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Nanyu Chen March 27, 2017

Monetary Policy and Nonfinancial Business Loans: an SVAR approach

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Abstract

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This paper investigates the issue of how monetary policy affects loans of public and private firms through the balance sheet and bank lending channel within a SVAR framework. The time period of the analysis stretches from 1973Q1 to 2007Q4. In order to precisely answer this question, this paper takes three empirical difficulties into account. First, in order to avoid the potential endogeneity problem of using monetary aggregates as an indicator of monetary policy, this paper uses the federal funds rate to indicate the stance of monetary policy. Second, firms' inventory is treated as a proxy for loan demand. However, this proxy only provides a qualitative measure of firms' loan demand. Third, this paper uses net worth of firms and commercial banks to differentiate the balance sheet and bank lending channel respectively. While the impulse response functions show that the balance sheet channel plays an important role in transmitting a monetary policy shock to loans of both public and private firms, there is no sufficient evidence to suggest that the bank lending channel is effective. More importantly, the balance sheet channel has more pronounced effects on loans of private firms than on loans for public firms.

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1 Introduction

In the United States, issues related to monetary policy have long been regarded as spotlights of economic research. On one hand, monetary policy can potentially exert significant impact on the financial market, which, through its development over time, has become an indispensable component of the economy. On the other hand, monetary policy can affect the real economy through various, and often subtle, transmission mechanisms.

This paper tries to analyze the impact of US monetary policy on nonfinancial business loans, including public (corporate) and private (non-corporate) firms. The importance of this question arises from three major reasons. First, the nonfinancial business sector accounts for a huge proportion of weights in the whole economy. Figure 1 presents the ratio of nonfinancial business assets to nominal GDP from 1950Q1 to 2016Q2. While this ratio fluctuates greatly over time, the assets of entire nonfinancial business sector almost always account for more than 200 percent of nominal GDP. Second, obtaining credit, as a way of external financing, is a key element for daily operations and development of firms. Empirical studies on the relationship between financing structure and firm growth provide strong evidence on the indispensability of loans for firms (Chittenden, Hall and Hutchinson, 1996; Rahaman, 2011). Third, different financing capabilities of public and private firms in nonfinancial business sector merit deeper analysis in terms of their respective responses to monetary policy. Indeed, many empirical works show that private firms are much more sensitive to monetary

policy shocks. Gertler and Gilchrist (1994) analyzes the responses of small versus large manufacturing firms in the US to monetary policy shock. They find that sales of small firms decline significantly compared to those of large firms after a tight monetary policy shock.[1] Therefore, evaluating the corresponding effects of monetary policy on the loans of public and private firms can provide great practical evidence in guiding future policy implementation.

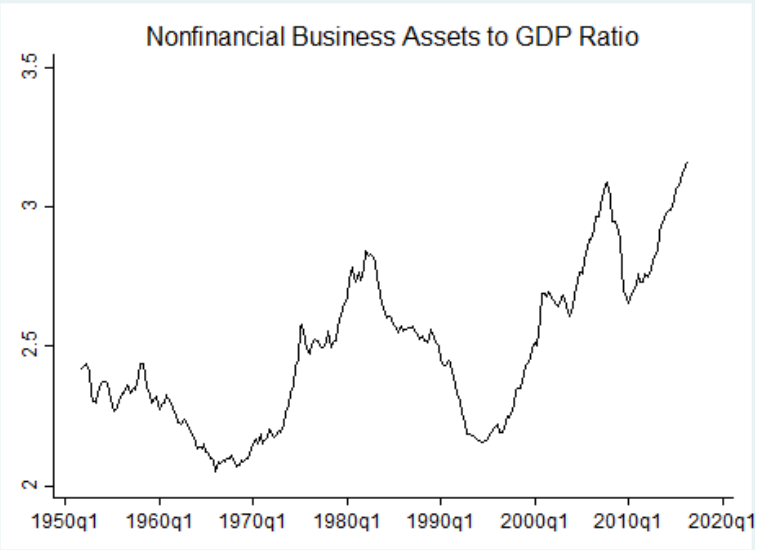


Figure 1: Nonfinancial Business Assets to Nominal GDP Ratio

However, to answer this question precisely, three problems naturally arise. First, it is essential to accurately measure the stance of monetary policy in the first place. Traditional measures, such as monetary aggregates (M1, M2 and etc.) are believed to be unable to reflect the true behavior of monetary policy, because changes in monetary aggregates often include both money demand and money supply fluctuations. Second, a monetary policy shock can affect both loan demand and loan supply. Therefore,

[1] In order to avoid term confusion, it is important to note that large firms often refer to public firms. Small firms, on the other hand, refer to private firms.

a strategy directly linking loans and monetary policy may cause serious endogeneity problems and lead to biased estimates. Third, monetary policy can potentially affect loan supply through different credit channels. Two major channels are widely considered in the traditional literature, which are the balance sheet channel and bank lending channel. Through the balance sheet channel, a tight monetary policy decreases the value of firms' assets and increases their interest payments, which then leads to a deterioration of firms' net worth. Theories on the balance channel postulate that a decrease in firms' net worth will not only increae their costs of external financing, but also make them look "riskier" to banks and reduce their chances of obtaining loans. Through the bank lending channel, a tight monetary policy reduces the availability of loanable funds to commercial banks, which consequently make bank-dependent firms harder to obtain loans.[2]

This paper takes these three problems into account in a structural vector-autogression (SVAR) framework. To the first problem, empirical works on this topic by Bernanke and Blinder (1992), and Christiano and Eichenbaum (1994) use federal funds rate and non-borrowed reserves respectively as better indicators of monetary policy. Compared to the traditional measures, federal funds rate and non-borrowed reserves are considered to have more robust theoretical and empirical grounds.[3] However, since the Federal Reserve has only targeted non-borrowed reserves for a relatively short period, this paper only considers using federal funds rate as an indicator of monetary policy.[4]To the

[2]Reducing the availability of loans essentially lowers the net worth of commercial banks, since banks can only provide fewer loans.

[3]More details are discussed in the literature review section.

