CREDIT FRICTIONS, DEBT CHOICE AND THE TRANSMISSION OF MONETARY POLICY

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Abstract

This paper presents a model where shocks to interest rates, company earnings and the earnings of financial intermediaries all affect the investment of small but not large firms. These shocks also affect the extent of financial intermediation and companies' debt choice. Evidence from micro and macro data supports the model's predictions. I show that shocks which work by weakening the financial position of firms can explain a sizeable part of the growth slowdown in recessions. Conversely, I show that shocks which work by restricting the ability of financial intermediaries to lend are not significant. Consistent with this I find little evidence of a bank lending channel.
Credit Frictions, Debt Choice and the Transmission of Monetary Policy

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1. Introduction

One of the problems facing macroeconomics is trying to explain how small or seemingly irrelevant shocks (such as small increases in interest rates) can get translated into large, persistent changes in aggregate output? Some have suggested an explanation based on frictions in credit markets which propagate financial shocks that otherwise wouldn’t matter. Gertler and Gilchrist (1994), for instance, argue that if all firms could obtain credit easily - like large firms - then monetary policy would be much less effective (it would take a larger increase in interest rates to generate the same decline in investment). They show that, following a monetary contraction, inventories of small firms decline significantly relative to those of large firms. They argue this is due to the fact small firms have difficulty getting credit following a monetary contraction. However, their work leaves open the fundamental question of why small firms have difficulty getting credit after monetary contractions - is it because of problems inherent in small firms or is it due to difficulties faced by financial intermediaries (which lend mainly to small firms)? The answer to this question determines whether economists and policy makers should be focused on financial conditions faced by firms or those faced by their lenders.

To get at this question I consider several types of financial shocks. In the model that I present, a decline in company earnings, or an increase in the riskless interest rate, raises firms’ likelihood of default. Small firms, which have high costs of financial distress, will be shunned by lenders. Alternatively, a decline in the earnings of financial intermediaries makes it harder for lenders to finance their loans. Instead they will cut lending, leaving small companies which depend on them to curtail investment. I test these predictions and, unlike previous research, assess the relative importance of the
different financial propagation mechanisms\footnote{Bernanke (1983) is an exception. He includes deposits of failing banks and liabilities of failing businesses in a regression explaining declines in industrial production during the Great Depression and finds both significant.}. The different financial shocks also lead to different predictions on the debt choice of individual firms. This allows me to further discriminate between the importance of different financial propagation mechanisms.

The model is a variant of one developed in Cantillo (1995) and Cantillo and Wright (1995), in which there is costly state verification between lenders, and the businesses which borrow from them, and in which these businesses can choose to borrow either from intermediaries such as banks, or through publicly traded securities such as bonds. Key assumptions of the model are that investors face fixed costs of verifying the firm’s return and that, for small firms, banks induce lower bankruptcy costs than do bondholders. The model is used to obtain predictions on movements in debt choice and investment across firms of differing size, following shocks to the earnings of these firms as well as their lenders and riskless interest rates. It predicts that an increase in interest rates, or a decline in the earnings of either businesses or financial intermediaries, will result in a decline in the investment of small firms relative to that of large firms. Because small firms use intermediated debt, these shocks will also lead to financial disintermediation. At the micro level it predicts that when the earnings of financial intermediaries are weak, companies will bypass them, preferring instead to borrow directly from bondholders. The opposite is true when company earnings are weak, or interest rates are high - companies will borrow more through financial intermediaries.

To test these predictions I make use of three data sets - each of which differs in its degree of aggregation. I focus on the postwar period for the U.S. explaining fixed and inventory investment as well as short term credit flows. My findings show that lower company earnings and higher interest rates lead to financial disintermediation and lower investment of small vs. large manufacturing firms. Both types of shocks are significant both statistically and economically. In contrast, changes in the earnings of financial intermediaries have small and insignificant effects on the extent of financial intermediation and investment of small vs. large firms. I quantify these credit channels - showing that in total they can have significant macroeconomic effects. For instance, in the 1980 recession I calculate they were
responsible for a decline in investment worth more than one percent of GDP. Riskless interest rates and company earnings were roughly equally important determinants of small vs. large firm investment. In the two years after the five most sizeable interest rate hikes, the decline in small vs. large firm investment averaged 1.01% of GDP, while company earnings, using the same metric, accounted for a 0.99% decline in GDP. Earnings of financial intermediaries were less than half as important - accounting for a 0.41% decline in GDP.

I also provide evidence on whether higher interest rates cause disintermediation and a drop off in small firm investment because they (a) make small firms unattractive lending prospects or (b) limit financial intermediaries' ability to lend. I do this by using data on the debt choice of individual firms. I show that with higher interest rates individual firms are more likely to borrow from financial intermediaries - not less. This suggests that higher interest rates do not inhibit financial intermediaries from lending but rather lead all lenders to shun small firms.

Based on these findings the evidence for a so called "bank lending channel" is reconsidered. A bank lending channel posits that banks will have difficulty lending as a direct consequence of a monetary contraction. This difficulty stems from the fact when monetary reserves decline so must bank deposits - since banks face reserve requirements. Two types of evidence against the bank lending channel are presented. First, as mentioned above, I provide evidence that firms are more, not less, likely to borrow from financial intermediaries than use the public markets, after hikes in interest rates. The second point I make is that bank lending does not behave differently than lending from other financial intermediaries, after interest rate hikes. Finance company lending declines by at least as much as bank lending following monetary contractions. Since both types of intermediaries lend to small firms, the result challenges the notion that banks, as intermediaries facing reserve requirements, play a special role in monetary policy.

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2 The apparently contradictory result that higher interest rates lead to disintermediation at the same time they lead individual firms to be more likely to borrow from financial intermediaries compared to the public debt markets is in fact entirely consistent as can be seen in Theorem 3. This highlights the benefit of embedding a model of debt choice in a theory of financial propagation.
The rest of the paper proceeds as follows. Section 2 presents the model and its predictions. Section 3 presents the empirical results on the importance of financial and non-financial firms' earnings, as well as interest rates, for companies' debt choice and investment. Section 4 tests the bank lending channel and section 5 summarizes the findings and concludes with some questions raised by this work.

2. A Model

I set up a standard contract problem in which firms have risky investment projects which need to be financed. A central assumption of the model is that for investors to observe the return of a firm they must pay a fixed verification cost. This generates higher costs of financial distress for small firms. In addition I assume financial intermediaries' fixed verification costs are lower than are bondholders. This implies small firms will borrow from financial intermediaries and not bondholders.

**Firms:**
- There are a continuum of firms differing in the size of their projects, \( z \in [z, z] \) where \( z \) has a density function \( g(z) \).
- If a firm of size \( z \) invests more than \( z \) at time 0 it has a return of \( (s + u)z \) at time 1.
- If a firm of size \( z \) invests less than \( z \) the return is 0.
- \( u \) gives a measure of the profitability of a firm.
- The state \( s \) has a density function \( f(s) \), distribution function \( F(s) \), \( s \in [0, \infty) \) where \( \int_0^\infty sf(s)ds = 1 \).
- Firms have no equity so must raise \( z \) to complete the project.
- Firms are risk neutral.

**Lenders:**
- Firms observe \( s \) at time 1, but outside investors do not.
- Outsiders of type \( j \), can verify the firms earnings \( s \), at a cost, \( c_j(z) = c_jz + f_j \), where the parameter \( f_j \) captures the notion of a fixed verification cost.
• Gale and Hellwig (1985) showed that in this setup the optimal contract is a standard debt contract, in which the firm promises to make a fixed payment at time 1. If, and only if, the firm is unable to make this payment does the lender seize the firm's remaining assets - incurring the verification cost in the process.

• There are two types of possible lenders, bondholders, denoted $j = 1$, and financial intermediaries, denoted, $j = 2$.

• Intermediaries have the advantage of inducing less costly reorganization when firms fall into financial distress - at least of small firms. This is modeled as lower fixed verification costs, $f_2 < f_1$. Without loss of generality assume $c_i = c_1 = 0$.

