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ABSTRACT

We investigate how changes in the availability of bank credit influence how public firms manage their working capital, which is essential to their operations. In doing so, we provide an enhanced understanding of what significantly influences corporate working capital management. We find that changes in the availability of bank credit significantly influence a number of aspects of a firm's working capital policies, and these effects often differ across firms that are more or less dependent on bank financing. Interestingly, our evidence points to the importance of the changing mix of U.S. companies for working capital practices.

Keywords: Bank credit, working capital management, cash management, inventory management, trade credit, supply chain financing

JEL codes: G21, G28, G32, O16

1. Introduction

How do changes in the availability of bank credit affect the way that firms manage their working capital, which is essential to their day-to-day operations? Further, are these effects, if they exist, either larger or smaller for firms that are more dependent on their access to bank financing? These questions are interesting and relevant because bank loans are often the primary source of working capital financing for many firms.

We address these questions and in doing so, confront two empirical issues. First, we use novel instruments to capture the effect of exogenous shocks to bank capital and thereby their supply of credit to commercial and industrial firms. For example, we use the write-offs of residential real estate and farm loans. Such write-offs reduce a bank's capital and therefore its ability to supply credit to businesses. As the recent financial crisis demonstrates, the write-off of these loans preceded a drop in commercial and industrial loans.

Second, we address a statistical issue often ignored in prior studies of different elements of a firm's working capital. Many studies scale a working capital account, say inventories, by total assets or some other aggregate measure to adjust for firm size and then estimate a linear regression model for their conditional mean. Such measures are doubly bounded random variables for which a linear regression model is invalid. See Cox (196) or Papke and Wooldrige (1996) for further discussion of this point.

To present our evidence, we organize this study as follows. In Section 2, we identify prior research that is relevant to our research focus. Section 3 describes our samples and the variables that we create to conduct our study. Section 4 discusses the statistical issue that we address and provides a baseline analysis of how different factors influence a firm's working capital management. Section 5 presents an analysis of the effects of changes in the supply of bank credit on corporate working capital policies. Section 6 then discusses the implications of our evidence for both what significantly influences corporate working capital policies, and for how changes in the availability of bank credit influences them. Section 7 concludes with a summary of our findings.

Using data on U.S. corporations from 2000 through 2016, we derive the following major conclusions. First, one derives different implications depending on whether one recognizes or ignores the doubly bounded nature of the dependent variables. Such evidence supports the

statistical arguments in Papke and Wooldridge (1996) and others. Consequently, we base our subsequent evidence on their panel data quasi-likelihood model (Papke and Wooldridge (2008)).

Second, we find that the most important common factors influencing different working capital policies of firms are its size, the proportion of its assets that are tangible assets, its profit margins, its sales and general administrative expense, its sales growth and its use of fixed claims financing. The first factor likely captures a firm's ability to finance its working capital, which is reinforce by the role of its profit margins. The third factor likely captures the nature of the firm's business (power tools versus software), which is reinforce by the fourth factor which is often considered to identify intangible intensity firms. A firm's prior sales growth captures the effects of firm growth on its working capital. Finally, the proportion of a firm's assets accounted for by fixed claims reflects the importance of debt financing to working capital policies. Interestingly, macroeconomic factors play less of a role than firm-specific factors do in these decisions.

Third, we find that the working capital policies of bank-dependent and non-bank-dependent firms are significantly different. As one might expect, bank-dependent firms tend to hold more in current assets and rely more on current liabilities in managing their working capital than do less bank-dependent firms. This evidence is altogether consistent with their lesser access to sources of non-bank financing.

Fourth, we find that the working capital responses of bank-dependent firms to changes in the availability of bank credit differ from the responses of less bank-dependent firms in a number of areas. The significance of these differences, however, depend on whether we also identify bank-dependent firms by their age. Younger and smaller firms appear to adjust their use and extension of reverse trade credit more to fluctuations in the availability of bank credit. This evidence is consistent with this form of credit being more important than trade credit to these firms as an alternative to bank credit. Probably the best example of this is Amazon, which largely financed its early growth through reverse trade credit.

Fifth, consistent with research that points to the changing mix of firms in the U.S. economy (e.g., Srivastava (2014), Barrero (2016), etc.), we find that SGA expenses play an important role in firms' working capital policies. Further, consistent with international evidence on the increasing role of reverse trade credit as a financing source for firms (e.g., IMF (2011),

etc.), we find that such source is more important for more R&D intensive firms, which again reflects the effects of the changing mix of U.S. corporations.

2. How might public corporations respond to changes in the supply of bank credit?

There is a large literature on the effects of either monetary policy or economic events on bank lending (loan volumes). Further, most of this literature focuses on the effect of credit rationing on the volume of loans to particular types of firms.[1] We find that only a few studies consider how changes in bank credit influence elements of a firm's working capital, and thereby management of its operations.

Therefore, our review of prior research will be brief, as we will only focus on studies pertinent to corporate working capital practices. In organizing this review, we follow how Compustat reports on a corporation's current assets and current liabilities, as it is the primary data source for this study. The specific accounts of interest are a corporation's cash holdings, extension of trade credit, inventories, prepayments given, use of trade credit, prepayments received. We do not consider debt in current liabilities as this includes bank credit. Nor do we include income tax payable as this is unlikely to be influenced by fluctuations in bank credit in any meaningful way. One outcome of this brief review is a set of hypotheses that represent our expectations.

2.1. Cash management policies

While there is a large and growing literature on the determinants of a firm's cash holdings, these studies mostly focus, like Bates, Kahle, and Stulz (2009), on examining how variation in certain firm characteristics influences its cash holdings. Nevertheless, there are studies that address similar issues to ours.

Sufi (2009) examines how the trade-off between a firm's use of bank lines of credit (revolving credit facilities) and its cash holdings varies as its operating cash flow varies. One aspect of Sufi' evidence is that there is a trade-off between a firm's use of revolving lines of credit and cash holdings. From a different perspective, Harford, Klasa, and Maxwell (2014)

[1] We did Google searches using credit rationing or monetary policies and corporate finances. The overwhelming majority of papers concern the effects of either credit rationing or monetary policy on loans to particular types of firms.

show that refinancing risk is an important determinant of cash holdings. Consequently, if bank credit becomes more (less) available and the probability of a firm being able to refinance its debt becomes higher (lower), then the firm should hold less (more) cash.

Consistent with this prediction, Francis, Hasan and Wang (2014) provide evidence of a reduction in the cash holdings of firms associated with an increased intrastate bank competition. Rice and Strahan (2010), however, find no evidence of a significant change in bank loans due to intrastate deregulation and so raise doubts about whether the "natural experiment" that Francis, Hasan and Wang (2014) use is appropriate. In addition, Flannery and Lockhart (2009) provide evidence that suggests that this trade-off does not exist for financially constrained firms. Consequently, the effect of a positive or negative shock to the availability of bank credit on firms' cash holdings is an open issue.

Based on the above discussion, we posit the following hypotheses.

Hypothesis 1: Expansions of bank credit lead public firms to reduce their cash holdings, whereas contractions of bank credit lead public firms to increase their cash holdings.

Hypothesis 2: *Expansions or contractions influence the cash holdings of bank-dependent firms more than they do for non-bank-dependent firms.*

2.2. Extension of trade credit to customers.

Prior literature tends to treat the extension of credit to a firm's customers as the same as the use of trade credit, and yet there is little evidence showing that what motivates a firm to offer trade credit is the same as what motivates a firm to use trade credit. We bring this up because Ahn, Amiti and Weinstein (2011) criticize the use of accounts receivable data to measure the dependence on trade credit. Nevertheless, they bring up the role of trade credit in explaining the volatility of international trade flows during the 2008 financial crisis. For this, they focus the effect of the mode of shipment on delivered prices to establish this link.

Given textbook treatments of what drives a firm's decision to offer credit to its customers, one might expect, all other things equal, that increases in bank credit increases the credit a firm offers to its customers, and that decreases in bank credit lead to reductions in the credit offered to its customers. These expectations must be tempered by a firm's ability to substitute other forms of financing and depend on the degree to which a firm feels the need to extend credit to its

customers to maintain sales. One can easily surmise that an unconstrained firm might maintain its extension of trade credit to its customers to maintain its sales despite a contraction in the supply of bank credit. Thus, we posit the following hypotheses.