[4]Since 2009, the federal funds rate dropped to its lower bound and did not have much variation

second and third problems, several recent works tend to investigate the bank lending channel and balance sheet channel by separating loan supply and demand based on firm-level data and bank surveys. Ciccareli, Maddaloni and Peydro (2010) constructs an innovative measure from the U.S Senior Loan Officer Survey (SLOS) released by the Federal Reserve to separate loan supply and demand. For instance, to quantify loan demand, they use the net difference in percentages between bankers who report that changes in loans are due to loan applications (demand) and bankers who report that changes in loans are due to factors not related to loan applications (demand). To indicate a bank lending channel and a balance sheet channel, they use similar approach by constructing net percentages from related survey questions. One potential problem of their work is that they *assume* that the answers from the SLOS are objective. If this assumption actually fails, their measure of loan demand and supply will potentially lead to biased results. Therefore, this paper uses another measure, the inventories of firms, to serve as a proxy for firms' demand for loans. This strategy is motivated by Gertler and Gilchrist (1994), as their work shows that inventory demands of firms decline after a tight monetary policy shock. Their result implies that firms' demand for loans can possibly be reflected by fluctuations in inventories. Figure 2 shows the movement of inventories and total loans of public and private firms from 1953Q1 to 2016Q2. In the case of public firms, inventories and loans move very closely. Although this measure cannot fully account for firms' demand for loans, it can potentially provide a *qualitative*

thereafter. Thus, the period after 2009 is excluded in the analysis, which is a potential limitation of this paper since the recent financial crisis has sparked a new wave of research direction.

and objective measure to reflect firms' demand for loans. On the supply side, this paper uses net worth of firms to indicate the balance sheet channel, and uses net worth of commercial banks to indicate the bank lending channel. This paper has a potential to contribute to the growing macro-prudential literature on monetary policy and credit. Specifically, this paper investigates the significance of balance sheet channel and bank lending channel on non-financial public and private firms by separating loan supply and demand in a standard SVAR framework.

Following this introduction section, section II provides a list of relevant literature review. Section III formally presents the SVAR methodology and data sources employed by this paper. Section IV presents and interprets the empirical results. Section V concludes with potential implications of this paper and its limitations.

2 Literature Review

1. Monetary Policy

Measuring the stance of monetary policy accurately has been a difficulty in research. Traditional measures of money aggregates (M1, M2 and etc.) are unable to reflect the true behaviors of the central bank (Zha, 1997). For instance, an increase in M1 can be attributed to both a positive money demand and supply shock. In response to this problem, alternative approaches are proposed in the empirical monetary policy research field. Friedman and Schwartz (1963), and Romer and Romer (1989) attempt

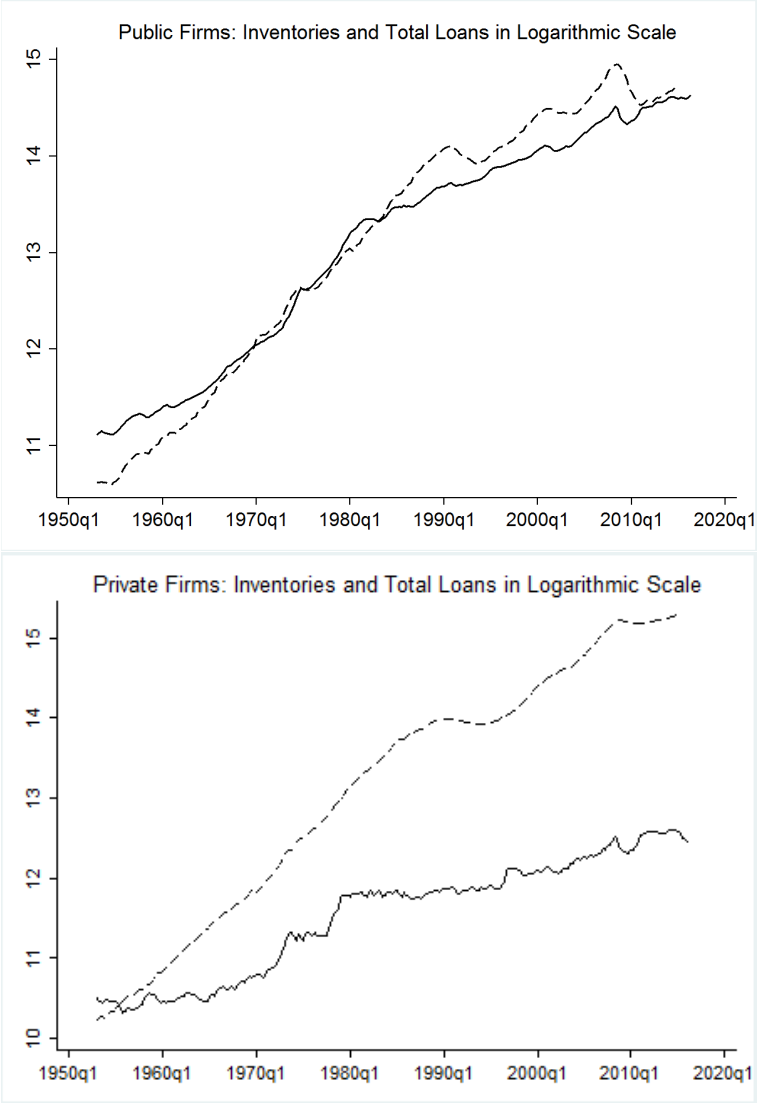


Figure 2: Inventories and Total Loans in Logarithmic Scale
Notes: Solid lines represent total loans. Dashed lines represent inventories.

to extract the information about the stance of monetary policy from the Fed's reports and decision-making processes. However, the problem of this approach, as mentioned by Bernanke (1995), is that such measure is highly subjective and thus exposed to bias. Sims and Zha (1993) also points out that such measure makes it difficult to distinguish between endogenous and exogenous components of policy changes. Considering these

problems, works by Bernanke and Blinder (1992), and Christiano and Eichenbaum (1994) use federal funds rate and non-borrowed reserves respectively as indicators of monetary policies within VAR frameworks, showing that these two measures affect various economic aggregates, such as GDP, inflation and unemployment, in ways that are largely predicted by traditional economic theories. Their approaches are also largely based on the Fed's operating procedures. Specifically, the federal funds rate is often employed as an instrument to control the price of money, while non-borrowed reserves are utilized to control the quantity of money. Thus, based on these considerations, these two measures are considered to have more robust theoretical and empirical grounds.

However, Bernanke and Mihov (1995) point out that the Fed sometimes changes its operating procedures at certain time periods. For instance, non-borrowed reserves were officially targeted for a short period from 1979 to 1982. As a result, the federal funds rate had fluctuated greatly over this period. To account for this potential problem, Strongin (1992) proposes a way to accommodate the shift in the operating procedure by using the portion of non-borrowed reserve growth that is orthogonal to total reserve growth. In this method, a change in the projection coefficient of non-borrowed reserves on total reserves is able to reflect a shift in the Fed's operating procedure. In a similar spirit, Bernanke and Mihov (1995) use a SVAR approach to compare different measures of monetary policy and suggest a broader way to accommodate the change in the Fed's operating procedures.