• The disadvantage of intermediaries is they themselves have to raise funds - which entails default risks and verification costs to their lenders. This is modeled as a premium which intermediaries will have to pay over the risk free\(^3\). Thus the cost of funds to a lender of type $j$, is $(1 + r + p_j)$ where $p_1 = 0, p_2 > 0$ and $r$ is the real risk-free interest rate.

• Both types of lenders are risk neutral and competitive.

**Optimal Contract:**

In the optimal contract a firm agrees to pay back a return, $rz$, to the lender at time 1. The firm will default whenever its earnings fall short of its promised payment: $(s + zi)z < rz$. Define the state in which the firm just defaults as the bankruptcy point, $b = r - u$. The average expected payoff to firms is then,

$$V(z, b) = \int_b^\infty (s + u - r) f(s)ds = \int_b^\infty (s - b) f(s)ds$$

and the average expected payoff to lenders is

\(^3\) The use of the intermediaries' premium is a short-hand way of capturing the effects of movements in lender earnings. I assume lower bank earnings imply a higher bank premium. In a general equilibrium (see Cantillo (1995)) lower earnings need not affect the premium - if banks reduce lending enough as their earnings decline, their risk of default and their premium could remain unchanged. This could explain why in practice banks premium hardly rises following a decline in bank earnings even though bank lending falls considerably. However even in this case lower bank earnings lower bank lending.
\[ U_i(z,b) = \int_0^b f(s)ds + \int_0^b (s + u) f(s)ds - \int_0^b (f_i/ z) f(s)ds - (1 + r_i + p_i) \]

\[ = u - \int_0^b (s - b) f(s)ds - F(b) f_i/ z - r_i - p_i \]

Finally assume

A1. The hazard rate \( h(s) = \frac{f(s)}{1 - F(s)} \) is strictly increasing in \( s \).

A2. \( u > r_i + p_i \)

A1. is a standard assumption in the finance and mechanism design literature and is satisfied by among others the Normal and Uniform distributions. A2. ensures the problem is well posed. Then the optimal contract for a firm of size \( z \) is

(1) \( \max_{j, b} V(z,b) \) such that \( U_i(z,b) \geq 0 \)

Define \( b_i = b_i(z) = \min(b : U_i(z,b) = 0) \). It is straightforward to show the solution to (1), if it exists, is to pick the lender \( j \) which has the lowest \( b_i \), and that lenders expected profits, \( U_i(z,b) \), is a single peaked function of \( b \), first increasing and then decreasing. If a solution to (1) doesn't exist the firm is unable to borrow and foregoes the investment opportunity. I show (in the appendix), that small firms will be unable to borrow, medium sized firms will borrow from intermediaries and large firms will borrow directly from bondholders.

Theorem 1

Large firms \( (z > z') \) borrow from the bondmarket \( (j = 1) \), medium firms \( (z' < z < z'') \) borrow from intermediaries \( (j = 2) \), and small firms \( (z < z') \) cannot borrow at all.
Small firms have prohibitive costs of verification, relative to their size, even if they borrow from intermediaries. Whatever interest rate the firm offers to pay, lenders refuse to lend to them - they are credit rationed. For medium sized firms the lower fixed verification cost of intermediaries makes lending possible. The largest firms are able to avoid the premium that intermediaries charge by borrowing directly from bondholders. The high fixed costs of verification for bondholders matter less when lending to large firms.

I now explore the response of small vs. large firms, as well as intermediated vs. non-intermediated debt to various macroeconomic shocks. Define the parameter vector \( x = (u, r_1, p_2) \). It is convenient, though not essential, to define the cutoff between small and large firms for the initial parameter vector \( x_0 \) as, \( z'' \), which is the cutoff between firms which borrow from intermediaries and those which borrow from the bond market.

Thus initially large firms' investment \( (I_L) \) equals non-intermediated debt \( (D_1) \), so that

\[
I_L = D_1 = \int_{z''}^{\infty} z g(z) dz
\]

and small firms' investment \( (I_S) \) equals intermediated debt \( (D_2) \), so that

\[
I_S = D_2 = \int_{z''}^{\infty} z g(z) dz
\]

**Theorem 2**

A decrease in the earnings of companies \( \Delta u < 0 \) lowers small firms' investment relative to large firms' investment \( (\Delta(I_S - I_L) < 0) \), but lowers intermediated debt relative to non-intermediated debt, by less, \( (\Delta(D_2 - D_1) > \Delta(I_S - I_L)) \). It leads some firms to no longer choose non-intermediated debt \( (j = 1) \), but instead choose intermediated debt \( (j = 2) \).

There are two effects. With lower company earnings, firms will be more likely to default. Intermediaries advantage - lower default costs - is more important when firms default more. Thus
intermediaries will now be able to out-compete the bond market in lending to some firms (those on the margin between using loans and bonds). These firms will switch from issuing bonds to borrowing from financial intermediaries. Smaller firms, with their high costs of default, will now be unprofitable for either type of lender. They will be rationed from the credit markets and will have to curtail their investment altogether. The decline in intermediated debt relative to non-intermediated debt will understate the decline in small firm vs. large firm investment. These arguments also apply for an increase in the risk-free interest rate which raises firms’ likelihood of default by forcing them to pay higher interest rates.

**Theorem 3**

An increase in the real riskless interest rate \( (\Delta r > 0) \) lowers small firms’ investment relative to large firms’ investment \( (\Delta(I_t - I_L) < 0) \), but lowers intermediated debt relative to non-intermediated debt by less \( (\Delta(D_2 - D_1) > \Delta(I_t - I_L)) \). It leads some firms to no longer choose non-intermediated debt \( (j = 1) \), but instead choose intermediated debt \( (j = 2) \).

Theorem 4 says there are two effects of higher bank premiums.

**Theorem 4**

An increase in the premium of intermediaries \( (\Delta p_i > 0) \) lowers small firms’ investment relative to large firms’ investment \( (\Delta(I_t - I_L) < 0) \), and lowers intermediated debt relative to non-intermediated debt, by even more, \( (\Delta(D_2 - D_1) < \Delta(I_t - I_L)) \). It leads some firms to no longer choose intermediated debt \( (j = 2) \), but instead choose non-intermediated debt \( (j = 1) \).

With higher premiums, financial intermediaries will require firms to cover the extra cost of their funds. Some firms (those on the margin between using loans or bonds) will not be willing to pay the extra cost of lenders funds, since for them the cost of issuing bonds, which is unaffected by the change in
premium, is now cheaper. Thus they will switch from intermediated finance to issuing bonds. Smaller firms, with their high default costs, will now be unprofitable for either type of lender. They will be rationed from the credit markets and will have to curtail their investment altogether. The decline in intermediated debt relative to non-intermediated debt will overstate the decline in small firm vs. large firm investment. I assume the primary determinant of banks and other lenders premium is their earnings.

In a general equilibrium there are, no doubt, other effects of these shocks. Two important ones come to mind. First, higher company earnings will impact earnings of financial intermediaries and so the premium lenders face. This does not pose a problem, since the empirical analysis includes both company and their lenders’ earnings as regressors, and calculates the contribution of company earnings which does not work through changes in their lenders’ earnings. Second, higher real riskless rates may raise lenders’ premiums, since with higher interest repayments financial intermediaries are more susceptible to default. This will also have the effect of lowering small firms’ investment, relative to the investment of large firms. However, unlike the direct effect of higher interest rates, it makes firms less likely to choose intermediated debt. In section 4.3 we provide panel data evidence which suggests that any effects of interest rates through higher premiums for lenders are dominated by the direct effect on firms’ likelihood of default.

3. Data Description

The macro data on the outstanding debt of non-financial firms comes from the Federal Reserve’s, Flow of Funds Accounts, as did data on the earnings of financial and non-financial firms and data on total financial assets for financial intermediaries. Interest rates and the PPI deflator are from Citibase. The real interest rate was calculated as the one year T-bill rate less the one year expected inflation rate (inflation expectations were taken from the Livingston index of inflation expectations).