Hypothesis 3: Expansions of bank credit lead public firms to extend more credit to their customers, whereas contractions of bank credit lead public firms to reduce their extension of credit to their customers.

Hypothesis 4: Expansions (contractions) of bank credit lead only lead bank-dependent firms to increase (reduce) their extension of credit to their customers.

2.3. Investment in inventories.

Since Metzler (1941), macroeconomists have been concerned with the relationship between fluctuations in bank credit and fluctuations in the inventories held by firms. We will not review this voluminous literature as most of these studies are concerned with aggregate rather than firm level responses. We will instead simply note that studies, like Lown and Morgan (2006), imply that negative shocks to bank credit reduce the investment by firms in their inventories. Further, studies like Carpenter, Fazzari and Petersen (1994) report evidence that smaller firms (more likely bank-dependent firms) exhibit stronger reactions to the monetary contractions. One concern with these studies is that they are typically time series studies that impounded the effects of economic contractions on a variety of other aspects of corporate operations that also influence inventory investment.

While early supply chain management models imply that the investment in inventories should rise and fall as the cost of financing them fall or rise, it is not clear how important the cost of financing is as a determinant of this investment. If firms optimize their inventories for expected demand, then they may not vary much with changes in the supply of bank credit.

Given the above discussion, we posit the following hypotheses.

Hypothesis 5: Expansions of bank credit lead public firms to increase their inventory investment, whereas contractions of bank credit lead public firms to reduce their inventory investment.

Hypothesis 6: Expansions (contractions) of bank credit lead only lead bank-dependent firms to increase (reduce) their inventory investment.

2.4. Reverse trade credit given (prepayment given)

There is little research on cash-in-advanced financing; sometime called either reverse trade credit or supply chain financing. Mateut (2014) uses data on French firms and finds that cash-in-advance payments are a way for stronger customers to provide financing for weaker suppliers.[2] Helper, Nicholson and Noonan (2014) note the the importance of such financing for small or young firms and it is supported by the U.S. government's creation of the "SupplierPay" program. Typically, this form of financing for suppliers takes the form of reverse factoring or approved trade payables: all of which shows up in Compustat's other current assets account.

Since prior literature suggests that this form of financing is an alternative to bank financing or trade credit, then one might expect that when bank credit becomes less available, firms will turn to this form of financing.

Based on the above considerations, we will posit the following hypothesis.

Hypothesis 7: Expansions of bank credit lead public firms to reduce their extension of credit to their suppliers (reverse trade credit), whereas contractions of bank credit lead public firms to increase their extension of credit to their suppliers.

Hypothesis 8: Expansions (contractions) of credit lead bank-dependent firms to reduce (increase) their extension of credit to their suppliers by less.

2.5. Use of trade credit.

Firms often use either bank credit or trade credit to finance a firm's inventory investment. However, whether these sources of financing are complements or substitutes is an unsettled issue. For example, Petersen and Rajan (1997) find evidence that financially constrained firms use trade credit when credit from financial institutions is unavailable. This evidence suggests that trade credit and bank credit are substitutes for financially constrained firms.

In contrast, Burkart and Ellingsen (2004) develop a model that argues that trade credit and bank credit are substitutes for financial unconstrained firms and complements for financially constrained firms. Somewhat consistent with this argument, Engemann, Eck and Schnitzer

[2] See Mateut (2014) for a fuller discussion of factors influencing reverse trade credit as we limit our discussion to those aspects most likely affected by a credit shock.

(2011) provide evidence that bank credit and trade credit are substitutes in general, but that they are complements for certain types of small firms. Similarly, Uesugi and Yamashiro (2008) find evidence that trade credit and bank loans are complements for small Japanese firms.

Finally, Liu and Zhao (2014) provide evidence that suggests that these forms of financing are not substitutes for financially constrained firms, but rather driven by different considerations. Because of the variety of conclusions about the relationship between bank debt and trade credit, we consider the following hypotheses.

Hypothesis 9: Expansions of bank credit lead public firms to reduce their use of trade credit, whereas contractions of bank credit lead public firms to increase their use of trade credit.
Hypothesis 10: Expansions (contractions) of bank credit lead only lead bank-dependent firms to reduce (increase) their use of trade credit.

2.6. Reverse trade credit received (prepayments received)

According to an IMF (2011) study, this form of financing accounts for 19 to 22% of international transactions.[3] Other than French data studied by Mateut (2014), there has been no prior empirical research on firms' use of advanced payments by customers. Mateut (2014) finds these liabilities are positively correlated with prepayments received from customers. More importantly, he finds that these advanced payments appear to be substitutes for bank loans. Since Compustat books these liabilities in other current liabilities, we should expect a positive correlation between this account and a firm's other current assets account. Thus, we should expect both accounts to respond to a bank credit shock, and in similar ways. Further, based on the arguments and evidence in Mateut (2014), one might expect that bank-dependent firms to be more likely to depend on advanced payments from customers in a credit crunch.

Based on the above considerations, we posit the following hypothesis.
Hypothesis 11: Expansions (contractions) of bank credit lead firms to reduce (increase) their dependence on advanced payments by customers.

[3] The size of the supply chain finance market is somewhat unclear as Gustin (2015) points out that many companies have an incentive to under report its use.

Hypothesis 12: Expansions (contractions) of credit lead only lead bank-dependent firms to decrease (increase) their dependence on prepayments.

2.7. Summary

Prior research on the effects of changes in the availability of credit, and particularly bank credit, on various working capital accounts has produced conflicting evidence on its effects. Further, prior research suggests that firms' responses to variations in bank credit depend on whether they are more or less dependent on bank financing. This research, however, has also produced conflicting results for some aspects of a firm's working capital policies.

3. Samples and Variables

3.1. Samples

We began by identifying all firms with Compustat data between 2000 and 2016. We then drop all firms that were not U.S. firms (fic not equal to USA). In addition, we dropped financial firms (SIC $\geqslant$ 6000 and SIC $\leqslant$ 6999), regulated firms (SIC $\geqslant$ 4900 and SIC $\leqslant$ 4999), and administrative firms (SIC >9000). The resulting sample of 8,187 firms represent our base sample.

3.2. Dependent Variables

We focus on several components of a firm's working capital, which we define broadly to encompass a firm's current assets and current liabilities. We consider a firm's current assets as the proportion of a firm's total assets in cash (and marketable securities), inventories, account receivable (trade credit extended), and other current assets (prepayments given). We consider a firm's current liabilities as the proportion of a firm's total liabilities in account payable (trade credit used) and other current liabilities (prepayment received). We exclude short-term debt from consideration because it reflects influenced by the ebbs and flows of bank credit: which is the conjectured source of variation in the other working capital accounts that we do consider. Specifically, we define the aspects of a firm's working capital management under study as follows.

Cash is cash and short-term investments (data item CHE) divided by total assets (data item AT). It includes cash and all securities readily transferable to cash. These securities can be cash in escrow, government and other marketable securities, letters of credit, CDs, and restricted cash.

Inventory is the ratio of a firm's total inventories (INVT) to its total assets (AT). This category includes raw materials, work in process as well as finished goods.

Receivable is the ratio of the firm's total accounts receivable (RECT) to its total assets (AT). This item represents the extension of trade credit by the firm to its customers.

Other CA is the ratio of other current assets (ACO) to total assets (AT). This account reflects pre-paid expenses, and so is the account most affected by prepayments by customers. As such, it reflects reverse trade credit, or is sometimes called, supply chain finance.

Trade Credit is the accounts payable (data item AP) scaled by total liabilities (data item LT). Since we are concerned with the substitution between different types of liabilities, we scale accounts payable (and our other current liability variable) by total liabilities.

Other CL is the ratio of other current liabilities (LCO) to total liabilities (LT). This account reflects liabilities related to current operations, and as such will include liabilities created by a customer's prepaid expenses (supply chain financing or reverse trade credit).

