as a percentage of capital spending is in the top tercile of firms in each quarter, and non-financially dependent firms are those by which the ratio is in the bottom tercile. Young firms are those by which the number of years listed in Compustat is in the bottom tercile, and old firms are those in the top tercile. High liquidity firms are those by which the ratio of cash and short-term investments to total assets is in the top tercile of firms in each quarter, and low liquidity firms are those by which the ratio is in the bottom tercile.

Table 5: Heterogeneity of Investment Intensity

	High default probability firms		**Low default probability firms**	
	Average	Standard deviation	Average	Standard deviation
1974:Q1–1979:Q4	0.258	0.114	0.212	0.104
1980:Q1–1989:Q4	0.315	0.188	0.233	0.155
1990:Q1–1999:Q4	0.377	0.212	0.235	0.164
2000:Q1–2009:Q4	0.340	0.211	0.227	0.174
2010:Q1–2017:Q1	0.289	0.221	0.215	0.185

	High leverage firms		**Low leverage firms**	
	Average	Standard deviation	Average	Standard deviation
1974:Q1–1979:Q4	0.188	0.107	0.235	0.105
1980:Q1–1989:Q4	0.214	0.169	0.311	0.190
1990:Q1–1999:Q4	0.211	0.168	0.374	0.222
2000:Q1–2009:Q4	0.199	0.167	0.350	0.226
2010:Q1–2017:Q1	0.200	0.186	0.303	0.245

	Large firms		**Small firms**	
	Average	Standard deviation	Average	Standard deviation
1974:Q1–1979:Q4	0.192	0.087	0.232	0.120
1980:Q1–1989:Q4	0.193	0.116	0.316	0.216
1990:Q1–1999:Q4	0.201	0.133	0.348	0.233
2000:Q1–2009:Q4	0.197	0.137	0.312	0.237
2010:Q1–2017:Q1	0.195	0.132	0.267	0.267

	Financially dependent firms		**Non-financially dependent firms**	
	Average	Standard deviation	Average	Standard deviation
1974:Q1–1979:Q4	0.206†	0.085	0.199†	0.107
1980:Q1–1989:Q4	0.318	0.215	0.233	0.170
1990:Q1–1999:Q4	0.333	0.212	0.261	0.195
2000:Q1–2009:Q4	0.302	0.214	0.240	0.193
2010:Q1–2017:Q1	0.270	0.216	0.243	0.204

	Old firms		**Young firms**	
	Average	Standard deviation	Average	Standard deviation
1974:Q1–1979:Q4	0.194	0.087	0.237	0.122
1980:Q1–1989:Q4	0.194	0.111	0.341	0.220
1990:Q1–1999:Q4	0.202	0.135	0.361	0.232
2000:Q1–2009:Q4	0.204	0.151	0.318	0.231
2010:Q1–2017:Q1	0.203	0.156	0.299	0.257

	High liquidity firms		**Low liquidity firms**	
	Average	Standard deviation	Average	Standard deviation
1974:Q1–1979:Q4	0.234	0.109	0.203	0.103
1980:Q1–1989:Q4	0.319	0.198	0.209	0.152
1990:Q1–1999:Q4	0.380	0.227	0.212	0.154
2000:Q1–2009:Q4	0.362	0.230	0.190	0.151
2010:Q1–2017:Q1	0.338	0.253	0.174	0.154

Note: This table provides the averages and standard deviation of investment intensity (Rajan and Zingales, 1998) by subsets of firms across time. The index is the ratio of capital expenditures to net property, plant, and equipment, where the top and bottom 2.5 percent are trimmed in calculation of these statistics. The † indicates that, using a two-sided t-test for mean equivalence, the means of investment intensity are not statistically different from one another at 5 percent. Firms with a probability of default exceeding 25 percent at a point in time are high default probability firms, and all others are low default probability firms. High leverage firms are those with a leverage ratio in the top tercile of firms in each quarter, and low leverage firms are those with the ratio in the bottom tercile. Large firms are those with an asset value in the top tercile of firms in each quarter, and small firms are those in the bottom tercile. Financially dependent firms are those by which the ratio of capital spending less operating cash flow as a percentage of capital spending is in the top tercile of firms in each quarter, and non-financially dependent firms are those by which the ratio is in the bottom tercile. Young firms are those by which the number of years listed in Compustat is in the bottom tercile, and old firms are those in the top tercile. High liquidity firms are those by which the ratio of cash and short-term investments to total assets is in the top tercile of firms in each quarter, and low liquidity firms are those by which the ratio is in the bottom tercile.