Inventory holdings, gross fixed capital stock (excluding land and mineral rights) and company earnings are from the Quarterly Financial Report for Manufacturing Corporations (QFR), for three classes of firms - small, medium and large firms. The cutoffs between classes of firms are calculated so that when the sales of small firms are aggregated they make up 20% of total manufacturing sales.
Similarly, medium firms represent the middle 20% of manufacturing firms (based on sales) and large firms the largest 60% (based on sales). The methods used to construct this data (including the method of seasonal adjustment) were identical to those outlined in Appendix A of Oliner and Rudebusch (1994), with two exceptions. Firstly, the size classes differ - Oliner and Rudebusch use a 15% cutoff (based on fixed capital) to divide the sample into small and large firms. Thus, to a first approximation, the firms I classify as medium, they include as large. Secondly, they deflate their series using the GDP deflator, whereas I use the PPI index.

Finally, I make use of micro data, from Moody's manuals, on firm’s choice between loans and bonds, for a panel of 291 companies over 19 years. This data is matched to Compustat data on the size and earnings of the companies. The 291 companies were chosen by ruling out firms in the following industries: agriculture, public utilities, transportation, financial services and industries with SIC codes above 8000, by requiring continuous data in Moodys, and by ruling out companies which had merger and acquisition activities (defined as a change of 25% or more in the firm’s gross physical capital stock for reasons other than physical investment or retirements).

All the data is quarterly (and seasonally adjusted) except the data from Moodys and Compustat which is annual. Macro data was available 1952Q1-1995Q1, QFR data 1958Q4-1995Q1, and Moody’s data 1974-1992. The only exception to this was the Federal Funds rate, which was only available, 1955Q1-1995Q1. I use the PPI index as the deflator throughout.

4. Empirical Results

This section tests and gauges the importance of the different financial propagation mechanisms suggested by the theoretical model. Section 4.1 provides evidence on these credit channels, based on the behavior of investment for small vs. large manufacturers. Section 4.2 compares this to evidence based on fluctuations in the extent of financial intermediation in the economy. Section 4.3 provides micro evidence on the predictions of the model and on whether interest rates work mainly by affecting firms' ability to borrow or intermediaries' ability to lend.
Before testing the hypothesis of the paper I first deal with stationarity issues in the quarterly data. I start by testing for unit roots. Interest rates are entered in their raw form, earnings of financial companies are entered as the ratio of earnings to lagged total financial assets - all other variables are logged. For each of the variables used in the VAR's below I cannot reject unit roots (at the 5% level) for both the case a constant is included and for that when it is not (in each case the number of lags of augmentation was chosen optimally based on the variant of mimimizing AIC criteria in Pantula et al. (1994))\(^4\). For each variable the differenced data is found to be I(0) and this result does not depend on whether a constant is included or not. Estimating the VAR's with the differenced variables then provides consistent estimates of the impulse response functions (this is not true for the level variables which are I(1) as is established in Phillips (1996)). For each of the VAR's below I test for optimal lag length based on the AIC criteria and, in every case, this is less than or equal to four lags of the variables. For comparability of results in each VAR below I use four lags of the data - except for the reasons discussed below in section 5 where I present results using both four and eight lags. Based on these lag lengths I test for any cointegrating relationships in the main results (i.e tables 2, 3 and 6). Using the Johansen procedure and a 5% level I found evidence of one cointegrating relationship in the models of tables 2 and 3 but only when there was no constant. However, the Johansen test has been criticized for finding "too much" cointegration so I also test for cointegration using the Engle-Granger methodology, checking all orderings of the variables. I found that whether a constant is included or not there are no significant cointegrating relationships at the 5% level regardless of the ordering of the variables with the following exceptions: when no constant is included for the model in table 2 the p-value of a unit root in the cointegrating regression is 0.04 for the fixed capital model and 0.01 for the inventories model. Given the above mixed support for a cointegration vector at the 5% significance level (it depended on the exclusion of a constant), given that cointegration in all cases could be rejected at the 1% significance level, and given there is no a-priori case for cointegration, I ignore any possible cointegrating relationships and estimate structural VAR's in the I(0) differenced data.

\(^4\) The only exception to this was for the mix variables between bank loans and commercial paper or finance company lending where we can reject a unit root for the case where a constant was included. For this case we also
4.1 Investment: Small vs. Large Manufacturers

According to the model, credit market frictions link the investment of small, but not large, companies with their earnings, the earnings of financial intermediaries and real riskless interest rates. In practice, demand and technology factors might link the investment of both small and large companies with their earnings and interest rates. For this reason I focus on the difference between small and large firms' investment to identify financial propagation mechanisms\(^5\).

I use QFR quarterly data on manufacturing firms, and aggregate the data on firms into three size classes - small, medium and large firms\(^6\). The structural model estimated is,

\[
\begin{align*}
Y_{t,1} &= \psi_1 + \psi_{1,4}(Y_{t,1}) + \psi_{1,4}(Y_{t,2}) + \psi_{1,4}(Y_{t,3}) + \psi_{1,4}(Y_{t,4}) + u_{t,1} \\
Y_{t,2} &= \psi_2 + \psi_{2,4}(Y_{t,1}) + \psi_{2,4}(Y_{t,2}) + \psi_{2,4}(Y_{t,3}) + \psi_{2,4}(Y_{t,4}) + u_{t,2} \\
Y_{t,3} &= \psi_3 + \psi_{3,4}(Y_{t,1}) + \psi_{3,4}(Y_{t,2}) + \psi_{3,4}(Y_{t,3}) + \psi_{3,4}(Y_{t,4}) + u_{t,3} \\
Y_{t,4} &= \psi_4 + \psi_{4,4}(Y_{t,1}) + \psi_{4,4}(Y_{t,2}) + \psi_{4,4}(Y_{t,3}) + \psi_{4,4}(Y_{t,4}) + u_{t,4}
\end{align*}
\]

where \(\psi_{r,q}(Y_{t,s}) = \psi_{r,p}^{s} Y_{t,s-p} + \ldots + \psi_{r,q}^{s} Y_{t,s-q}\)

and \(Y_1, Y_2, Y_3, Y_4\) represent the funds rate, company earnings, earnings of financial intermediaries, and inventories (or the capital stock). There are four lags.

\[U_t = (u_{t,1}, u_{t,2}, u_{t,3}, u_{t,4})' \sim NID(0, D)\]

where \(D\) is a diagonal matrix and the variables are defined below. I consider a 1-standard deviation shock to \(Y_{t,1}\) and summarize the results by reporting the cumulative impact on \(\Delta(Y_{t,1} + Y_{t,2} + Y_{t,3} + Y_{t,4})\), where \(Y_{t,s}\) measures the quarterly percentage growth in inventories or fixed capital stock during period \(t\).

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\(^5\) Micro studies which regress investment on earnings, for firms split based on access to financial markets, find instrumenting for technology and demand factors does not reduce the differential impact of earnings on financially constrained vs. unconstrained firms. Instead it changes the importance of earnings for both types of firms by similar amounts. See Fazzari et al. (1988) for fixed investment and Carpenter et al. (1994) for inventory investment.

\(^6\) Roughly speaking, in 1990, small firms were firms with less than 50 million dollars of sales, while large firms were firms with more than 250 million dollars of sales.
This ordering of the variables was chosen since it corresponds to the most natural structural specification. For the main specification (corresponding to table 2) this structure makes the following identifying restrictions - no variable has a contemporaneous effect on interest rates, only interest rates can affect company earnings contemporaneously, and the difference between small and large firm investment has no contemporaneous effect on financial intermediaries' earnings. This ordering makes sense if investment affects earnings only with a lag (the requirement is less stringent since we only require the difference between small and large firm investment can not affect earnings of companies or their lenders contemporaneously). This ordering allows company earnings to directly affect their lenders' earnings contemporaneously but not vice-versa. This makes sense - earnings of financial intermediaries can affect company earnings but only indirectly by first affecting investment and so company earnings next period. The identifying assumption on interest rates is based on the idea that the Federal Reserve targets the Federal Funds rate in advance and so it does not react to contemporaneous information - changing the ordering of interest rates did not materially alter the results.