3.3. Explanatory variables

For all of our regressions, we use the same set of controls, or explanatory variables. For these controls we drew from various studies of different working capital accounts (e.g., Bates, Kahle, Stulz (2009), Petersen and Rajan (1997), etc.). In identifying this set, we try to focus on a common set across the different elements of working capital in order to facilitate a comparison of which factors are important for some elements and not for others. Specifically, we use the following control variables.

Tangibility is the ratio of net property, plant, and equipment (data item $PPENT_t$) to total assets in year t (data item AT_t). Prior literature suggests that firms with more tangible assets are able to borrow more, particularly in the form of long-term debt. This variable also proxies for the nature of the business enterprise (producing goods versus services or software).

Profit margin is operating income before depreciation (data item $OIBDP_t$) divided by beginning of year total assets (data item AT_{t-1}). Textbook treatments of trade credit decisions imply that a firm's profit margin is an important determinant of its extension of trade credit.

Sales Growth is the percentage change in a firm's sales in the current year relative to the prior year (i.e., (Current Sales – Prior Sales)/Prior Sales). The evidence in Liu and Zhao (2014) suggests that *Sales Growth* is a critical determinant of a firm's use of trade credit.

Cash flow volatility is an important determinant of a firm's ability to finance working capital investments out of operating cash flow. For most firms, cash flow volatility is correlated with the future cash flow uncertainty that it faces. While there are a variety of ways to measure a firm's cash flow volatility, many of them introduce a subtle sample bias. For example, when one computes a firm's cash flow volatility using the standard deviation of its cash flows over the prior 3 or 5 years, then one is implicitly dropping firms without such a history. We address this problem by using a measure derived in De Veirman and Levin (2011). De Veirman and Levin's measure of a firm's conditional cash flow volatility uses the residuals from the following regression model:

$$GOCF_{ti} = \beta_0 + \beta_1 YEAR + \beta_2 IND + \beta_3 SIZE + \beta_4 YEAR * IND + \beta_5 YEAR * SIZE + \varepsilon_{it} \ ,$$

where $GOCF_{it}$ is the growth in firm i's operating cash flow (oibdp-xint-txt-dvc) from year t-1 to t, YEAR is a vector of year dummies, IND is a vector of industry dummies, and SIZE is a vector of size tercile dummies based on total revenue (revt). We use one digit SIC industry delineation in order to avoid introducing too many parameters in the above regression model. Based on the residuals from the above regression model we derive:

$$CCFVOL_{it} = \sqrt{\frac{\pi}{2}} \left| \varepsilon_{it} \right| \ .$$

Where $CCFVOL_{it}$ represents our *Cash Flow Volatility* measure for firm i in year t. Clearly, this measure adjusts for macroeconomic and industry (fixed and time varying) influences on the volatility of a firm's operating cash flows.

R&D Intensity represents the ratio a firm's R&D expense to its sales. Following prior literature, we treat missing observations of R&D expense as zeros. Bates, Kahle and Stulz (2009), along with other studies, show that a firm's cash holdings is positive correlated with this

measure. The rationale is that R&D intensive firms hold more cash in order to take advantage of their real options.

SGA represents the ratio of a firm's Sales and General Administrative expense to its sales. Srivastava (2014), and similar studies, use this variable to capture what they argue are intangible intensity because firms typically use SGA accounts to expense intangible expenditures.

Fixed claims represent the ratio of total liabilities to total assets. This variable not only controls for changes in total fixed claims, but it also reflects the firm's use of credit financing.

Real GDP Growth represents inflation adjusted U.S. GDP growth rate for a given year. We use this as a control for macroeconomic factors, and specifically broad economic conditions.

VIX represents the average of the CBOE's volatility index (VIX) over a fiscal year. Many view this index as capturing broad uncertainty about future economic growth, and thus some identify it as the "fear" index.

Table 1 reports the sample statistics for all of our study variables.

4. Statistical Issues and Baseline Evidence

4.1 Statistical Issues

In order to study the effects of changes in the supply of bank credit on corporate working capital policies, we need to confront a key issue ignored by prior research on this or similar topics. All of the studies of which we are aware define their dependent variable as a ratio, and often as a fraction. For example, many cash management studies will typically try to explain the ratio of cash and marketable securities to total assets, which is effectively the fraction of total assets in cash and marketable securities.[4] This type of scaling produces the kinds of sample statistics for our working capital measures reported in Table 1. The motivation for such scaling is obvious, but its statistical implications are less obvious.

Cox (1996), Papke and Wooldridge (1996), and others have pointed out the conditional expectation functions of fractional or proportional variables must be nonlinear. This point has important implications. Linear regression models for fractional models are mis-specified in a

[4] Another issue raised by prior research is demonstrated by Love, Preve and Sarria-Allende (2007) who use ratios of stocks to flows in their trade credit measures. These measures present timing and interpretative issues. For example, firms could extend the same level of credit to their regular customers (or receive the same level of credit from their regular suppliers) during a downturn in sales and so be mis-interpreted as increasing their extension of trade credit (or use of trade credit).

way that leads them to produce biased estimates of the coefficients and their standard errors. To understand this implication, we note that if one estimates a linear conditional expectation function when a nonlinear conditional expectation function is appropriate, then this is equivalent to estimating a first order Taylor series approximation to a nonlinear surface. As a result, the residual encompasses all the higher terms and so induces endogeneity bias in the linear regression model. As a result, one cannot trust either the parameter estimates or the standard errors produced by the linear regression model for fractional or proportional variables. Further, one cannot really test for the endogeneity bias associated with some explanatory variable, since endogeneity bias is produced by construction for all of the explanatory variables.

Consequently, we use the Papke and Wooldridge (1992, 2008) quasi-likelihood model for these types of data as our primary regression model. There is, however, another subtle implication of these nonlinear models that are also typically misunderstood. They have very different implications for the economic significance of different regressors from those in linear models. One cannot simply view the coefficients of the regressors as their marginal effects since in these models their marginal effects depend on the other characteristics of a firm. Specifically, $\frac{\partial Y}{\partial x_i} = \beta_i \left[\frac{exp(X\beta)}{(exp(X\beta)+1)^2} \right]$. Thus, these models imply that there is heterogeneity in a firm's responses to changes in an explanatory variable that will depend on the firm's current state. For example, the effects of an increased supply of bank credit on a firm's cash holdings will be very different for a firm holding lots of cash versus holding a small amount of cash, or a firm with rapid sales growth versus with slow sales growth, etc. Fortunately, if we just focus on the signs and significance of the variables, this does not present a big problem as their signs are determined by their coefficients. But, it does mean that one cannot simply examine the coefficient on a variable to determine its incremental effect since this will depend on where it is evaluated and so is heterogeneous across firms.

4.2 Baseline Analysis of Factors Influencing Corporate Working Capital Policies

We begin our study by first estimating a series of single equation models for each working capital component under study using a linear regression model and then comparing these results to the results from estimating a Papke and Wooldridge (1996, 2008) type nonlinear

model. We do this to get a sense of how different one's conclusion might be using one or the other statistical model.

For our baseline analyses, we treat the conditional expectation of each of our working capital measures as a function of a set of explanatory variables, which form the controls in our subsequent analyses. Specifically, we use *ln(TA)*, *CF volatility*, *Tangibility*, *Profit margin*, *Sales Growth*, *R&D Intensity*, S*GA*, *Fixed Claims*, *Real GDP growth*, and *VIX*. The rationale for the inclusion of each of these variables was set out above. In addition, we include dummy variables for a firm's industry and for the year. The first set of dummy variables captures industry fixed effects on a firm's working capital policies.[5] The second set of dummy variables captures year fixed effects, or common shock effects across firms.

Table 2 reports the results from estimating a standard panel data linear regression model for each of our working capital measures. Table 3 reports the results from estimating Papke and Woodridge's (2008) panel data quasi-likelihood model for these same variables. The results in Tables 2 and 3 suggest that there are around 21 different conclusions about the either the statistically significance or the sign of the coefficient on a regressor between these two sets of results. For example, the linear regression model results suggest that a firm's investment in inventories is positively but insignificantly correlated with its cash flow volatility, while the quasi-likelihood model implies that this investment is negatively and significantly correlated with a firm's cash flow volatility. This later result is more consistent with inventory management models.