Nevertheless, since the recent financial crisis in 2008, the Fed has dramatically changed its operating procedure. The federal funds rate dropped to its lower zero bound

in early 2009, forcing the Fed to conduct a set of unconventional monetary policies, which are known as forward guidance and quantitative easing. The ultimate goal of unconventional monetary policies is to lower the long-term interest rate (to flatten the yield curve), since the short-term interest rate has hit its lower bound. While forward guidance operates by strengthening public confidence, quantitative easing mainly works through a portfolio-rebalance channel. For instance, when the asset purchase programs conducted by the Fed decrease long-term interest rates on government bonds, investors readjust their portfolios by purchasing more corporate bonds, which further leads to a decrease in the interest rates of corporate bonds.[5] Cecioni, Ferrero and Secchi (2011) evaluate the effectiveness of unconventional monetary policies and show that unconventional monetary policies significantly improve the funding conditions in financial markets. In addition, Gertler and Karadi (2011) analyze the impact of credit expansion by the central bank (quantitative easing) based on a DSGE model, reaching a conclusion that central bank intervention greatly eases the balance sheet constraints faced by private intermediaries. Although the recent crisis has embarked a new wave of research interest, this special event has still not been fully understood, especially in the quantification of unconventional monetary policies, as pointed out by Cecioni et al (2011). Therefore, based on all of the considerations mentioned above, this paper uses only the federal funds rate as an indicator of monetary policy for two reasons. First, while non-borrowed reserves have been targeted only for a short period, the federal funds rate has been officially targeted for a more consistent and longer time

[5]Note that theoretically, there is an inverse relationship between bond rates and prices.

period. Second, due to the complicated nature of the recent crisis, especially in the quantification of unconventional monetary policies, this paper only analyzes the period from 1973Q1 and 2007Q4.

2. Credit Channel

One strand of literature on credit channel postulates that monetary policy can influence firms' financing capabilities and investment through their balance sheets, namely, the balance sheet channel. In a neoclassical model of business cycle, Bernanke and Gertler (1989) explain how reduction in borrowers' net worth can lead to increases in the agency costs of financing investment. Then, based on this model, Bernanke, Gertler and Gilchrist (1993) further show that the effects of an adverse shock to the economy, such as a monetary policy tightening, can be exacerbated due to decreases in borrowers' net worth. That is, as a monetary policy tightening tends to decrease firms' net worth, firms face higher costs of borrowing because commercial banks perceive firms with lower net worth as having higher risks and thus are unwilling to supply loans to them. As a result, these firms have to cut their investment, which then exerts downward pressure on the real economy. Another strand of theoretical works focus on lenders' balances sheets, namely, the bank lending channel. Holmstrom and Tirole (1997) show that insufficiently-capitalized financial intermediaries have incentives to supply fewer loans in response to a monetary tightening. Such phenomenon is often called as a "credit crunch". One implication of this result is that firms depending on

these financial intermediaries (i.e. banks) may face higher borrowing costs and thus reduce their investment following a "credit crunch". Nevertheless, Bernanke and Lown (1991) present evidence against the bank lending channel. They show that during some periods of "credit crunch", both monetary aggregates and interest rates tend to be lower than those in normal times. This conflicting phenomenon challenges the work by Holmstrom and Tirole (1997). Future studies focusing on explaining this phenomenon will certainly contribute to the literature on the bank lending channel.

While there is a large consensus in theoretical literature that monetary policy *does* affect lending and credit, though the exact channel may not be easily identified, empirical literature on credit channel also faces several difficulties. First, credit demand and supply may both change in response to a monetary policy shock. Second, similar to the problem faced in the theoretical literature, even though credit demand can be separated from credit supply, both the balance sheet channel and bank lending channel can potentially be active on the supply side. In face of these challenges, recent empirical works tend to use firm-level and bank-level data to tease out the interactions between loan supply and demand. Jiménez and Ongena (2012) use a unique dataset in Spain, which contains all monthly information on banks and loan requests from their respective borrowers. Based on this dataset, they separate loan demand from loan supply by studying closely on the loan applications from bank-dependent borrowers. On the supply side, they investigate the bank-lending channel by using banks' capital and liquidity ratio to reflect changes in banks' net worth. In a similar spirit, Ciccarelli, Maddaloni and Peydró (2015) extract the information of banks and their borrowers

from two banking surveys, one in the US and the other in Europe. They innovatively construct a measure of loan demand and supply by using net percentages of particular responses from bankers. For example, the percentage of bankers who report that changes in lending conditions are due to changes in loan applications (demand) minus the percentage of bankers who report that changes in lending conditions are due to factors not related to loan applications (demand) indicates the extent of changes in loan demand. As mentioned before, one potential problem of their work lies in the assumption that responses from bankers are objective and accurate. If this assumption fails, loan supply and demand are subject to bias. However, working on firm-level and bank level data is certainly a promising direction, in that empirical analysis can potentially yield more precise and convincible results.

3 Methodology and Data

3.1 Framework

This subsection formally addresses a standard SVAR framework. First, suppose the structure of the economy is as follows:

$$AY_t = B_1 Y_{t-1} + B_2 Y_{t-2} + \cdots + B_p Y_{t-p} + \epsilon_t \tag{1}$$

, where $E(\epsilon_t) = 0$, $E(\epsilon_t \epsilon_\tau') = \sum_\epsilon$ for $t = \tau$ and 0 otherwise.

In the equation (1), Y_t is a $K \times 1$ matrix including observable nonpolicy macro-

economic variables and monetary policy variables. ϵ_t is a $K \times 1$ matrix representing the orthogonalized structural innovations. $A, B_1, B_2, \ldots, B_p$ are structural parameters on Y_t and its lagged values.

By premutiplying a matrix A^{-1}, the equation (1) may be written in its reduced form as:

$$Y_t = A^{-1}BY_{t-1} + A^{-1}B_2Y_{t-2} + \cdots + A^{-1}B_pY_{t-p} + A^{-1}\epsilon_t \tag{2}$$

Then, the equation (2) becomes:

$$Y_t = A_1{}^*Y_{t-1} + A_2{}^*Y_{t-2} + \cdots + A_p{}^*Y_{t-p} + u_t \tag{3}$$

, where $A_j{}^* = A^{-1}B_j$ for j=1, 2,..., p, and $u_t = A^{-1}\epsilon_t$.

Now, the reduced-form and structural errors can be connected:

$$Au_t = \epsilon_t \tag{4}$$

The equation (4) provides a shock view to analyze the effect of unexpected policy shock on other endogenous variables. This relationship is of particular interest in this study because the impulse response functions can be directly calculated once the matrix A is found. To recover the relationship in (4), it is necessary to impose some restrictions on the matrix A. This paper follows a conventional Cholesky decomposition strategy, which will be discussed in the third subsection.