Table 1 presents results based on a separate VAR, for each size class. After an increase in interest rates large firms build up inventories, perhaps as the result of lower sales following higher interest rates. This is consistent with production smoothing. Small firms appear unable to finance such an inventory buildup. Fixed capital declines strongly for small firms, but barely declines for large firms. This suggests when credit frictions are absent, interest rates have little effect on firms' production. Earnings, whether they be for firms or financial intermediaries, have their largest impact on small firms and their smallest impact on large firms.

The economic impact of these shocks is striking for small firms. For instance, a temporary one standard deviation shock to the company earnings of small firms generates a 3.43% change in their inventories' holdings. The equivalent shock for large firms generated a 1.34% change in the inventories of large firms. By way of comparison, the standard deviation change in inventories (based on changes in inventories over any five consecutive quarters in the sample) is 7.54% for small firms and 6.65% for large firms.
Table 1. Percentage Change in Inventories and Fixed Capital of Small, Medium and Large Sized Manufacturers, 1 Year after Various Shocks.

<table>
<thead>
<tr>
<th></th>
<th>Small Firms (Smallest 20%)</th>
<th>Medium Firms (Middle 20%)</th>
<th>Large Firms (Top 60%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stocks of Inventories</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Federal Funds Rate</td>
<td>-0.29</td>
<td>0.41</td>
<td>2.06**</td>
</tr>
<tr>
<td>(By Size Class)</td>
<td>(0.54)</td>
<td>(0.38)</td>
<td>(0.39)</td>
</tr>
<tr>
<td>Earnings of Firms</td>
<td>3.43**</td>
<td>2.68**</td>
<td>1.34**</td>
</tr>
<tr>
<td>(By Size Class)</td>
<td>(0.48)</td>
<td>(0.34)</td>
<td>(0.37)</td>
</tr>
<tr>
<td>Earnings of Financial</td>
<td>0.94*</td>
<td>0.89**</td>
<td>0.42</td>
</tr>
<tr>
<td>Intermediaries</td>
<td>(0.46)</td>
<td>(0.32)</td>
<td>(0.39)</td>
</tr>
<tr>
<td>Fixed Capital Stock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Federal Funds Rate</td>
<td>-1.39**</td>
<td>-0.88**</td>
<td>-0.20</td>
</tr>
<tr>
<td>(By Size Class)</td>
<td>(0.40)</td>
<td>(0.32)</td>
<td>(0.24)</td>
</tr>
<tr>
<td>Earnings of Firms</td>
<td>0.73*</td>
<td>0.06</td>
<td>-0.22</td>
</tr>
<tr>
<td>(By Size Class)</td>
<td>(0.37)</td>
<td>(0.30)</td>
<td>(0.22)</td>
</tr>
<tr>
<td>Earnings of Financial</td>
<td>0.48</td>
<td>0.47</td>
<td>-0.17</td>
</tr>
<tr>
<td>Intermediaries</td>
<td>(0.37)</td>
<td>(0.29)</td>
<td>(0.23)</td>
</tr>
</tbody>
</table>

Note: Results show the percentage change in the deflated stock of inventories and fixed capital, 1 year after a standard deviation shock to the variable on the left. Approximate standard errors in parenthesis - calculated from Monte-Carlo procedure with 5000 trials. * indicates that a 95% confidence interval excludes the origin, ** indicates a 99% confidence interval excludes the origin. Company earnings (after tax profits plus depreciation) for each size class are deflated and log differenced. Earnings of financial intermediaries are bank, thrift and finance co. undistributed profits, scaled by their beginning of quarter total financial assets and then differenced. The funds rate is differenced. Sample period is 1958Q4-1995Q1.

I focus on the difference between small and large firms' investment to identify financial propagation mechanisms. To check whether the differences between small and large firms are statistically significant, $Y_{s1}$ is replaced in the system (1)-(4) above with the difference between the growth rates of small and large firms inventories (or fixed capital stock), and $Y_{s1}$ is replaced with the average of the growth rates for the earnings of small and large manufacturers. Columns 1 and 3 of table 2 presents the results of standard deviation shocks to each variable. They mirror the differences between small and large firms found in table 1 above. They show that shocks to interest rates and company earnings are more important sources of financial propagation than the earnings of financial intermediaries, and that financial intermediaries' earnings are not statistically significant at the 5% level.
Shocks can affect investment through indirect channels. Higher interest rates might give rise to lower investment, in part, by depressing company earnings. The model only makes predictions on direct channels. Thus to test the predictions of the model I employ the estimated system (1)-(4), but now “turn off” all indirect channels. This is done by zeroing out all estimated parameters where the variable being shocked could influence, or be influenced, by variables other than itself. Thus simulations are done within the following system, where the parameters are still estimated from (1)-(4) above.

\[ Y_{1,t} = \hat{\Psi}_{14}^1 (Y_{1,t}) \]

\[ Y_{2,t} = \hat{\Psi}_{14}^2 (Y_{2,t}) \]

\[ Y_{3,t} = \hat{\Psi}_{14}^3 (Y_{3,t}) \]

\[ Y_{4,t} = \hat{\Psi}_{04}^4 (Y_{4,t}) + \hat{\Psi}_{04}^4 (Y_{5,t}) + \hat{\Psi}_{04}^4 (Y_{3,t}) + \hat{\Psi}_{14}^4 (Y_{4,t}) \]

**Table 2. Difference between Small and Large Firms Investment, 1 Year after Various Shocks.**

<table>
<thead>
<tr>
<th></th>
<th>(Small - Large) Firms Inventories</th>
<th>(Small - Large) Firms Fixed Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct + Indirect Impacts</td>
<td>Direct Impact Only</td>
</tr>
<tr>
<td>Federal Funds Rate</td>
<td>-2.28**</td>
<td>-2.12**</td>
</tr>
<tr>
<td></td>
<td>(0.51)</td>
<td>(0.58)</td>
</tr>
<tr>
<td>Earnings of Manufacturers</td>
<td>1.84**</td>
<td>2.50**</td>
</tr>
<tr>
<td></td>
<td>(0.47)</td>
<td>(0.49)</td>
</tr>
<tr>
<td>Earnings of Financial Intermediaries</td>
<td>0.74</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>(0.48)</td>
<td>(0.43)</td>
</tr>
</tbody>
</table>

Note: Dependent variable is the percentage change in small firms inventories (fixed capital) less the percentage change in large firms inventories (fixed capital). Earnings of manufacturers is the average of the growth rates for small firms earnings and the growth rates for large firms earnings. See table 1 for other definitions.

Columns 2 and 4 of table 2 report the direct impact of standard deviation shocks to each variable. Eliminating indirect effects raises the relative importance of company earnings. To get an idea over what horizon the financial propagation mechanisms work, I present in figure 1 the impulse response

---

7 Measuring only the direct impact of shocks also has the advantage that the effects of different shocks can be added together without double counting their consequences.
functions, for inventories, where I only consider the direct impact of shocks. At short horizons I find company earnings were the most potent financial variable for explaining small vs. large firm inventories. Over longer horizons interest rates become more important. The results for fixed investment are quite similar.

To quantify the extent to which these shocks affect the macroeconomy I simulate the impact of actual movements in the three financial variables. I do this by picking episodes when, for four consecutive quarters, interest rates increased, company earnings declined, or bank earnings declined considerably. In particular, for each variable, the five most sizeable distinct episodes are selected. Then for each episode I enter the actual series less its mean into equation (8), using the estimated parameter values from above. Since each episode lasts for four quarters and there are four quarterly lags in equation 8, the cumulative impact on the difference between small and large firms quarterly growth rate of inventories is calculated over eight quarters. This is multiplied by the outstanding inventories of small firms. Thus I make the conservative assumption that no part of the impact of financial shocks on medium or large firms

Note: All figures report the cumulative response of the quarterly percentage growth rate to a one-standard deviation shock to the particular financial variable. 95% confidence interval included - calculated from Monte-Carlo procedure with 5000 trials.
investment is due to credit frictions. I multiply the resulting number by the ratio of non-financial companies to manufacturers' inventories at the time of the episode. Thus I assume there are the same proportion of small manufacturers as there are other small businesses in the economy\textsuperscript{8}. Finally, I divide by the gross domestic product and take the average of this calculation over all five episodes, for each variable. I then repeat the same procedure for the fixed capital stock series.