Appendix

Alternative Credit Flow Measure

Credit flow measures are calculated using quarterly growth rates of debt from Compustat North America. This follows HKM, who measure credit flow measures using annual growth rates over a longer horizon. The following table presents averages and coefficients of variation by decade using year-over-year growth rates. These more closely resemble credit flow measures constructed with annual data.

Descriptive Statistics of Quarterly Credit Flow Measures Using Annual Growth Rates

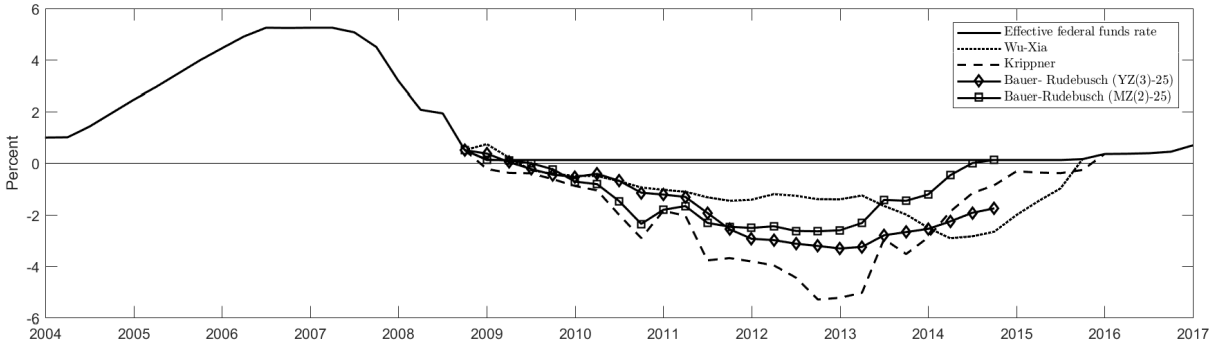
	Average					**Coefficient of variation**				
	NEG	POS	NET	SUM	EXC	NEG	POS	NET	SUM	EXC
1974:Q1–1979:Q4	5.56	10.68	5.12	16.24	10.86	25.49	53.30	119.86	34.39	22.85
1980:Q1–1989:Q4	7.05	20.02	12.97	27.08	13.89	22.92	54.36	84.12	40.98	20.82
1990:Q1–1999:Q4	7.55	14.95	7.40	22.50	14.97	32.88	39.00	71.40	32.17	32.70
2000:Q1–2009:Q4	8.38	17.27	8.89	25.66	16.64	25.19	32.08	71.54	21.30	24.19
2010:Q1–2017:Q1	6.44	13.23	6.79	19.67	12.88	22.37	13.31	36.02	10.62	22.37

Note: This table reports averages and coefficients of variation for of credit measures for publicly traded firms. NEG is credit destruction, POS refers to credit creation, NET is net credit change ($NET_{st} = POS_{st} - NEG_{st}$), SUM is credit reallocation ($SUM_{st} = POS_{st} + NEG_{st}$), and EXC is excess credit reallocation ($EXC_{st} = SUM_{st} - |NET_{st}|$).