3.2 Specification

Following Christiano and Eichenbaum (1994), the benchmark model includes seven variables with the ordering of real GDP (RGDP), GDP deflator (GDPDEF), commodity price index (COM), federal funds rate (FEDFR), inventories, net worth and loans. The inclusion of the first four variables is widely discussed in the VAR literature. First, the real GDP and GDP deflator are conventionally used to capture the general economic conditions in the economy. Second, commodity price index is used here to avoid the famous "price puzzle" problem, which exhibits a counter-intuitive observation that tigher monetary policies tend to raise the price level. Third, federal funds rate represents the stance the monetary policy, as discussed in the literature review section. Thus, one standard deviation increase in this variable indicates a positive monetary policy shock. The ordering assumes that monetary policy does not have contemporaneous effect on the aggregate macro-economic variables. In other words, the central bank is assumed to be unable to respond to the economy and make decisions in a short period of time. Since the data in this study is based on quarterly frequency, it seems to be reasonable to make this assumption.

However, the last three variables need to be further clarified. First, it is important to note that there are two sets of specifications, one focusing on private firms and the other focusing on public firms. With this in mind, the variables of inventories, net worth and loans can relate to public firms or private firms.[6] In addition, the variable

[6]For public firms, inventories are indicated as CORINV, and for private firms, inventories are indicated as NCORINV. Similarly, CORNW and NCORNW represent the net worth of public firms and that of private firms respectively.

loans can represent total loans, short-term loans and long-term loans.[7] Second, the variable inventories represents a measure of loan demand of public or private firms. As mentioned before, this is a qualitative measure of loan demand. Thus, one standard increase in this variable can be interpreted as a loan demand shock. Third, on the supply side, in order to differentiate the bank lending channel from the balance sheet channel, the variable net worth refers to different meanings. When testing the balance sheet channel, the net worth variable represents net worth of either public or private firms. For instance, one standard deviation increase in the net worth of public firms (CORNW) can be interpreted as a balance sheet shock on public firms. On the other hand, when testing a bank lending channel, one standard deviation increase in the net worth of commercial banks (CMNW) can be interpreted as a bank lending shock. In addition, CORNW, NCORNW and CMNW are added with a negative sign in order to make the impulse response functions more straightforward.[8] Fourth, the variable inventories is ordered before the variable net worth because the assumption that loan supply does not have contemporaneous effects on loan demand is imposed, as suggested by Ciccarelli, Maddaloni and Peydró (2015). While this order may be subject to a more critical review, robustness check with different orders is conducted, which shows qualitatively similar results. Lastly, the time period of analysis stretches from 1973Q1 to 2007Q4, as discussed before.

[7]For public firms, total loans, short-term loans and long-term loans are indicated respectively as CORL, CORSL and CORLL. Similarly, for private firms, these loans are represented as NCORL, NCORSL and NCORLL.

[8]In this way, a negative shock to CORNW, NCORNW and CMNW in impulse response functions can be interpreted as one standard deviation increase in these variables.

3.3 Identification

This subsection deals with the technical issues of recovering the structural relationship in the equation (4).

$$Au_t = \epsilon_t \tag{4}$$

In order to recover this relationship, two restrictions are required. First, structural innovations in the model are assumed to be orthogonal. That is: innovation of each endogenous variable in the structural form is uncorrelated with innovations of other endogenous variables. Bernanke (1986) justifies this assumption by treating these structural innovations as "primitive exogenous forces", which implies that these structural innovations do not share common causes. Thus, it seems to be natural to treat these structural innovations as orthogonal. Furthermore, the variance-covariance matrix of structural innovations is normalized into an identity matrix. The normalization does not impose any additional restrictions, but it simplifies the analysis so that one standard deviation shock corresponds to one unit change in innovation.

Second, as suggested by Sims (1980), since $\sum_\epsilon$ is an identity matrix and $\sum_u$ is a Hermitian and positive-definite matrix, it is possible to find the matrix A recursively by using Cholesky decomposition such that $\sum_u = A^{-1} \sum_\epsilon A^{-1'} = A^{-1} A^{-1'}$, where the matrix A has a lower unit triangular form. Then, the contemporaneous restrictions among the endogenous variables is imposed on the matrix A such that the variable in one row contemporaneously affects the variables in rows below, but not vice versa. The

restrictions become clear when the equation (4) is written explicitly in the matrix form:

$$\begin{bmatrix} \epsilon_{trgdp} \\ \epsilon_{tgdpdef} \\ \epsilon_{tcom} \\ \epsilon_{tfedfr} \\ \epsilon_{tinv} \\ \epsilon_{tnw} \\ \epsilon_{tloans} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \begin{bmatrix} u_{trgdp} \\ u_{tgdpdef} \\ u_{tcom} \\ u_{tfedfr} \\ u_{tinv} \\ u_{tnw} \\ u_{tloans} \end{bmatrix} \tag{5}$$

Once the restrictions are imposed, the impulse response of each variable to an unexpected structural shock can then be calculated.

3.4 Data

This paper uses data from two main sources stretching from 1950 to the present in quarterly frequencies.[9] First, Real GDP, GDP deflator and commodity price index are drawn from U.S Economic Accounts released by the Bureau of Economic Analysis. Second, federal funds rate, inventories, net worth of firms and commercial banks, and firm loans are from the Financial Accounts of the United States released by the Board of Governors of the Federal Reserve System.

For both public and private firms, inventories, net worth and loans are level data. Similarly, in order for the analysis to be consistent, net worth of commercial banks

[9]While the analysis only includes 1973Q1 to 2007Q4, this paper presents the time-series ratio of nonfinancial business assets to nominal GDP in Figure 1 from 1950Q1 to 2016Q2.

is also level data. Furthermore, for firm loans, the comprehensive data released by the Federal Reserve System allows this paper to implement the analysis by looking further at short-term loans and long-term loans (mainly mortgages). When conducting the analysis, this paper converts all of these variables (except federal funds rate) into logarithmic forms in order to have percentage implications.

4 Empirical Results

4.1 Public Firms

Selected impulse response functions of related variables are presented in Figure 3 and 4. Specifically, graphs of a positive monetary policy shock (FEDFR) on loan demand (CORINV), as well as on net worth of public firms (CORNW) and net worth of commercial banks (CMNW) are presented in Figure 3. Then, the impulse responses of total loans (CORL) to a balance sheet shock (CORNW) and a bank lending shock (CMNW) are presented in Figure 4. The response of total loans (CORL) to loan demand, as partly reflected by inventories of public firms (CORINV), is also presented in Figure 4.[10] From these results, three important findings need to be highlighted. [11]

First, loan demand initially increases by four quarters and then declines in response to a positive monetary policy shock. This result seems to be counter-intuitive, and it also contrasts with findings by Ciccarelli et al (2010) in that they show loan demand directly

[10] Dashed lines are 95 percent error bands.