My calculations reveal the importance of financial factors in business cycles. By using the difference between the investment of small and large firms, I claim to control for technological and demand factors. The three financial shocks matter only because of credit market frictions. Despite this, higher interest rates cause a decline in inventories and physical capital over 2-years of 1.01 percent of GDP, lower company earnings cause a decline of 0.99 percent of GDP, and lower bank earnings cause a decline of 0.41 percent of GDP. To put these numbers in context, compare them to the rule of thumb that on average GDP declines by 2.5% below its trend in a recession. Thus, these declines in GDP represent 40% of the slowdown in GDP growth during recessions. In the 1980 recession I calculate the contribution of all three shocks was responsible for a decline in inventories and physical capital worth 1.07 percent of GDP (taking only the impact over the recession period). I find that although inventories are more sensitive to these financial factors, changes in fixed capital actually contribute more to the decline in GDP. This reflects simply that firms hold substantially more fixed capital than inventories.

\textbf{4.2 Fluctuations in the Extent of Financial Intermediation}

Another way one might try to determine the relative importance of these channels of financial propagation is to look at the impact of the three financial variables on the intermediation process. According to the model, credit market frictions link the extent of financial intermediation with the earnings of firms and financial intermediaries, and real riskless interest rates. However, the model also implies that the relative importance of bank or financial intermediaries' earnings as a financial propagation mechanism will be overestimated by this metric. Even though this is the case, I still find

\textsuperscript{8} Firms outside the manufacturing sector tend to be smaller than manufacturers, but less cyclical. It is not clear whether they will, on average, be more or less responsive to financial factors.
here that fluctuations in the earnings of financial intermediaries are less than half as important as company earnings in explaining financial disintermediation.

I measure the extent of financial intermediation as businesses' outstanding level of loans relative to commercial paper. The same VAR system, (1)-(4), is used as before, with small firms less large firms inventories $Y_{t,..}$ replaced by the extent of financial intermediation, and the earnings of manufacturers $Y_{t,..}$ replaced by the earnings of all non-financial firms. Table 3 presents the results of different specifications - column 1 gives the results where financial intermediaries just include banks, column 2 excludes indirect effects, column 3 uses a more general measure, where financial intermediaries include banks, thrifts and finance companies, and column 4 excludes indirect effects for this more general measure. The results echo those in the previous section. Financial disintermediation occurs mainly due to factors which affect the ability of small firms to borrow (low earnings and high interest rates) rather than due to factors which affect banks or other lenders' ability to lend (low bank earnings).

<table>
<thead>
<tr>
<th>Table 3. Percentage Change in Loans relative to Commercial Paper, 1 Year after Various Shocks.</th>
<th>Bank Loans / Commercial Paper</th>
<th>Loans / Commercial Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direct + Indirect Impacts</td>
<td>Direct + Indirect Impacts</td>
</tr>
<tr>
<td></td>
<td>Direct Impact Only</td>
<td>Direct Impact Only</td>
</tr>
<tr>
<td>Federal Funds Rate</td>
<td>-5.87* (2.71)</td>
<td>-6.03* (2.64)</td>
</tr>
<tr>
<td></td>
<td>-5.50 (2.99)</td>
<td>-5.69 (3.33)</td>
</tr>
<tr>
<td>Earnings of Non-Financial Firms</td>
<td>4.87* (2.47)</td>
<td>5.19* (2.48)</td>
</tr>
<tr>
<td></td>
<td>6.02** (2.35)</td>
<td>6.26* (2.36)</td>
</tr>
<tr>
<td>Earnings of Financial Interm.</td>
<td>3.36 (2.32)</td>
<td>2.90 (2.54)</td>
</tr>
<tr>
<td></td>
<td>2.66 (2.40)</td>
<td>2.44 (2.44)</td>
</tr>
</tbody>
</table>

Note: Loans are non-financial firms outstanding bank loans plus thrift and finance companies loans. The dependent variable above (the mix) is the percentage change in loans less the percentage change in commercial paper. For columns 1 and 2, earnings of financial intermediaries are just undistributed profits of banks, scaled by the beginning of quarter total financial assets for banks, and then differenced. Sample period is 1955:1-1995:1. See table 1 for other definitions.

4.3 Micro Data on Firms Debt Choice

In section 4.1 we showed that higher interest rates lead to large declines in small vs. large firm investment. In section 4.2 we showed that higher interest rates lead to financial disintermediation. The
model says these results occur because more small firms will be rationed when interest rates are high. The model also predicts that when interest rates are high some larger firms will drop from the public debt markets and borrow instead from financial intermediaries. An alternative explanation for the results of sections 4.1 and 4.2 is that, with higher interest rates, financial intermediaries have difficulty raising funds themselves and so restrict lending. However, if this is the case, larger firms who are not rationed will now be more likely to borrow from public debt markets rather than financial intermediaries. With micro data we can sort out the two explanations by seeing whether individual firms are more or less likely to borrow from financial intermediaries when interest rates are high. I use unique data that combines detailed information on a panel of large firms' long term debt choice from Moodys' manuals with information on these firms' financial status from Compustat. The data is for 291 publicly traded companies which are tracked from 1974 to 1992. Their median size was 533 million dollars in 1990.

In columns 1 and 2 of table 5 the ratio of firms privately placed to total long term debt is regressed on fixed effects, interest rates, the firm's earnings, earnings of financial intermediaries, and the firm's size. Asterisks denote statistical significance of the coefficient estimates. For each company I calculate the impact of a standard deviation change (for that company) in the variable on the left on the ratio. I report the typical such impact by taking the median impact over all companies. According to this metric, the earnings of financial intermediaries are the most important determinant of firms' debt choice, followed by interest rates. The fixed effects regressions link movements in a companies' ratio of privately placed debt to total debt away from its average level to interest rates, bank earnings, its cash flow, and its size. Thus, with higher interest rates, a firm's ratio will increase above its average level, suggesting it issues more private rather than public debt.

Columns 3 and 4 try to be more specific about the link between financial variables and firms' debt choice. This is done by modelling a firm's decision whether to issue more new private (intermediated) debt than public (non-intermediated) debt or vice-versa based on the level of interest rates, financial intermediaries' earnings, its earnings and its size. I create a dummy variable (Dumpri)
which is 1 when the firm issues more new private debt than public debt and 0 when the firm issues more
new public debt than private debt. To determine whether a firm issues more private or public debt in any
year, I need data on new issues by debt type. I create this by using data on the level of private and public
debt outstanding each year and by making the assumption that private debt retires at 0.125% per year (8
year debt) and public debt retires at 0.033% per year (30 year debt). I then run a probit allowing whether
a company decides to issue private or public debt to depend on its choice last year (i.e. I include the
lagged value of dumprin\textsuperscript{10}). In columns 3 and 4 I report the impact on the probability of issuing more
private debt than public debt of standard deviation changes in the variables on the left. A standard
deviation increase in the Federal Funds rate means the probability of a firm issuing more private debt
than public debt will increase by 0.08. A standard deviation decrease in the earnings of financial
intermediaries means the probability of a firm issuing more private debt than public debt will decrease
by around 0.12.