These results imply that one does not derive the same statistical evidence using the standard linear regression model as one derives after recognizing the double bounded nature of the dependent variables in working capital equations. This evidence is consistent with prior econometric research and raises questions about some of the prior empirical research on what influences particular working capital accounts. Thus, we will use the quasi-likelihood models in our subsequent analyses.

[5] While we do not report the evidence on these industry dummies in the interest of focusing on our main results, it is worth noting that they are often statistically significant and so typical working capital practices within an industry are an influence on any given firm's working capital policies.

We will say more about what these second results imply about the determinants of the different working capital components when we summarize the implications of all of our analyses in Section 6. We will just note here that some of our evidence is new as we are not aware of any published study that reports the evidence of a relationship between a firm's *SGA* expense or the *VIX* and the different components of its working capital policies. One reason for pointing this out is because Srivastava (2014) and others have shown the importance of *SGA* expense to the kinds of firms that are increasingly populating the U.S. economy, and the *VIX* is often viewed as a measure of macroeconomic uncertainty.

5. The effects of changes in the supply of bank credit on corporate working capital policies

5.1 Identification of changes in the supply of bank credit

We recognize that changes in the supply of bank credit to businesses are not directly observable. Rather, what we do observe is the volume of loans to businesses by banks and this volume will reflect both supply and demand factors. Thus, to tease out the supply response we need to use instruments that are correlated with a supply response but not with a demand response. Prior research, and recent events, suggests that the write-off of existing loans precedes changes in the supply of bank credit and contractions in both macroeconomic and industry activity.[6] The obvious reason for this linkage is that such write-offs affect a bank's capital and thereby its ability to extend further loans given regulatory capital requirements, and thereby represent potentially exogenous shocks to banks' supply of credit.

With this point in mind, for our instruments, we collect data from the Federal Deposit Insurance Corporation on the percentage change in the dollar amount of commercial and industry loans by banks and their percentage write-offs of business loans, farm loans and residential real estate loans. We then regress the percentage change in aggregate bank loans to commercial and industrial firms on our regressors in Tables 2 and 3, and combinations of these instruments. Specifically, we regress the percentage change in bank loans to commercial and industrial firms first on all three instruments in column 1, and then just on the write-off of farm loans and

[6] It is worth noting that some studies (e.g., Jena, Mohapatra and Wong (2017)) suggest that these write-offs are more significantly correlated with the quality of the bank's loan officers than with macroeconomic factors.

residential real estate loans in column 2. The rationale for choosing a sub-set of instruments will be clearer later when we discuss the robustness of our evidence.

Table 4 reports the results of these two regressions. The F-statistic associated with the instruments in the first regression is 5489.67 (p = 0.00), which clearly indicates that they are strong instruments. These results are consistent with our argument that past write-offs are significant influences on the current percentage changes in bank loans to businesses. The F statistic associated with the instruments in the second regression is 36.31 (p = 0.00), again showing that they are strong instruments.

Because our statistical models are quasi-likelihood model, statistical tests for exogeneity in these models are not well developed and so there is little agreement on this testing. Nevertheless, consistent with Sargan's (1958) over-identification test, we compute the residuals from our second stage regression and regress these residuals on our regressors and instruments. None of the computed J statistics are larger than 2.01 or significant at less than the 10% marginal significance level (a standard benchmark for these tests). Thus, by these debatable statistical tests, we think that both sets of our instruments are reasonably exogenous. Nevertheless, we depend more on a subsequent set of statistical analyses to support this conclusion.

5.2 The effects changes in the supply of bank credit on corporate working capital practices across all types of firms

We use the predicted percentage changes in commercial and industrial loans from our first regression model in Table 4 as our measure of the change in the supply of bank credit to corporations. We then include these predicted changes along with our prior control variables to examine the effects of changes in the availability of bank loans to businesses on their working capital accounts. Table 5 reports these results.

The evidence in Table 5 suggests that increases in the supply of bank credit are associated with significant increases in firms' average cash holdings and inventory investment, and significant decreases in firms' extension of trade credit to their customers. The positive correlation between increases in the availability of bank credit and inventory investment is consistent with the effect of decreases in the cost of credit in inventory management models. The negative correlation between increases in the availability of bank credit and the extension of credit to customers may reflect the shrinkage of such credit from retail companies, rather than

from wholesale companies, given the lack of changes in trade credit from suppliers. The positive correlation between the availability of bank credit and corporate cash holdings is consistent with the evidence in Dasgupta, Noe and Wang (2011) that firms first build up cash reserves when issuing new debt.

5.3 The differential effects of changes in the supply of bank credit on corporate working capital practices of bank-dependent versus non-bank-dependent firms

While the evidence in Table 5 suggests that the primary effects of a change in the availability of bank credit is on a few aspects of firms' working capital policies, it is not clear whether bank-dependent and non-bank-dependent firms respond differently. For the reasons provided earlier, we expect their respective responses to a change in the availability of bank credit to be quite different.

To address this issue, we need to identify bank-dependent and non-bank-dependent firms. In this, we follow Leary (2009) and other studies that argue that firm size is a key determinant of a firm's dependence on bank financing. Further, we argue that small firms that do not pay dividends are more likely to depend on bank credit to finance working capital investments. This conjecture is consistent with financial constraint measures that include whether a firm pays dividends or not. Thus, we define a firm as *Bank Dependent* if it falls in the bottom three deciles of the firm size (total assets) distribution and pays no dividends. Otherwise, we consider the firm not to be bank-dependent. This identification is consistent with how much of the banking or macroeconomic literature has identified bank-dependent firms (e.g., Carpenter, Fazzari and Petersen (1994)).

Using this dummy variable, we then interact it with our instrumented predict percentage change in business loans measure to identify the differential response of bank-dependent firms to a change in the supply of bank credit. Table 6 reports the results of these expanded specifications; which suggest a number of interesting findings.

First, bank-dependent firms differ significantly from non-bank-dependent firms in their working capital policies. Bank-dependent firms tend to hold more cash, extend and use more trade credit, hold larger inventories, and extend and use more reverse trade credit than less bank-dependent firms. This evidence suggests that bank-dependent firms hold more current assets and

use more supplier and customer provided financing since access to bank financing may be more tenuous for them.

Second, bank-dependent and non-bank-dependent firms respond quite differently to changes in the availability of bank credit. Much of the prior observed response of firms to changes in the availability of bank credit in Table 5 primarily reflects the responses of less bank-dependent firms. The signs and significance of the coefficients associated with changes in the availability of bank credit for a firm's cash holding, extension of trade credit and inventory investment are consistent with those same coefficients in Table 5.

Interestingly, we observe a different pattern for bank-dependent firms. First, bank-dependent firms significantly reduce their use of trade credit, whereas less bank-dependent firms do not. This behavior is different from that predicted in Burkart and Ellingsen's (2004) model. Since bank-dependent firms use significantly more trade credit on average than less bank-dependent firms, the availability of bank credit allows them to reduce their dependence on this source of financing. Thus, the substitution between bank credit and trade credit appears in our evidence to only exist for bank-dependent firms.

Another contrast between bank-dependent and non-bank-dependent firms is how they adjust their extension of trade credit to their customers in response to a change in the availability of bank credit. Non-bank-dependent firms significantly reduce their extension of credit to their customers, which may reflect their customers' easier access to financing. Whereas bank-dependent firms do not significantly reduce their extension of trade credit to their customers. This behavior is consistent with their greater dependence on offering such credit to either make sales or insure the supplies of critical components.

Finally, bank-dependent firms do not significantly change their inventory investment, whereas less bank-dependent firms significantly increase their inventory investment. These relative changes may simply reflect that less bank-dependent firms already have large inventory investments and that an increase in bank credit allows less bank-dependent firms to take advantage of lower interest expense, which is consistent with inventory models.

5.4 Robustness checks

There are two critical aspects of our evidence: the choice of instruments and the delineation of bank-dependent firms. To address the first issue, we generate new predict percentage changes in commercial and industry loans using just the write-offs of farm loans and residential real estate loans. As the recent financial crisis demonstrated that these write-offs preceded the reduction in business loans rather than following it. So, they are plausibly exogenous to the commercial demand for bank loans for working capital purpose. Nevertheless, they are likely to influence bank capital and thereby their willingness to extend bank credit.