[11] Due to space issues, graphs relaed to short-term and long-term loans are presented in the Appendix (Figure 7).

falls after a positive monetary policy shock. Nevertheless, it is important to note that their results are based on all non-financial firms. Indeed, theories on firm inventories suggest that this initial increase in loan demand can be explained by adjustment costs in firms' production process. One of the theories, based on a production-smoothing model, demonstrates that public firms faced with a positive monetary policy shock may face higher adjustment costs if they change their level of inventories instead of keeping their original production levels. Ramey (1991) further shows that in some situations, unit costs of production may decline when firms can produce more. Therefore, loan demand of public firms, as partly reflected by inventories, may react similarly as their inventories change. Although this is beyond the scope of this paper, future researchers may take a closer look at firm inventories in order to yield more meaningful results. In addition, total loans and long-term loans of public firms in response to a positive shock on loan demand initially show a slight decline, though insignificant, and increase thereafter. Short-term loans, however, directly increase after a positive loan demand shock. These results can be explained by the previous argument that inventories can only serve as a qualitative, instead of a quantitative proxy for loan demand. Nevertheless, these impulse response results also suggest that inventories seem to be a better measurement of loan demand for short-term loans, rather than for total and long-term loans.

Second, the balance sheet channel is active in transmitting a positive monetary policy shock to all three types of loans of public firms. Similar to loan demand, a positive monetary shock initially leads to a short-period increase in the net worth of public firms, which lasts for approximately 4 quarters. After that, the net worth of

public firms starts to decline rapidly. In addition, total loans of public firms in response to a balance sheet shock directly decrease by approximately 0.4 percent in the first quarter, and by 1.5 percent in 4 quarters. Therefore, following a positive monetary policy shock, total loans of public firms initially increase and then decrease thereafter through the balance sheet channel. Short-term and long-term loans have quantitaively similar results, as shown in Table 2. Indeed, the onset of both the recession during the early 1990s and the period from 2004 and 2006 when the Fed largely increased the federal funds rate exhibit such pattern. The behavior of loans is also consistent with findings by Christiano and Eichenbaum (1994). They show that net funds raised by public firms initially increase and eventually decline in response to a positive monetary policy shock. However, they argue that such increase in net funds can largely be explained by a more significant increase in liabilities of public firms than assets of public firms. This contrasts with the result of this paper that a positive monetary policy shock initially leads to an increase in net worth of public firms. These two conflicting results may be better dealt with a more rigorous analysis based on firm-level and bank-level data.

Third, surprisingly, the bank lending channel does not play a significant role in transmitting a positive monetary policy shock. While a positive monetary policy shock initially leads to an increase and eventually a decline in the net worth of commercial banks, the response of all three types of loans to the net worth of commercial banks are insignificant, which can be seen from the large error bands in Figure 3. These results can potentially be explained by the fact that commercial banks can raise funds in the

public markets. Indeed, the abolition of reserve requirements on certificates of deposits in 1980s partly lifts the burden on commercial banks in meeting short-term liquidity constraints, because commercial banks can then issue new securities not backed by reserve requirements (Mishkin, 1996). While many empirical works show that the bank lending channel plays a significant role in transmitting a monetary policy shock to firm loans, the result presented here challenges the conventional finding. The conflicting result may be reconciled by conducting analysis on two separate periods, which are before and after the abolition of reserve requirements on certificates of deposits. Future studies separating the analysis of firm loans into these two periods may yield completely different but very meaningful results.

Figure 3: Public Firms: A Positive Monetary Shock

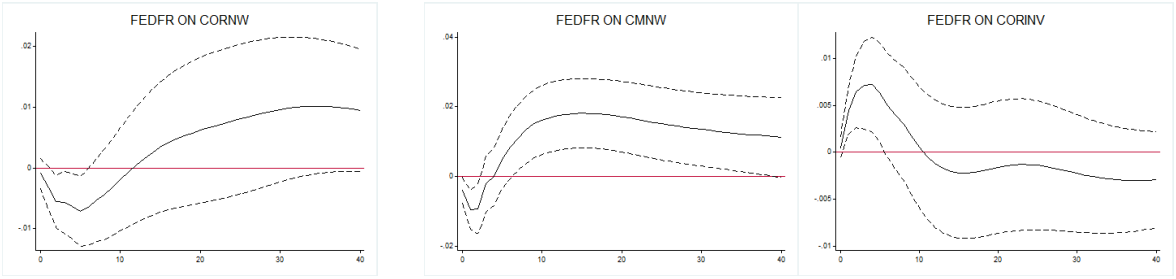
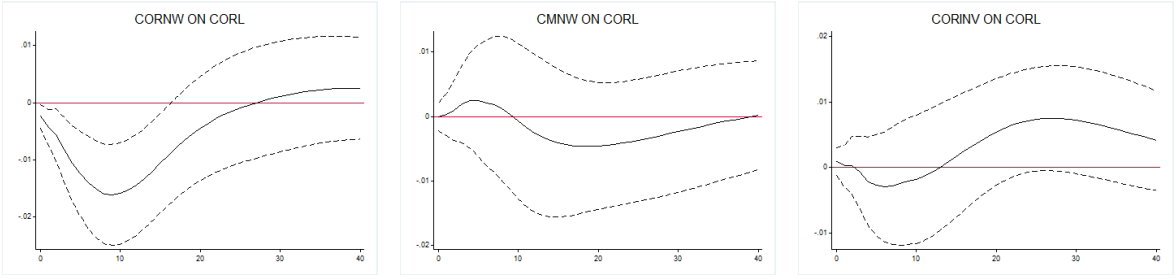


Figure 4: Public Firms: Credit Channel and Loan Demand Shock



4.2 Private Firms

Selected impulse response functions of related variables for private firms are presented in Figure 5 and 6. Specifically, graphs of a positive monetary policy shock (FEDFR) on loan demand (NCORINV), as well as on net worth of private firms (NCORNW) and net worth of commercial banks (CMNW) are presented in Figure 5. Then, the impulse responses of total loans (NCORL) to a balance sheet shock (NCORNW) and a bank lending shock (CMNW) are presented in Figure 6. The response of total loans (NCORL) to loan demand, as partly reflected by inventories of private firms (CORINV), is presented in Figure 6.[12] While some variables exhibit similar patterns as in the case of public firms, some important differences need to be discussed. As in the case of public firms, the bank lending channel is also not significant in the case of private firms, so the following discussion tends to avoid making repetitive comments on this channel.[13]

First, loan demand of private firms directly decreases in response to a positive monetary policy shock. As discussed before, theories on firm inventories, such as a production-smoothing model, suggest that unlike public firms, private firms may incur lower costs if they adjust downwards their levels of inventories, which reduces their corresponding loan demand. Nevertheless, other potential factors may also play a role here. In addition, faced with a positive loan demand shock, total loans of private firms increase directly, which is different from the intially insignificant decrease observed in the loans of public firms. Short-term loans and long-term loans of private firms

[12] Dashed lines are 95 percent error bands.