\textit{Table 5. Firms Debt Choice (Loans / Bonds) on Micro and Macro Shocks}

<table>
<thead>
<tr>
<th></th>
<th>Fixed Effects Regression on Ratio</th>
<th>Probit on Issue Pri vs. Pub Dummy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Dependent Var = Ratio)</td>
<td>(Dependent Var = Dumprin)</td>
</tr>
<tr>
<td>Real Interest Rate</td>
<td>1.52**</td>
<td>0.07**</td>
</tr>
<tr>
<td>Federal Funds Rate</td>
<td>1.27**</td>
<td>0.08**</td>
</tr>
<tr>
<td>Earnings of Firm</td>
<td>-0.42*</td>
<td>-0.05*</td>
</tr>
<tr>
<td>Earnings of Financial</td>
<td>2.23**</td>
<td>0.14**</td>
</tr>
<tr>
<td>Intermediaries</td>
<td>1.36**</td>
<td>0.10**</td>
</tr>
<tr>
<td>Size of Firm</td>
<td>-1.29**</td>
<td>-0.09**</td>
</tr>
</tbody>
</table>

Note: * indicates significance at the 5% level. ** indicates significance at the 1% level. For regressions with fixed effects numbers
measure the percentage impact on the ratio for a standard deviation change in the variable on the left. The dependent variable (Ratio) is
the ratio of long term intermediated debt to total long term debt. For probits numbers measure the impact on the probability of issuing
more private than public debt. The dependent variable (Dumprin) is a dummy variable which is 1 when the firm issues more private debt
than public debt and 0 when the firm issues more public debt than private debt. Probits include a constant and lagged value of the
dependent variable. Earnings of firms are the firms after tax profits plus depreciation scaled by its sales. Earnings of financial firms are
all financial intermediaries undistributed profits scaled by their beginning of year total financial assets. Firm size is the logarithm of

\textsuperscript{10} Dumprin(-1) had an estimated coefficient of 0.94 and was highly significant. I also ran the probits without
Dumprin(-1) and obtained qualitatively the same results.
These results suggest that higher interest rates make individual firms more likely to borrow from financial intermediaries not less. This implies that higher interest rates reduce small firm relative to large firm investment as well as the extent of financial intermediation predominantly by curtailing the ability of small firms to borrow rather than financial intermediaries ability to lend.

5. Reinterpreting the Evidence for a Bank Lending Channel

According to the bank lending channel, following a monetary contraction firms will borrow less from banks relative to other lenders. A monetary contraction will reduce bank deposits because of reserve requirements. This raises bank premiums, as banks replace deposits with other more expensive sources of funds. If they can, firms will switch to other providers of funds, otherwise they will simply borrow less from banks. Based on this logic, KSW tested the bank lending channel by comparing the behavior of bank loans vs. commercial paper following monetary contractions. They found that following monetary contractions, firms, in aggregate, borrow less from banks, while at the same time borrowing more from the commercial paper market. The problem with KSW’s approach is that higher interest rates can reduce bank lending relative to commercial paper issuance for another reason. Higher interest rates raise firms’ likelihood of default. This hinders small firms’ ability to borrow, as small firms have high costs of default. Since small firms rely primarily on bank loans, bank lending will fall relative to commercial paper. I mitigate this identification problem using two alternative approaches. However first I need to comment on the related work of Oliner and Rudebusch (1996).

They mitigate the identification problem by dividing firms into small and large size classes. They show within these classes there is no change in the fraction of bank debt to “other debt” following monetary contractions. Thus they find no evidence of a bank lending channel. In a reply, to Oliner and Rudebusch’s work, Kashyap et al. (1996) point out this “other debt” series contains serious problems - during 1988-89 it had percentage movements of 40-50 percent per quarter. As far as I can ascertain, these problems arise because QFR incorrectly allowed for rule FASB94 which was introduced in 1988 by the Financial Accountants Standards Board and which required all companies to consolidate the balance sheets of their wholly owned subsidiaries. This had massive effects on the debt composition of
non-financial companies with finance subsidiaries (e.g. General Motors consolidated its accounts with its finance company subsidiary) and these companies represent some of the largest in the U.S. It would be interesting to know how Oliner and Rudebusch’s results stand up if corrected data was used. In the mean time I provide alternative ways of mitigating the identification problem.

Section 4.3 showed, using micro data, that higher interest rates made firms which previously tapped the public debt markets more likely to borrow instead from financial intermediaries. These results contradict the prediction of a bank lending channel that firms switch lenders from banks to the commercial paper market (or bond market), after a monetary contraction. Instead, they suggest monetary policy works predominantly through the direct impact higher interest rates have on smaller firm’s ability to repay debt, and thus borrow and invest.

The second approach to mitigating the identification problem is to compare bank loans with finance company loans to non-financial companies using Flow of Funds aggregate data. Both banks and finance companies lend to small firms. From the perspective of the bank lending channel, the main difference between banks and finance companies is that only banks are subject to reserve requirements. Thus, the bank lending channel would imply changes in monetary policy affect bank lending more than finance company lending. Table 6 presents the results of a bi-variate VAR analysis where interest rates are placed first in the ordering. Since interest rates can no longer work through earnings (as they could in section 3), the VAR’s are also estimated with eight lags of both variables to allow that interest rates might work with longer lags. Finance company lending to firms behaves much the same as bank lending to firms following monetary contractions. In fact, after a monetary contraction finance company lending to firms generally declines more than bank lending to firms. This could be because lending of finance companies is more sensitive to deteriorations in their earnings, which occur after monetary contractions. It could also be because, on average, finance companies lend to smaller firms than banks do - and smaller firms are more sensitive to higher interest rates.

11 The results were not sensitive to this ordering.
12 Unit root tests when a constant was included suggest that the log of the mix variable is I(0). I ran the VAR’s with the mix in levels and obtained very similar results. The only qualitative difference occurred for row 3 where the
Table 6. Percentage Change in Loans Relative to Alternative Types of Debt, 
1 and 2 Years after a Monetary Policy Contraction

<table>
<thead>
<tr>
<th></th>
<th>Bank Loans - Finance Co. Loans</th>
<th>Bank Loans - Commercial Paper</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 year horizon (4 qtr. Lags)</td>
<td>2 year horizon (8 qtr. lags)</td>
</tr>
<tr>
<td></td>
<td>1 year horizon (4 qtr. Lags)</td>
<td>2 year horizon (8 qtr. lags)</td>
</tr>
<tr>
<td>Funds Rate</td>
<td>0.88</td>
<td>-5.01*</td>
</tr>
<tr>
<td>1955Q1-1995Q1</td>
<td>(0.58)</td>
<td>(2.54)</td>
</tr>
<tr>
<td></td>
<td>1.62</td>
<td>-2.30</td>
</tr>
<tr>
<td>1955Q1-1980Q2</td>
<td>(1.06)</td>
<td>(4.89)</td>
</tr>
<tr>
<td>Funds Rate</td>
<td>-0.59</td>
<td>-6.78**</td>
</tr>
<tr>
<td>1980Q3-1995Q1</td>
<td>(0.61)</td>
<td>(1.89)</td>
</tr>
<tr>
<td>Funds Rate</td>
<td>-0.74</td>
<td>-6.78**</td>
</tr>
<tr>
<td>1980Q3-1995Q1 #</td>
<td>(0.67)</td>
<td>(1.89)</td>
</tr>
<tr>
<td>RRMA dates</td>
<td>1.10*</td>
<td>-4.64</td>
</tr>
<tr>
<td>1952Q1-1995:1</td>
<td>(0.56)</td>
<td>(2.55)</td>
</tr>
<tr>
<td>RRCA dates</td>
<td>1.49**</td>
<td>-7.39**</td>
</tr>
<tr>
<td>1952Q1-1995:1</td>
<td>(0.58)</td>
<td>(2.53)</td>
</tr>
</tbody>
</table>

Note: Approximate standard errors in parenthesis - calculated from Monte-Carlo procedure with 5000 trials. * indicates that a 95% confidence interval excludes the origin, ** indicates a 99% confidence interval excludes the origin. The federal funds rate is differenced and the mix is log differenced. RRMA is a dummy variable which takes 1 in dates identified by Romer and Romer (1992) as shifts to tighter monetary policy. I also include the 1966 credit crunch date as suggested by KSW. RRCA is a dummy variable which takes 1 in dates identified by Romer and Romer (1993) as shifts to tighter bank regulation. # - excludes leases from the definition of finance company lending. Sample period is 1955:1-1995:1.