Since our primary focus is on the different response of bank-dependent and non-bank-dependent firms, we will simply report the evidence in Table 7 of estimating statistical models that are similar to those reported in Table 6, but using the predict percentage change in commercial and industrial loans based on the second regression model in Table 4. The similarity of results between these two tables in terms of the signs and significance of certain variables suggests that our results are robust to this variation in the instruments used to identify changes in the supply of bank loans. These results have another implication, which is why we choose this second set. Based on the arguments in Stock and Watson (2011), the similarity of results demonstrates that at least one of our instruments was exogenous, and so supports our earlier over-identification test results. Otherwise, the change in correlations would have produced significantly different parameter estimates.

The second issue, how we define bank-dependent firms, is more difficult because there is a lot of controversy over how to identify just what separates firms in their access to alternative sources of capital. We have focused on firm size since Leary (2009) and others in the bank literature have focused on this feature as the distinguishing feature of bank-dependent firms. In addition, we have required these small firms to pay no dividends since the ability to pay dividends may signal a lack of dependency on external financing. Others, however, have focused on identifying financially constrained firms using additional firm features (e.g., firm age, whether the firm has a bond rating, etc.). Adding whether a firm has a commercial paper rating or a bond rating does not change our evidence. We focus on firm age since this characteristic figures prominently into Hadlock and Pierce's (2010) financial constraint measure and it better identifies the kinds of firms increasingly populating the U.S. economy.

With these considerations in mind, we create a dummy variable that takes on a value of 1 if a firm is in the bottom three deciles of firm size (total assets), pays no dividends, and is in the bottom three deciles of firm age as measured by time since listing, or 0 otherwise. We then re-estimates the models reported in Table 6, but now use this measure of a firm's bank dependency. Table 8 reports these results.

The evidence in Table 8 is consistent with the evidence in Tables 6 and 7 on the direction and significance of the responses of non-bank-dependent firms to an increase in the availability of bank credit. Further, the evidence in Table 8 is consistent with the evidence in Tables 6 and 7 on the average working capital policies of bank-dependent firms being quite different from less bank-dependent firms.

The main difference in results between Table 6, 7 and 8 is that the evidence in Table 8 suggests that the reduction in reverse trade credit (both extended and received) is more statistically significant than in Tables 6 and 7. These contrasting results are interesting because the age of a firm is another marker of the change in the mix of firms. More will be said about this evidence below.

6. What does our evidence tell us about our hypotheses and the determinants of working capital policies?

We can now step back and assess what our evidence implies about what factors significantly influence corporate working capital practices and about our hypotheses. To organize this discussion, we will proceed as we did in our literature review and discuss each working capital account separately. We will begin each discussion by first addressing what factors significantly influence that account without considering the effects of fluctuations in the availability of bank credit on it. After that discussion, we focus on how fluctuations in the availability of bank credit influence that account for bank-dependent and non-bank-dependent firms since we observe heterogeneity in responses to changes in the availability of bank credit across these types of firms.

6.1. Cash management policies

Our evidence suggests several interesting results about a firm's cash management policies. First, based on the evidence in Table 3, the primary determinants of a firm's cash

holdings appear to be its size (-), cash flow volatility (+), the proportion of its assets that are tangible assets (-), its profitability (+), its R&D intensity (+), its SGA expenses (+), and its use of fixed claim financing (-). The importance of a firm's SGA expense to its cash holdings is a new result to the literature. This speaks to the fact that new economy firms are changing working capital policies. Further, the insignificant sign on the VIX suggests that some stories about how macroeconomic uncertainty influences corporate cash holdings need to be re-examined.

Second, the evidence in Tables 6, 7 and 8 suggests that bank-dependent firms tend to hoard much more cash and marketable securities than less non-bank-dependent firms do. This result is consistent with these firms needing to hold more cash due to their greater difficulty in raising outside capital.

Third, based on the evidence in Tables 6, 7 and 8, we find that both bank-dependent and non-bank-dependent firms increase their cash holdings in response to an increase in the availability of bank credit. This behavior appears to be consistent with that observed in Dasgupta, Noe and Wang (2011).

Altogether, our evidence is inconsistent with both our first and second hypotheses. U.S. corporations appear to build up their cash balances when bank credit is more readily available, which illustrates the importance they place on the precautionary motive to hold cash. However, the different effects of firm level uncertainty (cash flow volatility) and macroeconomic uncertainty (VIX) suggests that it is firm level uncertainty that really matters in these decisions.

6.2. Extension of trade credit to customers.

Based on the evidence in Tables 3, we find that the primary determinants of a firm's account receivables are its size (-), its proportion of assets that are tangible (-), its profitability (-), its sales growth (-), its R&D intensity (-), its SGA (-), its fixed claims (+). The negative sign on sales growth is consistent with the argument that firms do not need to extend as much credit to customers to generate sales when its sales are expanding. The negative sign on SGA once again is consistent the argument that firms with higher SGA are newer firms that produce intangibles or receive credit from their customers.[7] This last point is illustrated by the fact that Internet

[7] One of the interesting features of internet retailers is that they often receive payment from their customers before they acquire to deliver the goods. This pattern is why many have a negative cash conversion cycle.

retailers, such as Amazon and Dell, often receive payments from their customers before they acquire or deliver the goods. This pattern explains why many of these firms have a negative cash conversion cycle.

Based on the evidence in Tables 6, 7 and 8, we find that bank-dependent firms extend more credit to their customers (relative to their size) than do less bank-dependent firms. This evidence is consistent with credit models that emphasize the role of extending credit to customers to make sales. Our evidence suggests that for smaller and more bank-dependent firms, the extension of credit to their customers is more important.

In terms of their respective responses to changes in the availability of bank credit, non-bank-dependent firms are clearly more sensitive than are more bank-dependent firms. When bank credit is more widely available, they significantly reduce their extension of credit to their customers. This change is consistent with their customer having better access to credit as well as them not needing to extend such credit to make sales.

The response of bank-dependent firms is less clear. If we ignore the age of the firms, then they do not significantly change their extension of credit to their customer – which is consistent with their greater dependence on providing such credit to make sales. However, once firm age is considered, they also reduce their extension of credit to their customers. Once again, this illustrates that new economy firms are changing working capital policies. As noted in Table 5, newer firms are less dependent on extending credit to customers to make sales, consequently they reduce their extension of this costly credit when feasible.

Altogether, our evidence is inconsistent with our third and fourth hypotheses. However, these contrasting results illustrate the changing nature of U.S. firms that makes them less likely to extend credit to their customers.

6.3. Investment in inventories.

The evidence in Table 3 suggests that the primary determinants of the proportion of a firm's assets in inventory are firm size (-), its cash flow volatility (-), the proportion of assets that are tangible (-); firm profitability (-), firm sales growth (-), its R&D intensity (-), the proportion of sales accounted for its SGA expense (-), and the firm's use of fixed claim financing (+). Altogether, this evidence is consistent with firms minimizing their investment in inventories

unless they are able to support substantial mark-ups since our profitability measure is a type of mark-up measure. In addition, the greater the intangible intensity of a firm (based on the SGA metric), the less it invests in inventories. This evidence is roughly consistent with the standard characterization of the kinds of firms that are increasingly populating the U.S. economy. While there has been a lot of attention paid to the effects of monetary policy on corporate inventory behaviors, our evidence suggests that only macroeconomic uncertainty plays a significant role in these decisions.

Comparing the inventory investment of bank-dependent and non-bank-dependent firms in Tables 6, 7 and 8 once again reveals that they behave differently. Bank-dependent firms hold more of their assets in inventories than do less bank-dependent firms. This behavior probably reflects that larger and less bank-dependent firms are also better able to take advantage of information technology in managing their supply chain (see Zaman (2017) for further discussion of this point).

On the other hand, less bank-dependent firms appear to respond more to changes in the availability of bank credit. This contrasting response may seem odd at first blush, but our evidence suggests that these firms hold larger inventories and so may have less of a need to adjust their inventories.