[13] Due to space issues, graphs relaed to short-term and long-term loans are presented in the Appendix (Figure 8).

also exhibit a secular increase in response to a positive loan demand shock. More importantly, short-term loans show a more pronounced increase in response to a positive loan demand shock, which is consistent with the response of short-term loans of public firms. This result further shows that inventories can serve as a better proxy of loan demand for short-term loans.

Second, although the balance sheet channel is also active in private firms, unlike the net worth of public firms, a positive monetary shock leads to a direct decrease in the net worth of private firms. In addition, after 4 quarters, all three types of loans of private firms decline at a faster pace than in the case of public firms in response to a balance sheet shock. Therefore, following a positive monetary policy shock, all three types of loans of private firms directly decreases through the balance sheet channel, and more importantly, at a larger magnitude than loans of public firms. The difference in responses of loans to a balance sheet shock between public and private firms can potentially be explained by the fact that private firms have relatively limited access to draw funds from the public markets compared to public firms. In other words, faced with a positive monetary policy shock, private firms are often unable to prevent their balance sheets from shrinking. This is consistent with Gertler and Gilchrist (1994), as they find that sales of small manufacturing firms, which are part of their assets, tend to decline at a faster pace than those of large manufacturing firms. Therefore, as predicted by the theory of balance sheet channel, when net worth of private firms declines, it becomes more difficult for them to obtain loans from banks, not only because the external finance costs increase, but also because these private firms are considered

to be riskier clients by commercial banks.

Third, while short-term loans and long-terms loans of public firms do not exhibit significant differences in their responses to a balance sheet shock, these two types of loans do show differences in the case of private firms. In response to a balance sheet shock, short-term loans of private firms decrease by 2.2 percent in 5 quarters. Long-term loans, on the other hand, decrease only by 0.7 percent in 5 quarters. Such result suggests that the balance sheet channel has stronger effects on constraining short-term liquidities of private firms than on long-term liquidities.

Figure 5: Private Firms: A Positive Monetary Shock

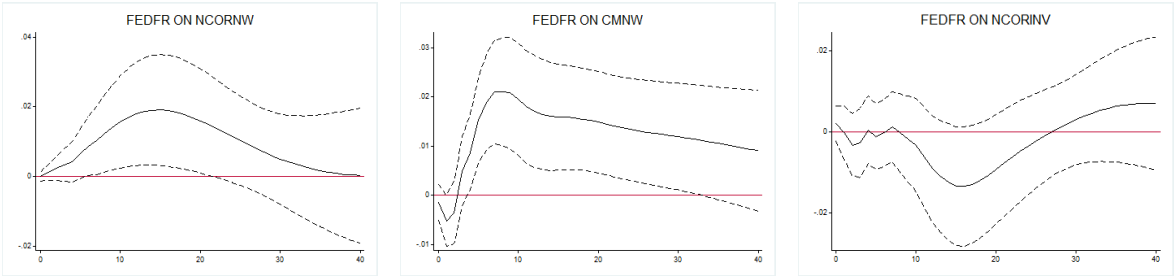


Figure 6: Private Firms: Credit Channel and Loan Demand Shock

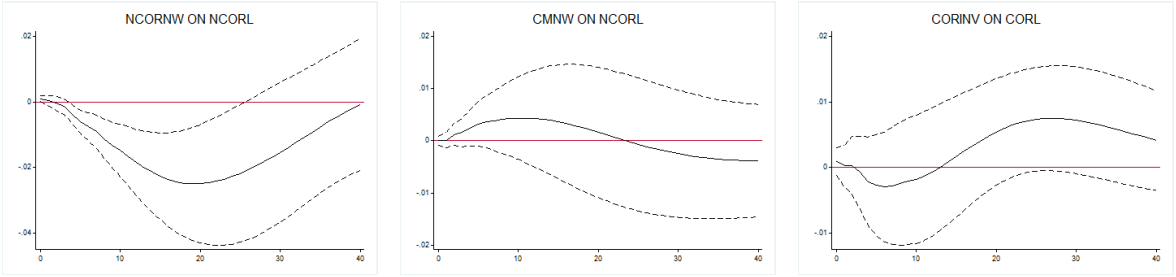


Table 1: A Positive Monetary Policy Shock

Reponse Variables	**Estimates**
CORNW	−.0047
CORINV	.0054
NCORNW	.0029
NCORINV	−.0007
CMNW	−.0033

Table 2: A Credit Channel Shock on Loans

	Balance Sheet Channel			**Bank Lending Channel**		
	Short-Term	Long-Term	Total	Short-Term	Long-Term	Total
Public Firms	−0.0048	−0.0043	−0.0072	0.0032	0.0010	0.0014
Private Firms	−0.0037	−0.0011	−0.0017	0.0008	0.0019	0.0014

[a] Note: The estimates from table 1 and 2 are five-quarter averages in response to a particular shock (one standard deviation). In addition, all variables are in logarithmic form (except federal funds rate). Therefore, the estimates, once multiplied by 100, may be interpreted as percentages. Also, it is important to note that the estimates of the bank lending channel for both types of firms are insignificant.

5 Conclusion

This paper investigates how monetary policy can potentially affect loans of public and private firms through the balance sheet and bank lending channel within a SVAR

framework. Three empirical difficulties in analyzing this issue are taken into account in this paper.

First, in order to avoid the potential endogeneity problem by using monetary aggregates as an indicator of monetary policy, this paper uses the federal funds rate to indicate the stance of monetary policy. Theoretically, the federal funds rate can serve as a benchmark for the price of money. Empirically, the federal funds rate has been targeted by the Fed for a relatively long period in its operating procedure. Therefore, this measure has stronger empirical and theoretical grounds than the traditional measure of monetary aggregates in indicating the stance of monetary policy. However, one limitation of this paper is its exclusion of the recent financial crisis. As mentioned before, this period has sparked a new wave of research interest, because the Fed has conducted a set of unconventional monetary policies in response to a lower zero bound on short-term interest rates. The difficulty of analyzing this period lies in the quantification of unconventional monetary policies, including the forward guidance and quantitative easing. However, some recent works try to meet this challenge in both empirical and theoretical fields. Therefore, future studies analyzing the response of firm loans to monetary policy can greatly contribute to the literature if they can further include the period of the recent crisis.