Alternative Monetary Policy Rates

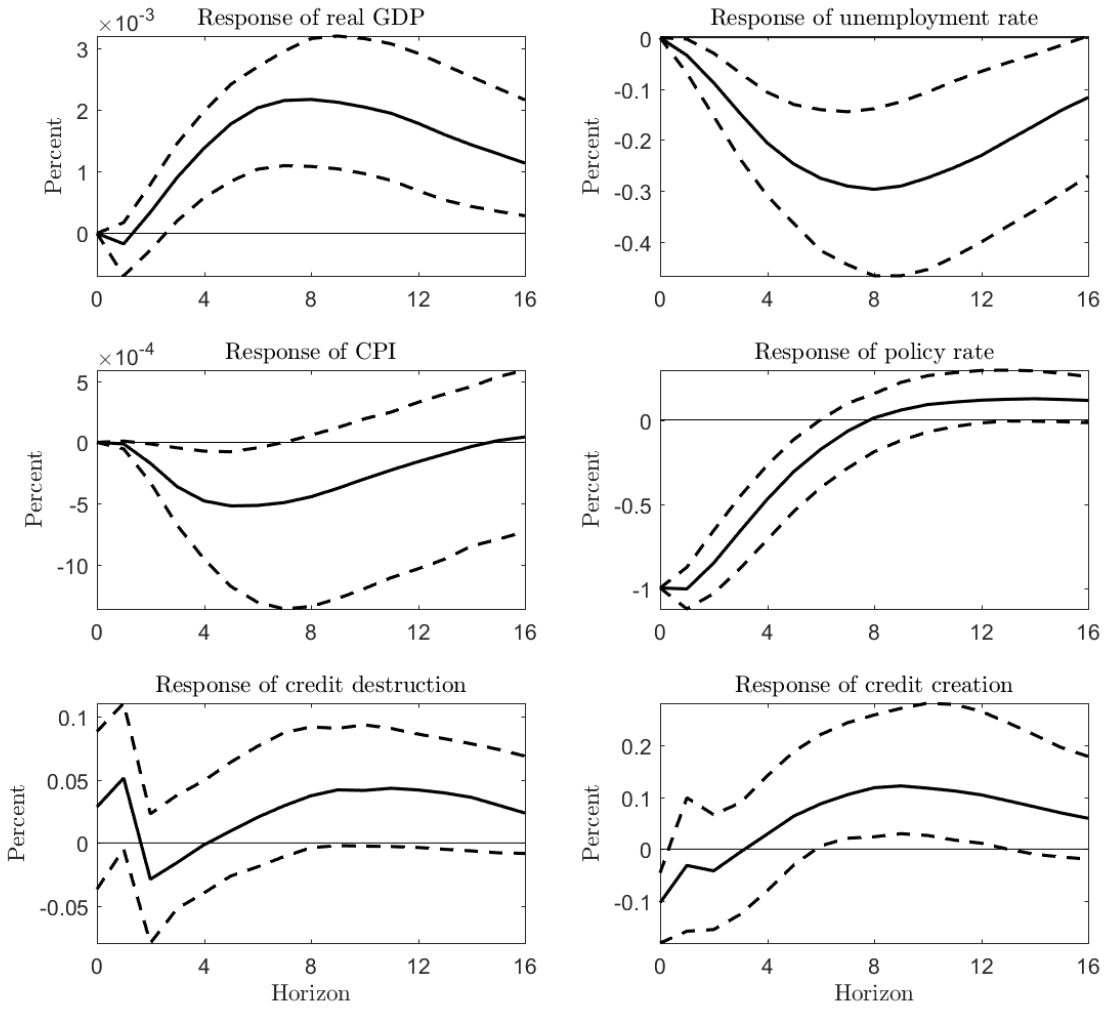
In the empirical analysis of the effect of monetary policy on credit flows, I utilize the effective federal funds rate in normal times and the Wu-Xia shadow rate during the zero lower bound. Alternative measures of monetary policy during the zero lower bound are by Krippner (2012) and Bauer and Rudebusch (2016). The following plots these rates along with the effective federal funds rate and the impulse responses derived from a VAR utilizing these alternative measures as monetary policy rates.