Altogether, our evidence is consistent with our fifth hypothesis, but inconsistent with our sixth hypotheses. Further, our evidence suggests differences between firms producing tangibles versus firms producing intangibles in their baseline inventory policies.

6.4. Reverse trade credit given (prepayments given)

As noted earlier, there has been a large change in the financing of firms within a supply chain. Effectively, customers are pre-pay suppliers which helps finance their operations. One reason is because what these suppliers provide may be important to the firms. This relationship may be especially important in the kinds of firms increasingly populating the U.S. economy since they tend to depend more on specialized inputs.[8]

The evidence in Table 3 suggests that a firm's extension of reverse trade credit is significantly correlated with firm size (-), the volatility of a firm's cash flows (+), the proportion

[8] See Dass, Kale and Nanda (2014) for the commitment role of credit in R&D intensive firms.

of a firm's assets that are tangible (-), its sales growth (-), its use of fixed claim financing (+). By and large, these features are consistent with firms that are more involved in intangible production being more likely to provide reverse trade credit to suppliers of unique or relationship specific goods or services.

The evidence in Tables 6, 7 and 8 suggest that bank-dependent firms invest more of the current assets in reverse trade credit. This finding is consistent with the fact that these are the same firms that depend more on relationship specific inputs. However, we do not see either type of firms adjusting their extension of reverse trade credit unless they are young firms. Young and small firms reduce their extension of such credit when bank credit is more readily available to their suppliers.

In the end, we do not find our evidence to be consistent with either our seventh or eighth hypothesis. Thus, we argue that there is a need to better understand the components of other current assets, and how each asset responds to changes in the availability of bank credit.[9]

6.5. Use of trade credit.

The evidence in Table 3 suggests that the use of trade credit is significantly correlated with firm size (-); the tangibility of the firm's assets (-); its profit margin (-), sales growth (+), its SGA expenses (-), and its use of fixed claims financing (-). These results imply that the kinds of intangible intensive firms that are increasing populating the U.S. economy are less dependent on this form of financing.

The evidence in Table 6, 7, and 8 suggest that bank-dependent firms are more relying on the use of trade credit financing than less bank-dependent firms. Such evidence is consistent with trade credit being an important source of financing for smaller and more bank-dependent firms.

As noted earlier, the relationship between bank credit and trade credit is contentious as prior evidence supports all three possible interpretations of this relationship. Notably, our evidence does not support the idea that bank credit and trade credit are substitutes for less bank-

[9] Compustat includes prepaid expenses, which is customer provided financing, with current assets of discontinued operations in its other current asset account and so this measure is not a clean measure of customer provided financing.

dependent firms and so does not support the implications of Burkart and Ellingsen's (2004) model.

Whether bank credit is a substitute or compliment for trade credit for bank-dependent firms is less clear. If we ignore firm age, then we observe statistically significant substitution effects for these firms. However, if we consider firm age, we do not. These contrasting results may again simply reflect that young small firms differ from older small firms in their business model.

In summary, our evidence is not consistent with our ninth hypotheses and only partial consistent with our tenth hypothesis.

6.6. Reverse trade credit received (prepayments received)

The evidence in Table 3 implies that the use of reverse trade credit is significantly correlated with firm size (-), a firm's cash flow volatility (-), the tangibility of the firm's assets (-), , its profit margin (+), its sales growth (-); its R&D intensity (+), its SGA intensity (+), and its use of fixed claims financing (-).[10] These results are consistent with the type of firms increasingly populating the U.S. economy (e.g., smaller, more R&D intensive, and more SGA intensive firms) using reverse trade credit.

As one might expect, according to the evidence in Tables 6, 7 and 8, bank-dependent firms use more of this form of financing than do less bank-dependent firms. This evidence is somewhat consistent with the evidence in the IMF (2011) study about the increasing use of this form of financing. Further, it reinforces our inferences about these being the kinds of firms that are increasingly populating the U.S. economy.

Whether these two types of firms responding differently to changes in the supply of bank credit is less clear. If we ignore firm age, then both types of firms do not make statistically significant adjustments in their use of such financing. However, if we do consider firm age, then bank-dependent firms do reduce their use of such financing when bank credit become more readily available, which suggests a substitution effect for these firms.

[10] Compustat includes accrued expenses as well as deferred revenue in other current liabilities and so it is not a clean measure of reverse trade credit. But here, as with reverse trade credit given, we are following Mateut (2014) to insure comparability.

7. Summary and conclusions

How do fluctuations in the availability of bank credit affect the way that firms manage their working capital, which is essential to their operations? Further, are these effects, if they exist, either larger or smaller for firms that are more dependent on their access to bank financing? Because bank financing has historically been a major source of financing of a firm's working capital, these are important questions.

We address these questions and in doing so, address two empirical issues. First, many prior studies of different working capital components scale their dependent variable in a way that it becomes a fractional variable. In which case, the estimation of a linear regression model for their conditional means is questionable given the arguments in Papke and Wooldridge (1996) and similar studies. Second, we address the fact that we do not directly observe the supply of bank credit.

Using data on U.S. corporations from 2000 through 2016, we derive the following major conclusions. First, one derives different conclusions depending on whether one recognizes or not the doubly bounded nature of the dependent variables. Such evidence supports the statistical arguments in Papke and Wooldridge (1996) and others. Consequently, we base our subsequent evidence on their panel data quasi-likelihood model (Papke and Wooldridge (2008)).

Second, we find that the most important common factors influencing different working capital policies of firms are its size, the proportion of its assets that are tangible assets, its profit margins, its sales and general administrative expense, its sales growth and its use of fixed claims financing. The first factor likely captures a firm's ability to finance its working capital, which is reinforce by the role of its profit margins. The third factor likely captures the nature of the firm's business (power tools versus software), which is reinforce by the fourth factor that is often considered to identify intangible intensity firms. A firm's prior sales growth captures the effects of firm growth on its working capital. Finally, the proportion of a firm's assets accounted for by fixed claims reflects the importance of debt financing to working capital policies. Interestingly, macroeconomic factors play less of a role than firm-specific factors do in these decisions.

Third, we find that the working capital policies of bank-dependent and non-bank-dependent firms are significantly different. As one might expect, bank-dependent firms tend to

hold more in current assets and depend more on current liabilities in managing their working capital than do less bank-dependent firms.

Fourth, we find that the working capital responses of bank-dependent firms to changes in the availability of bank credit differ from the responses of less bank-dependent firms in a number of areas. The significance of these differences, however, depend on whether we also identify bank-dependent firms by their age. Younger and smaller firms appear to adjust their use and extension of reverse trade credit more to fluctuations in the availability of bank credit, which is consistent with this form of credit being more important for these firms as an alternative to bank credit than trade credit is. Probably the best example of this is Amazon, which largely financed its early growth through reverse trade credit.

Fifth, consistent with research that points to the changing mix of firms in the U.S. economy (e.g., Srivastava (2014), Barrero (2016), etc.) we find that SGA expenses play an important role in firms' working capital policies. Further, consistent with international evidence on the increasing role of reverse trade credit as a financing source for firms (e.g., IMF (2011), etc.), we find that such source of finance is more important for more R&D intensive firms; which again reflects the effects of the changing mix of U.S. corporations. Such changes, for example, are illustrated by the difference between firms with a positive cash conversion cycle and firms with a negative cash conversion cycle.

Overall, we think that our evidence points to a need to better understand the working capital practices of the kinds of firms increasingly populating both the U.S. and the world economy as they do appear to behave differently than firms that engage more in the production of tangible goods.

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Table 1: Summary Statistics for Events

This table reports summary statistics for key variables, whose definitions are given in Appendix A. We report summary statistics for the period from 2000 through 2016 period.