Second, firm inventories are treated as a proxy for their loan demand. It is important to note that this proxy only provides a qualitative measure of firms' loan demand, which is another limitation of this paper. Furthermore, results from impulse response functions suggest that firm inventories seem to be a better measurement of loan demand

for short-term loans, rather than for total and long-term loans. Indeed, these results suggest that while it is important to separate loan demand and supply, it will be even better if future empirical researchers can come up with ways to further tease out factors that can influence short-term and long-term demand for loans.

Third, the balance sheet channel is analyzed by using the net worth of firms as an indicator of a balance sheet shock. This paper shows that the balance sheet channel is effective in transmitting a monetary policy shock on loans of both public and private firms. However, these two types of firms exhibit different patterns. On one hand, following a positive monetary policy shock, all three types of loans of public firms initially increase for approximately 4 quarters and ultimately decrease thereafter. On the other hand, all three types of loans of private firms directly decrease after a positive monetary policy shock. These results can be explained by the fact that compared to public firms, private firms have relatively limited access to draw funds from public markets. As a result, private firms are usually unable to prevent their balance sheets from shrinking when faced with a positive monetary policy shock. More importantly, for private firms, a balance sheet shock leads to a more pronounced decrease in short-term loans than in long-term loans. This suggests that a monetary policy shock is more likely to affect the short-term liquidities of private firms.

The bank lending channel, as measured by the net worth of commercial banks, is insignificant for loans of both public and private loans. This surprising result can potentially be explained by the fact that the abolition of reserve requirements on certificates of deposits in 1980s partly lifts the burden on commercial banks in meeting

their short-term liquidity constraints. Therefore, future studies focusing on the bank lending channel may separate their analysis into two periods, which are before and after the abolition of reserve requirements on certificates of deposits. Such separation can potentially produce different, yet very meaningful results.

Overall, while this paper analyzes how one specific part of firms, namely, loans, respond to a monetary policy shock, it also highlights the importance of analyzing the monetary policy transmission mechanism on different types of firms. Although public and private firms are considered in this paper, firms can potentially be divided into more specific categories. Therefore, future researchers can study the impact of monetary policy on some specific industries. In this way, their findings can certainly have very meaningful implications in guiding future policy implementations.

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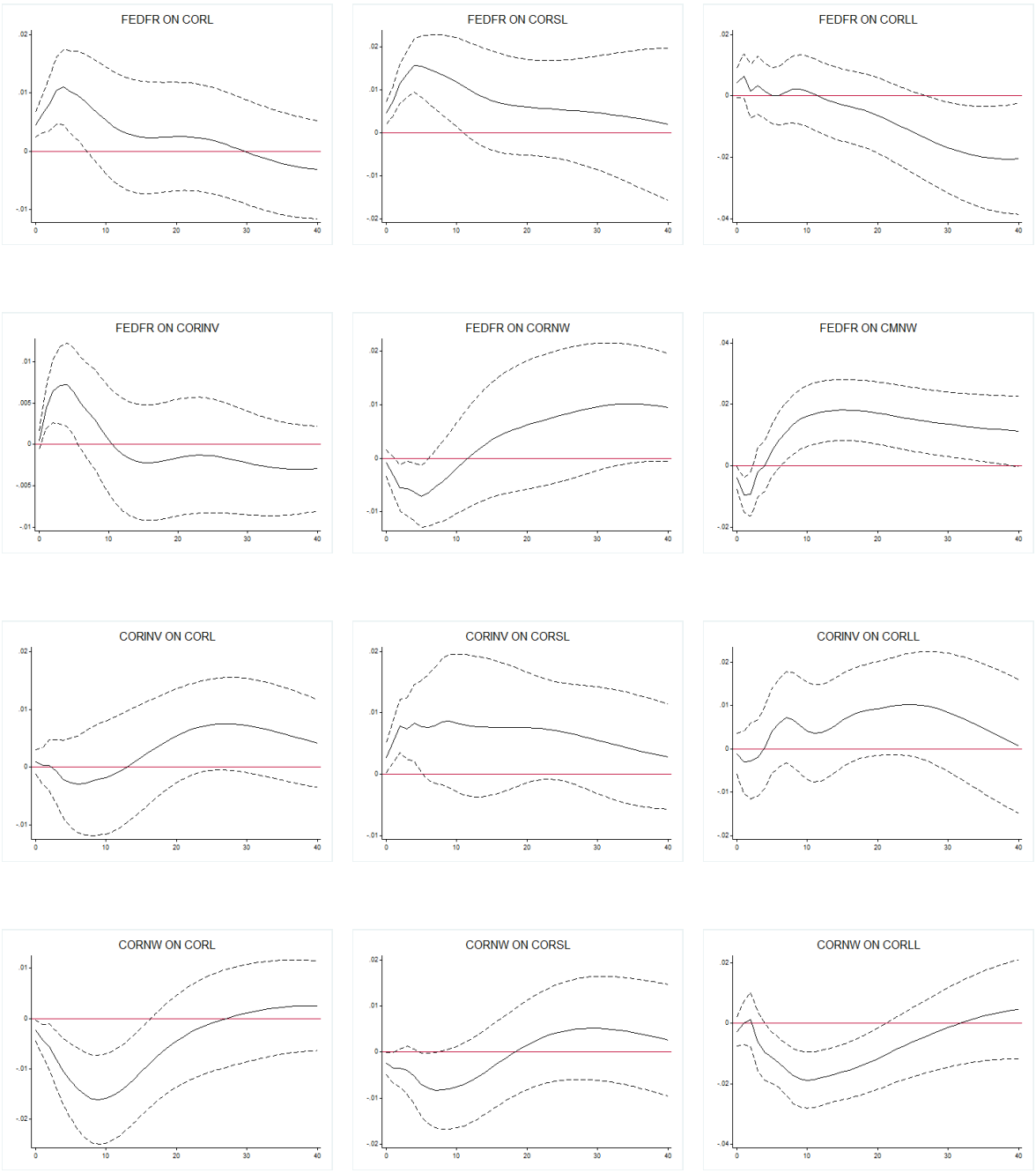
6 Appendix