If regulations, which existed prior to the 1980’s, prevented banks from issuing CD’s, then the bank lending channel should be particularly powerful during this earlier period. The results for the two sample periods 1952:1-1980:2, and 1980:3-1995:1, are reported in table 6. The beginning of the later period corresponds approximately to the start of President Reagan’s first term, and the corresponding deregulation of financial markets^{13}. Rows 2 and 3 show declines in bank loans following interest rate hikes are actually more pronounced in the later period - suggesting heightened sensitivity of bank lending to interest rates during the period of deregulation.

Rows 5 and 6 show that bank loans do not decline relative to finance company loans after dates representing monetary contractions - Romer and Romer (1989, 1992) - nor after dates representing results reversed sign. This only can strengthen the case against the bank lending channel. The new estimates are (0.28 1.00 -7.51 -5.23) instead of (-0.59 -0.71 -6.78 -6.66).
Federal Reserve direct regulations on bank lending - Romer and Romer (1993). These findings suggest that either regulations did not play a role in limiting bank lending in earlier periods - or that they also limited finance company lending to a similar extent.

One contention with using finance company lending as a yardstick for the behavior of bank lending is that finance company "lending" might be tied specifically to equipment purchases - since a large part of finance company lending is actually providing leases. Since data on leases became available in June 1980, the percentage of finance company debt held by businesses which is due to leases has risen steadily from 27% to nearly 50%. Without getting into a debate over whether leases are good substitutes for bank loans, or whether we should necessarily think of tying types of credit to specific uses by firms, I instead present the results after excluding leases from finance company lending. First note that prior to 1980, when leases were less important, finance company lending declines more than bank lending after monetary contractions. Secondly, when leases are excluded from finance company lending for the period where data is available - compare rows 3 and 4 of table 6 - the results are essentially the same as before, suggesting that the inclusion of leases in finance company lending is not driving my results.

These results suggest that the bank lending channel is not as important as the other financial propagation mechanisms studied above. Monetary policy works predominantly through the direct impact higher interest rates have on the ability of small firms to repay debt, and thus borrow and invest, rather than through regulating banks' ability to lend. Moreover, they show the important distinction is between intermediated and non-intermediated debt, not bank and non-bank debt.

5. Conclusion

Rather than restate the findings of the paper here I will instead use them to tell a story of how monetary policy could influence investment in practise\(^\text{14}\). Suppose a monetary policy tightening raises interest rates and so lowers consumer durable expenditure and business investment. If this were the end

\(^{13}\)It was chosen based on the availability of data on finance company leases.

\(^{14}\)Obviously this is a story based on sticky prices and as such is a story about the short run consequences of monetary policy.
of the story the drop in business investment would be modest. Instead, the higher interest rates together
with lower company sales squeeze company cashflows. Lower company cashflows and higher interest
rates raise the likelihood of firms defaulting. This impinges most on small firms who have high costs of
default. Small firms are unable (or unwilling given the premium they must pay) to borrow and so cut
back on investment. This shows up as a decline in bank as well as finance company loans (both
specialize in lending to small firms), and represents a major channel of monetary policy. Larger firms
will continue to be able to borrow, although some will no longer be “good” enough for the bond market
and will find it relatively cheaper to borrow from banks or other financial intermediaries. Financial
intermediaries, including banks, have little trouble financing these firms, especially since at the same
time they are cutting back on their lending to small firms.

In the above story the bank lending channel played no role. In practise, a bank lending channel
(or a channel of monetary policy through financial intermediaries in general) could still exist, but if it
does it is buried by the other more substantial financial propagation mechanisms studied here. Given the
potential importance for policy of knowing the extent of a bank lending channel, further tests on the
issue seem warranted. One direction is to obtain higher frequency panel data on firms’ debt choice to
run regressions like those in section 4.3. Another direction would be to study the link between interest
rates and small and large firm investment or the extent of financial intermediation in the U.K. prior to,
and after, 1982, when reserve requirements on commercial banks were set to zero.

Further research should explore the possibility that large banks, like large firms, will be mostly
unaffected by changes in their earnings. In this case, only small banks (and other small financial
intermediaries), which predominantly lend to small firms, will be sensitive to changes in their earnings.
To study this possibility, bank earnings could be split into the earnings of small and large banks. In this
case it may be that, following a monetary contraction, small banks have difficulty lending (which affects
small firms) yet at the same time large banks are able to finance large firms who find that they are no
longer “good” enough for the bond market.

It would also be intriguing to assess the relative importance of the financial propagation
mechanisms studied in this paper in episodes of financial crisis, prior to the 1933 banking act. With less
regulatory constraints, banks' financial strength is likely to be more important - not less - in business cycle activity. This is not just interesting from an historical point of view but with deregulated financial systems may become increasingly relevant in the future.

Appendix

To prove the theorems, I make use of four lemma's.

Lemma 1
If a firm prefers \( j = 1 \) then \( U_1(b) > U_2(b) \). If a firm prefers \( j = 2 \) then \( U_2(b) > U_1(b) \).

Proof: Suppose a firm prefers \( j = 1 \) but \( U_1(b) \leq U_2(b) \). Now since \( U_2(b) \geq U_1(b) = 0 \) it is feasible for intermediaries to offer the same or lower \( b \). Since firms choose the contract with the lowest \( b \) this contradicts that they prefer \( j = 1 \). Likewise for the case \( j = 2 \). QED

Lemma 2
Consider any two parameter vectors \( x_0 \) and \( x_1 \). If a firm at \( x_0 \) prefers to borrow from \( j = 1 \) and is able to borrow and if,
\[
(L1) \quad U_j(x_1,b) > U_j(x_0,b) \quad \text{for all } b, j = 1 \text{ and } 2
\]
\[
U_j(x_1,b) - U_j(x_1,b) \geq U_j(x_0,b) - U_j(x_0,b) \quad \text{for all } b
\]
then the firm will prefer to borrow from \( j = 1 \) at \( x_1 \), and will be able to borrow.

Proof: Since the firm borrows from \( j = 1 \) at \( x_0 \), competitive markets imply \( U_j(x_0,b(x_0)) = 0 \). Note from (L1), bondholders would still be willing to lend to a firm, at \( x_1 \), at the same rate as before, \( b(x_0) \). From the definition of the optimal contract (1), the firm would only prefer \( b < b(x_0) \). For any such \( b < b(x_0) \), \( U_j(x_1,b) - U_j(x_1,b) \geq U_j(x_0,b) - U_j(x_0,b) > U_j(x_0,b(x_0)) - U_j(x_0,b(x_0)) > 0 \) from (L1), that \( U_1 - U_2 \) is decreasing in \( b \) and lemma 1. Thus for any contract that the firm would prefer, \( U_j(x_1,b) > U_j(x_1,b) \), so the firm cannot borrow from the bank at \( x_1 \) (this would contradict lemma 1). QED

Lemma 3
Consider any two parameter vectors \( x_0 \) and \( x_1 \). If a firm at \( x_0 \) is indifferent between \( j = 1 \) and \( j = 2 \) or prefers \( j = 2 \), and is able to borrow, and if,
\[
(L2) \quad U_j(x_1,b) < U_j(x_0,b) \quad \text{for all } b, j = 1 \text{ and } 2
\]
\[
U_j(x_1,b) - U_j(x_1,b) \leq U_j(x_0,b) - U_j(x_0,b) \quad \text{for all } b
\]
then the firm will prefer to borrow from \( j = 2 \) at \( x_1 \).