	N	Mean	Median	Std Dev.
Cash	85039	0.2196	0.1083	0.2581
Receivable	85039	0.1367	0.1046	0.1295
Inventory	85039	0.1019	0.0387	0.1378
Other Current Assets	85039	0.0400	0.0260	0.0527
Trade Credit	85039	0.1943	0.1339	0.1863
Other Current Liabilities	85039	0.2807	0.2031	0.2371
Ln(TA)	85039	4.9574	5.1900	2.8880
Tangibility	83988	0.5224	0.3872	0.4677
Profit margin	79902	-2.4571	0.0823	13.5995
Sales Growth	69369	0.2241	0.0591	0.9946
Ln(Cash Flow Volatility)	73047	3.3811	3.4247	1.5931
Fixed Claims	85039	1.2370	0.5443	3.8548
R&D Intensity	80049	0.6330	0	3.3839
SGA	68989	1.0528	0.2806	3.7240
Real GDP Growth	85039	1.9461	2.0365	1.6193
VIX	85039	20.6426	21.4468	6.2305
Commercial & Industrial loans	85039	1280.7320	1192.3500	332.8263

Table 2: Working capital management using linear regression models

This table reports results from the estimation of a linear regression model for the corporate financial policies associated with cash management., the extension of trade credit, inventory investment, the extension of reverse trade credit, trade credit use, and the use of reverse trade credit. Other variable definitions for dependent and explanatory variables are provided in Appendix A. P-values are associated with the null hypothesis that the coefficient equals zero and are reported below the coefficient estimates. Standard errors are robust standard errors with adjustment for clustering at the firm level.

	Cash	Receivables	Inventory	Other CA	Trade Credit	Other CL
Ln(TA)	-0.0181	-0.0171	-0.0117	-0.0041	-0.0273	-0.0250
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(CF volatility)	-0.0002	-0.0002	0.0003	0.0009	-0.0002	0.0005
	(0.62)	(0.56)	(0.13)	(0.00)	(0.61)	(0.27)
Tangibility	-0.1161	0.0064	0.0137	-0.0031	-0.0261	-0.0368
	(0.00)	(0.06)	(0.00)	(0.01)	(0.00)	(0.00)
Profit margin	0.0016	-0.0006	-0.0002	-0.0002	-0.0001	0.0001
	(0.00)	(0.00)	(0.12)	(0.11)	(0.74)	(0.72)
Sales Growth	-0.0032	0.0008	-0.0002	-0.0014	0.0029	-0.0043
	(0.00)	(0.20)	(0.74)	(0.00)	(0.00)	(0.00)
R&D Intensity	0.0053	0.0004	-0.0014	-0.0002	-0.0000	0.0010
	(0.00)	(0.59)	(0.06)	(0.63)	(0.97)	(0.33)
SGA	0.0070	-0.0069	-0.0025	-0.0001	-0.0010	0.0002
	(0.00)	(0.00)	(0.00)	(0.73)	(0.10)	(0.76)
Fixed Claims	-0.0044	0.0008	-0.0000	0.0015	-0.0091	-0.0061
	(0.00)	(0.14)	(0.94)	(0.00)	(0.00)	(0.00)
Real GDP Growth	0.0020	-0.0001	-0.0001	0.0000	-0.0005	0.0016
	(0.01)	(0.91)	(0.87)	(0.98)	(0.50)	(0.05)
VIX	0.0002	-0.0006	0.0002	0.0000	-0.0010	0.0004
	(0.41)	(0.00)	(0.25)	(0.74)	(0.00)	(0.23)
Constant	0.3243	0.2925	0.0751	0.0603	0.3016	0.4871
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	58,301	58,301	58,301	58,301	58,301	58,301
chi2	2333	1403	5001	707.5	1898	2278
p	0.00	0.00	0.00	0.00	0.00	0.00

Table 3: Corporate working capital management using quasi-likelihood models

This table reports results from the estimation of Papke and Wooldridge's (2008) quasi-likelihood (nonlinear) regression for the corporate financial policies associated with cash management, the extension of trade credit, inventory investment, the extension of reverse trade credit, trade credit use, and the use of reverse trade credit. Variable definitions for dependent and explanatory variables are provided in Appendix A. P-values are associated with the null hypothesis that the coefficient equals zero and are reported below the coefficient estimates. Standard errors are robust standard errors with adjustment for clustering at the firm level.

	Cash	Receivables	Inventory	Other CA	Trade Credit	Other CL
Ln(TA)	-0.1225	-0.0992	-0.0937	-0.0583	-0.1589	-0.1093
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(CF volatility)	0.0169	-0.0031	-0.0070	0.0351	0.0049	-0.0086
	(0.00)	(0.32)	(0.08)	(0.00)	(0.18)	(0.01)
Tangibility	-0.9461	-0.4259	-0.2812	-0.1958	-0.2873	-0.5361
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Profit margin	0.0322	-0.0473	-0.0212	-0.0023	-0.0081	0.0093
	(0.00)	(0.00)	(0.00)	(0.18)	(0.00)	(0.00)
Sales Growth	-0.0060	-0.0523	-0.1134	-0.0398	0.0095	-0.0553
	(0.36)	(0.00)	(0.00)	(0.00)	(0.07)	(0.00)
R&D Intensity	0.0995	-0.0670	-0.0594	-0.0039	-0.0056	0.0246
	(0.00)	(0.04)	(0.00)	(0.48)	(0.21)	(0.00)
SGA	0.0711	-0.2441	-0.1094	0.0039	-0.0250	0.0154
	(0.00)	(0.00)	(0.00)	(0.35)	(0.00)	(0.00)
Fixed Claims	-0.0711	0.0282	0.0189	0.0263	-0.0677	-0.0508
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Real GDP Growth	0.0131	0.0001	0.0109	0.0016	-0.0016	0.0136
	(0.24)	(0.99)	(0.30)	(0.88)	(0.87)	(0.14)
VIX	0.0006	-0.0032	0.0054	0.0024	-0.0051	0.0026
	(0.87)	(0.23)	(0.10)	(0.49)	(0.10)	(0.39)
Constant	-0.5302	-0.5476	-3.1185	-2.9176	-0.8805	0.2355
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	58,301	58,301	58,301	58,301	58,301	58,301
chi2	11711	7523	15379	2162	11546	15533
p	0.00	0.00	0.00	0.00	0.00	0.00

Table 4: Prediction equation for changes in aggregate commercial and industrial loans

This table reports results from regressing the percentage change in aggregate bank loans to commercial and industrial firms on our prior regressors and our instruments, i.e., the percentage write-offs by banks on business loans, farm loans, and residential real estate loans. Variable definitions for dependent and explanatory variables are provided in Appendix A. P-values are associated with the null hypothesis that the coefficient equals zero and are reported below the coefficient estimates. Standard errors are robust standard errors with adjustment for clustering at the firm level.

	% Change in Commercial and Industrial Loans *(% ChgLoans)*	% Change in Commercial and Industrial Loans *(% ChgLoans)*
Constant	19.2834	24.9375
	(0.00)	(0.00)
Ln(TA)	0.0155	0.0397
	(0.05)	(0.00)
Ln(CF volatility)	-0.0212	-0.0111
	(0.08)	(0.40)
Tangibility	0.0274	0.0402
	(0.44)	(0.30)
Profit margin	0.0029	0.0037
	(0.46)	(0.40)
Sales Growth	-0.0593	-0.0328
	(0.00)	(0.07)
R&D Intensity	0.0068	0.0170
	(0.59)	(0.22)
SGA	0.0018	0.0066
	(0.85)	(0.54)
Fixed Claims	0.0090	0.0152
	(0.17)	(0.03)
Real GDP Growth	-0.9686	-1.2047
	(0.00)	(0.00)
VIX	-0.5484	-1.0428
	(0.00)	(0.00)
% charge-off rate on business loans	-7.9068	
	(0.00)	
% charge-off rate on farm loans	-0.8456	-8.4568
	(0.00)	(0.00)
% charge-off rate on residential real estate loans	-0.9819	-0.2444
	(0.00)	(0.08)
Year Fixed Effects	Yes	Yes
N	58,301	58,301
Adjusted R^2	0.897	0.875

Table 5: Corporate working capital management using predicted changes in aggregate commercial and industrial loans

This table reports results from the estimation of Papke and Wooldridge's (2008) quasi-likelihood (nonlinear) regression for the corporate financial policies associated with cash management, the extension of trade credit, inventory investment, the extension of reverse trade credit, trade credit use, and the use of reverse trade credit. Included in each regression model is the instrumented predicted change in aggregate commercial and industrial loans. Variable definitions for dependent and explanatory variables are provided in Appendix A. P-values are associated with the null hypothesis that the coefficient equals zero and are within parentheses. Standard errors are bootstrapped to address the issues discussed in Hardin and Schmiediche (2003).