Figure 7: Public Firms



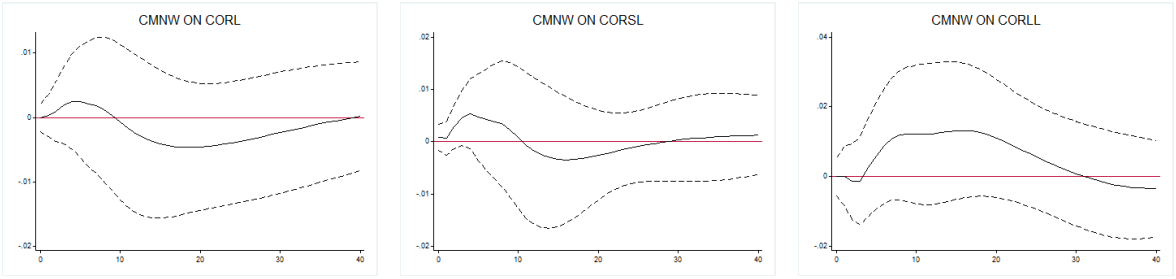
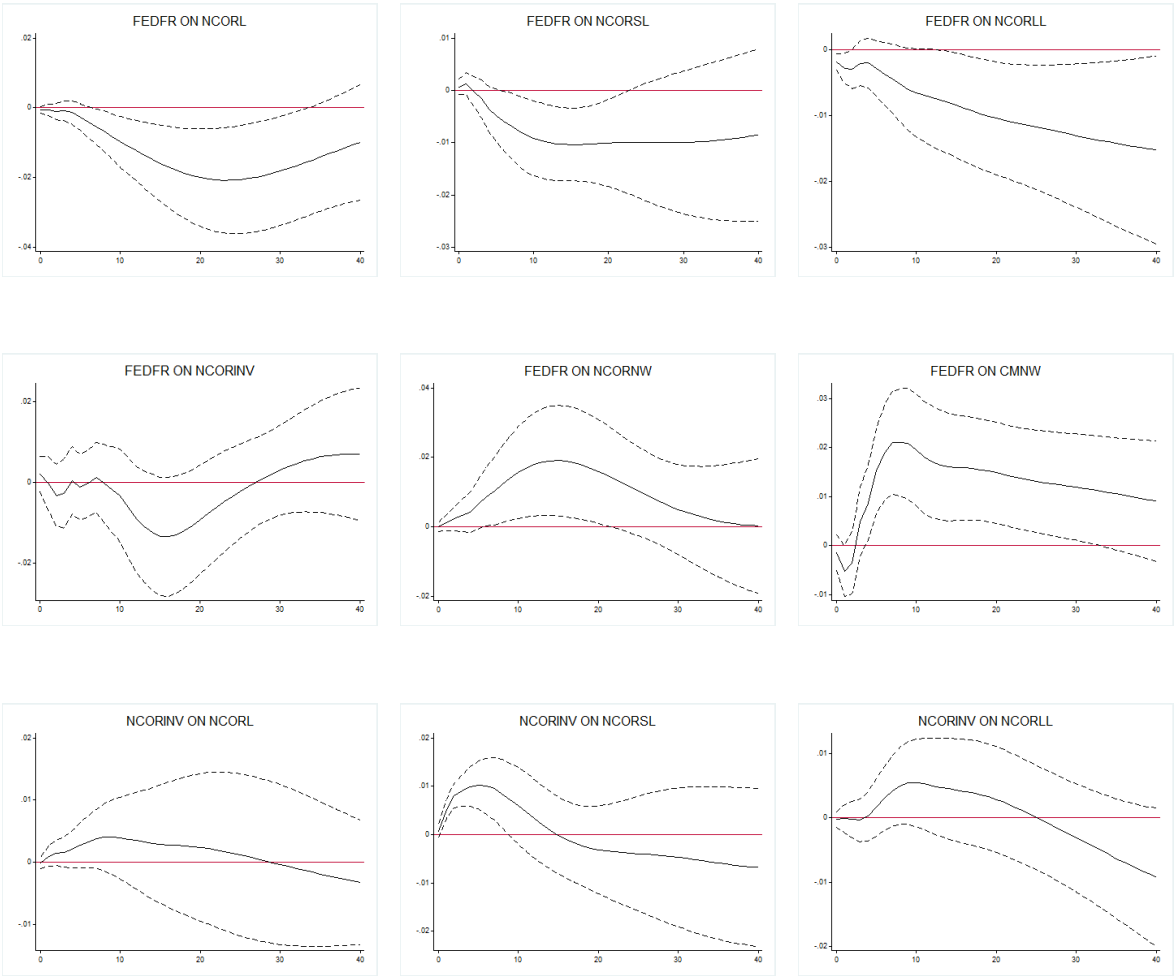
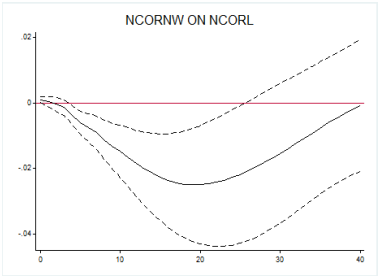


Figure 8: Private Firms

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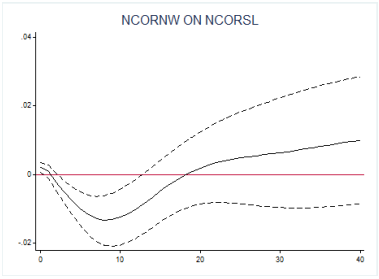
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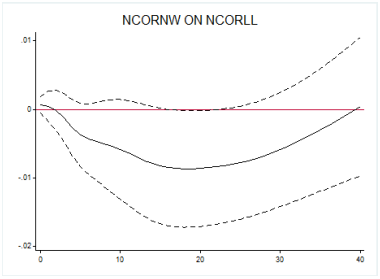
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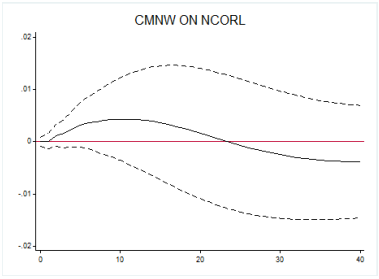
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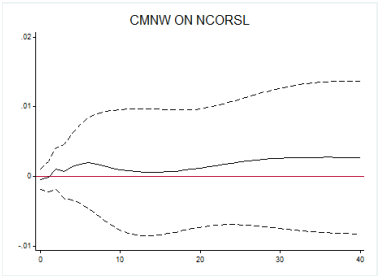
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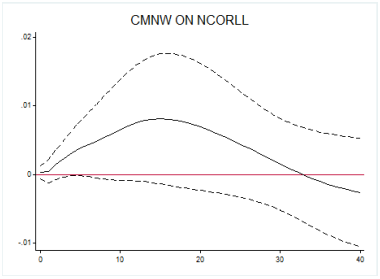
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