Alternative Monetary Policy Rates



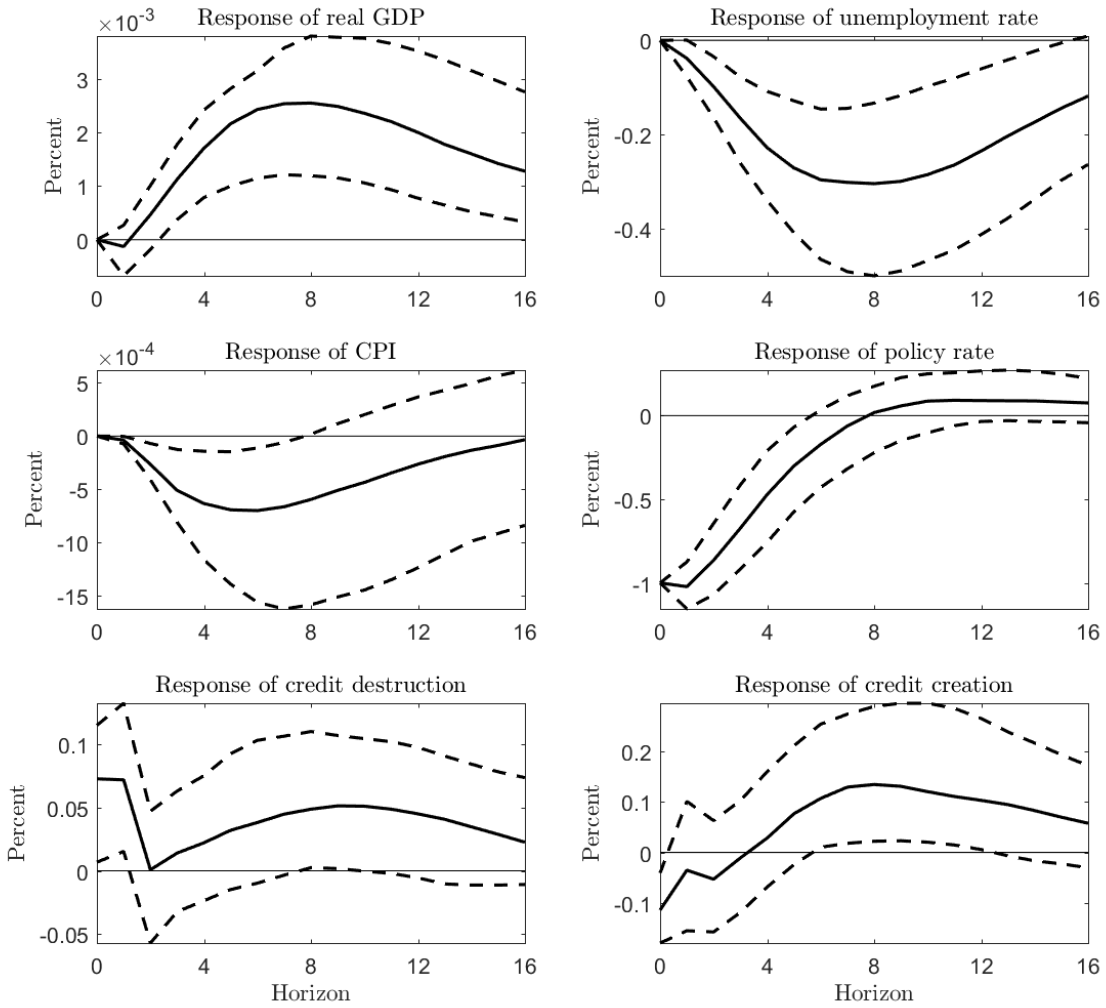
Source: Federal Reserve Board; Federal Reserve Bank of Atlanta; Federal Reserve Bank of San Francisco; Reserve Bank of New Zealand.

Impulse Responses to an Expansionary Monetary Policy Shock Using the Policy Rate by Krippner (2012)