Proof: Competitive markets imply \( U_j(x_0,b(x_0)) = 0 \). At \( b(x_0) \), \( U_1 \) is increasing (otherwise a lender could make a profit by offering a lower \( b \) which firms prefer). So,
\[
(1) \quad U_1(x_0,b(x_0)) \leq 0 \quad \text{for } b \leq b(x_0)
\]
\[
(2) \quad U_1(x_1,b) < U_1(x_0,b) \quad \text{for all } b, \text{ from (L2)}
\]
(1) and (2) imply (3), \( U_1(x_1,b) < 0 \) for \( b \leq b(x_0) \)
Now,
\[
(4) \quad U_1(x_0,b) \leq 0 \quad \text{for } b \leq b(x_0) \quad \text{otherwise firms would prefer } j = 1 \text{ at } x_0, \text{ and this would be feasible.}
\]
\[
(5) \quad U_1(x_1,b) < U_1(x_0,b) \quad \text{for all } b, \text{ from (L2)}
\]
(4) and (5) imply (6), \( U_1(x_1,b) < 0 \)
Thus to be feasible, at \( x_1 \), the solution satisfies \( b > b(x_0) \). But for \( b > b(x_0) \),
\[
U_1(x_1,b) - U_2(x_1,b) \leq U_1(x_0,b) - U_2(x_0,b) < U_1(x_0,b(x_0)) - U_2(x_0,b(x_0)) \leq 0 \quad \text{from (L2), that } U_1 - U_2 \text{ is decreasing in } b \text{ and lemma 1. Thus for any contract that would be feasible, } U_1(x_1,b) > U_2(x_1,b), \text{ so it cannot be}
that the firm borrows from bondholders at \( x_1 \) (this would contradict lemma 1). The firm will prefer to borrow from 
\( j = 2 \) at \( x_1 \). QED

**Lemma 4**
Consider any two parameter vectors \( x_0 \) and \( x_1 \).
If a firm at \( x_0 \) is only just able to borrow ( \( \max(U(x_0,b) : j = 1,2, \text{ for all } b) = 0 \) ) or is unable to borrow ( \( \max(U(x_0,b) : j = 1,2, \text{ for all } b) < 0 \) ) and if (L2) above holds then the firm will be unable to borrow at \( x_1 \).

**Proof:** (L2) implies \( U(x_1,b) < U(x_0,b) \) for all \( b \), \( j = 1 \) and 2 so,
\[
\max(U(x_1,b) : j = 1,2, \text{ for all } b) < \max(U(x_0,b) : j = 1,2, \text{ for all } b) = 0 .
\] QED

**Theorem 1**
Large firms \((z > z^\ast)\) prefer \((j = 1)\), medium firms \((z^\ast < z < z^\ast)\) prefer \((j = 2)\), and small firms \((z < z^\ast)\) cannot borrow at all ( \( \max(U(x_0,b) : j = 1,2, \text{ for all } b) < 0 \) ).

**Proof:** (1) \( U(1,b) - U(0,b) = F(b)(z_1 - z_0) \text{ for all } b \)
(2) \( (U(1,b) - U(0,b)) - (U(1,b) - U(0,b)) = F(b)(z_1 - z_0) \text{ for all } b \)
For \( z_1 > z_0 \), (1) and (2) are positive. Thus from lemma 2 the firm will prefer \( j = 1 \) at \( z_1 \) if it preferred \( j = 1 \) at \( z_0 \). For \( z_1 < z_0 \), (1) and (2) are negative. Thus from lemma 3 the firm will prefer \( j = 2 \) at \( z_1 \) if it preferred \( j = 2 \) at \( z_0 \). Also from lemma 4 the firm will be unable to borrow at \( z_1 \) if it was unable to borrow at \( z_0 \). The only ordering of firms consistent with these results is large firms prefer \( j = 1 \), medium firms prefer \( j = 2 \) and small firms cannot borrow. QED

**Theorem 2**
A decrease in the earnings of companies ( \( \Delta u < 0 \) ) lowers small firms investment relative to large firms investment ( \( \Delta(l - l) < 0 \) ), but lowers intermediated debt relative to non-intermediated debt, by less, ( \( \Delta(D_1 - D_0) > \Delta(l_1 - l_0) \) ). Some firms will now prefer \( j = 2 \) even though before they did not.

**Proof:** (1) \( U(1,b) - U(0,b) = u_1 - u_0 \)
(2) \( (U(1,b) - U(0,b)) - (U(1,b) - U(0,b)) = 0 \).
For \( u_1 < u_0 \), (1) is negative. From lemma 4 the firm \( z_0' \) which was previously able to borrow at \( u_0 \) can no longer borrow at \( u_1 \). All smaller firms are still not able to borrow. Thus at \( u_1 \) the firm \( z_1' \) which is just able to borrow, satisfies \( z_1' > z_0' \). From lemma 3 the firm \( z_0'' \) which was previously indifferent between \( j = 1 \) and \( j = 2 \) at \( u_0 \) will now prefer \( j = 2 \) at \( u_1 \). All firms which preferred \( j = 2 \) at \( u_0 \) will also prefer \( j = 2 \) at \( u_1 \). Thus at \( u_1 \) the firm \( z_1'' \) which is indifferent between \( j = 1 \) and \( j = 2 \), satisfies \( z_1'' > z_0'' \).

Therefore,
\[
\Delta(l - l) = \int_{z_0''}^{u_1} z^2(z) dz < 0
\]
\[
\Delta(D_1 - D_0) = \int_{z_0''}^{u_1} z^2(z) dz + \int_{z_0''}^{u_1} z(z) dz > \Delta(l - l) \text{ . QED}
\]

**Theorem 3**
An increase in the real risk free interest rate ( \( \Delta n > 0 \) ) lowers small firms investment relative to large firms investment ( \( \Delta(l - l) < 0 \) ), but lowers intermediated debt relative to non-intermediated debt by less ( \( \Delta(D_1 - D_0) > \Delta(l_1 - l_0) \) ). Some firms will now prefer \( j = 2 \) even though before they did not.

**Proof:** (1) \( U(1,b) - U(0,b) = r_0 - r_1 \)
(2) \( (U(1,b) - U(0,b)) - (U(1,b) - U(0,b)) = 0 \).
Since an increase in \( r_1 \) is equivalent to a decrease in \( u \) the proof follows exactly that for theorem 2. QED
Theorem 4
An increase in the premium of intermediaries ($\Delta p_l > 0$) lowers small firms investment relative to large firms investment ($\Delta I_l - I_l < 0$), and lowers intermediated debt relative to non-intermediated debt, by even more, ($\Delta (D_l - D_l) < \Delta (I_l - I_l)$). Some firms will now prefer ($j = 1$) even though before they did not.

Proof: (1) $U_l(p_1, b) - U_l(p_0, b) = 0$, $U_l(p_1, b) - U_l(p_0, b) = p_0 - p_1$.
(2) $(U_l(r_1, b) - U_l(r_1, b)) - (U_l(r_0, b) - U_l(r_0, b)) = p_1 - p_0$.
For $p_1 > p_0$, the second part of (1) is negative. It is easy to show a modified version of lemma 4 holds, and the firm $z_0$ which was previously able to borrow at $p_0$, can no longer borrow at $p_1$. All smaller firms are still not able to borrow. Thus at $p_1$, the firm $z_1'$ which is just able to borrow, satisfies $z_1' > z_0'$. The firm $z_0''$ which was previously indifferent between $j = 1$ and $j = 2$ at $p_0$, will now prefer $j = 1$ at $p_1$, since bondholders can offer the firm the same contract as before, whereas intermediaries have to charge a higher interest rate (this follows from (1)). It is also easy to show a modified version of lemma 2 holds, so firms which preferred $j = 1$ at $p_0$. will also prefer $j = 1$ at $p_1$. Thus at $p_1$, the firm $z_1''$ which is indifferent between $j = 1$ and $j = 2$, satisfies $z_1'' < z_0''$.

Therefore, 
\[ \Delta (I_l - I_l) = -\int_{z_0}^{z_1'} z g(z) \, dz < 0 \]
\[ \Delta (D_l - D_l) = -\int_{z_0}^{z_1''} z g(z) \, dz - 2 \int_{z_1''}^{z_0''} z g(z) \, dz < \Delta (I_l - I_l) . \] QED

References


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