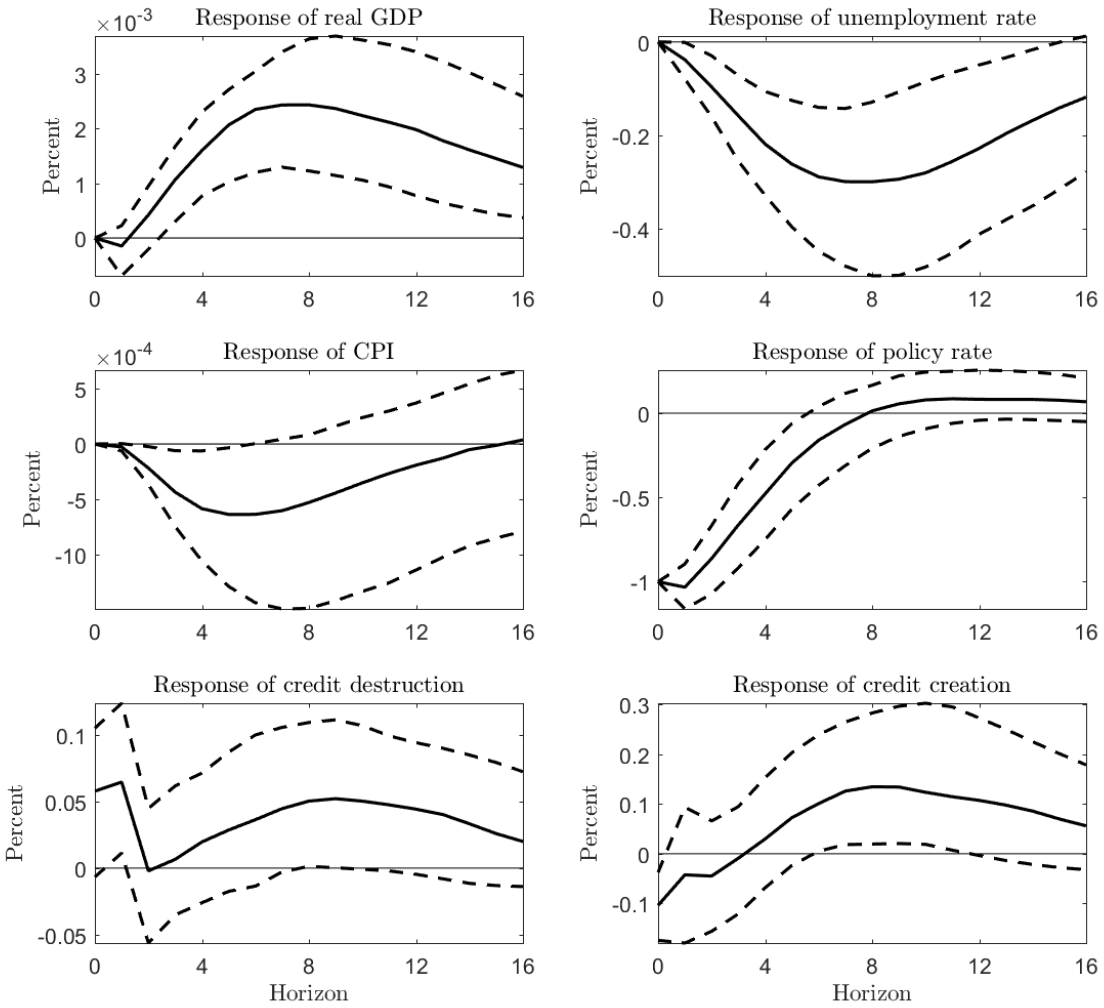
Note: These graphs plot quarterly impulse responses to a -100 basis point monetary policy shock. The impulse responses are derived from a VAR that includes a block of macroeconomic variables, the shadow short rate Krippner (2012), and two credit flow measures. It includes a constant and two lags, chosen by BIC. The bands represent the 68 percent mean-bias-corrected residual-based wild bootstrap interval with 10,000 repetitions.

Impulse Responses to an Expansionary Monetary Policy Shock Using the YZ(3)-25 Policy Rate by Bauerand Rudebusch (2016)



Note: These graphs plot quarterly impulse responses to a -100 basis point monetary policy shock. The impulse responses are derived from a VAR that includes a block of macroeconomic variables, the YZ(3)-25 policy rate Bauer and Rudebusch (2016), and two credit flow measures. It includes a constant and two lags, chosen by BIC. The bands represent the 68 percent mean-bias-corrected residual-based wild bootstrap interval with 10,000 repetitions.

Impulse Responses to an Expansionary Monetary Policy Shock Using the MZ(2)-25 Policy Rate by Bauerand Rudebusch (2016)



Note: These graphs plot quarterly impulse responses to a -100 basis point monetary policy shock. The impulse responses are derived from a VAR that includes a block of macroeconomic variables, the MZ(2)-25 policy rate Bauer and Rudebusch (2016), and two credit flow measures. It includes a constant and two lags, chosen by BIC. The bands represent the 68 percent mean-bias-corrected residual-based wild bootstrap interval with 10,000 repetitions.