	Cash	Receivables	Inventory	Other CA	Trade Credit	Other CL
Predict % ChgLoans	0.0153	-0.0078	0.0065	-0.0011	0.0036	0.0021
	(0.00)	(0.00)	(0.01)	(0.67)	(0.11)	(0.35)
Ln(TA)	-0.1217	-0.0995	-0.0947	-0.0584	-0.1595	-0.1094
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Ln(CF volatility)	0.0155	-0.0029	-0.0062	0.0343	0.0045	-0.0089
	(0.00)	(0.34)	(0.11)	(0.00)	(0.20)	(0.01)
Tangibility	-0.9469	-0.4257	-0.2815	-0.1955	-0.2875	-0.5362
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Profit margin	0.0322	-0.0474	-0.0213	-0.0023	-0.0082	0.0093
	(0.00)	(0.00)	(0.00)	(0.18)	(0.00)	(0.00)
Sales Growth	-0.0054	-0.0522	-0.1130	-0.0396	0.0100	-0.0550
	(0.41)	(0.00)	(0.00)	(0.00)	(0.06)	(0.00)
R&D Intensity	0.0993	-0.0670	-0.0595	-0.0040	-0.0059	0.0245
	(0.00)	(0.04)	(0.00)	(0.46)	(0.18)	(0.00)
SGA	0.0713	-0.2443	-0.1098	0.0039	-0.0252	0.0154
	(0.00)	(0.00)	(0.00)	(0.35)	(0.00)	(0.00)
Fixed Claims	-0.0709	0.0281	0.0187	0.0263	-0.0680	-0.0509
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Real GDP Growth	0.0460	-0.0057	0.0060	0.0128	0.0129	0.0184
	(0.00)	(0.26)	(0.36)	(0.05)	(0.03)	(0.00)
VIX	0.0107	-0.0087	0.0119	0.0072	0.0030	0.0022
	(0.00)	(0.00)	(0.00)	(0.03)	(0.34)	(0.48)
Constant	-0.8761	-0.3635	-3.1790	-2.9551	-0.9629	0.2519
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
chi2	11702	7529	15362	2150	11525	15523
p	0.00	0.00	0.00	0.00	0.00	0.00

Table 6: Effects of changes in bank credit on the working capital policies of bank-dependent and non-dependent firms

This table reports results from the estimation of Papke and Wooldridge's (2008) quasi-likelihood (nonlinear) regression for the corporate financial policies associated with cash management, the extension of trade credit, inventory investment, the extension of reverse trade credit, trade credit use, and the use of reverse trade credit. Included in each regression model is the instrumented predicted change in aggregate commercial and industrial loans using all three instruments in Table 4. The indicator variable, *Bank Dependent*, equal to one if firms are small (three lowest deciles of book assets following Leary (2009) and pay no dividends. Variable definitions for dependent and explanatory variables are provided in Appendix A. P-values are associated with the null hypothesis that the coefficient equals zero and are within parentheses. Standard errors are bootstrapped to address the issues discussed in Hardin and Schmiediche (2003).

	Cash	Receivables	Inventory	Other CA	Trade Credit	Other CL
Predict % ChgLoans	0.0114	-0.0089	0.0051	-0.0019	0.0024	-0.0000
	(0.00)	(0.00)	(0.04)	(0.44)	(0.29)	(0.98)
Bank Dependent	0.2008	0.3310	0.3403	0.1799	0.4825	0.1997
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Predict%ChgLoans *	0.0037	-0.0011	0.0006	-0.0001	-0.0034	-0.0005
Bank Dependent	(0.00)	(0.22)	(0.60)	(0.92)	(0.00)	(0.62)
Ln(CF volatility)	-0.0622	-0.0530	-0.0528	0.0016	-0.0781	-0.0781
	(0.00)	(0.00)	(0.00)	(0.65)	(0.00)	(0.00)
Tangibility	-0.9393	-0.4124	-0.2707	-0.1885	-0.2677	-0.5172
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Profit margin	0.0344	-0.0414	-0.0185	-0.0016	-0.0059	0.0114
	(0.00)	(0.00)	(0.00)	(0.36)	(0.00)	(0.00)
Sales Growth	0.0101	-0.0439	-0.1053	-0.0343	0.0245	-0.0408
	(0.13)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
R&D Intensity	0.0921	-0.0769	-0.0656	-0.0063	-0.0138	0.0175
	(0.00)	(0.03)	(0.00)	(0.25)	(0.00)	(0.00)
SGA	0.0906	-0.2118	-0.0935	0.0102	-0.0058	0.0336
	(0.00)	(0.00)	(0.00)	(0.01)	(0.10)	(0.00)
Fixed Claims	-0.0454	0.0420	0.0318	0.0348	-0.0378	-0.0291
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Real GDP Growth	0.0347	-0.0122	-0.0022	0.0083	0.0009	0.0089
	(0.00)	(0.02)	(0.74)	(0.20)	(0.88)	(0.14)
VIX	0.0080	-0.0104	0.0103	0.0061	0.0001	-0.0001
	(0.04)	(0.00)	(0.00)	(0.07)	(0.98)	(0.97)
Constant	-1.2212	-0.7532	-3.5439	-3.1586	-1.5435	-0.0789
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.30)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
chi2	9344	6733	14846	1882	8767	13223
p	0.00	0.00	0.00	0.00	0.00	0.00

Table 7: Effects of changes in bank credit on the working capital policies of bank-dependent and non-dependent firms using different instruments

This table reports results from the estimation of Papke and Wooldridge's (2008) quasi-likelihood (nonlinear) regression for the corporate financial policies associated with cash management, the extension of trade credit, inventory investment, the extension of reverse trade credit, trade credit use, and the use of reverse trade credit. Included in each regression model is the instrumented predicted change in aggregate commercial and industrial loans using only write-offs on farm loans and residential loans as instruments. The indicator variable, *Bank Dependent*, equal to one if firms are small (three lowest deciles of book assets following Leary (2009) and pay no dividends. Variable definitions for dependent and explanatory variables are provided in Appendix A. P-values are associated with the null hypothesis that the coefficient equals zero and are within parentheses. Standard errors are bootstrapped to address the issues discussed in Hardin and Schmiediche (2003).

	Cash	Receivables	Inventory	Other CA	Trade Credit	Other CL
Predict %ChgLoans2	0.0114	-0.0089	0.0051	-0.0019	0.0024	-0.0000
	(0.00)	(0.00)	(0.04)	(0.44)	(0.29)	(0.98)
Bank Dependent	0.2008	0.3310	0.3403	0.1799	0.4825	0.1997
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Predict%ChgLoans2*	0.0037	-0.0011	0.0006	-0.0001	-0.0034	-0.0005
Bank Dependent	(0.00)	(0.22)	(0.60)	(0.92)	(0.00)	(0.62)
Ln(CF volatility)	-0.0622	-0.0530	-0.0528	0.0016	-0.0781	-0.0781
	(0.00)	(0.00)	(0.00)	(0.65)	(0.00)	(0.00)
Tangibility	-0.9393	-0.4124	-0.2707	-0.1885	-0.2677	-0.5172
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Profit margin	0.0344	-0.0414	-0.0185	-0.0016	-0.0059	0.0114
	(0.00)	(0.00)	(0.00)	(0.36)	(0.00)	(0.00)
Sales Growth	0.0101	-0.0439	-0.1053	-0.0343	0.0245	-0.0408
	(0.13)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
R&D Intensity	0.0921	-0.0769	-0.0656	-0.0063	-0.0138	0.0175
	(0.00)	(0.03)	(0.00)	(0.25)	(0.00)	(0.00)
SGA	0.0906	-0.2118	-0.0935	0.0102	-0.0058	0.0336
	(0.00)	(0.00)	(0.00)	(0.01)	(0.10)	(0.00)
Fixed Claims	-0.0454	0.0420	0.0318	0.0348	-0.0378	-0.0291
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Real GDP Growth	0.0347	-0.0122	-0.0022	0.0083	0.0009	0.0089
	(0.00)	(0.02)	(0.74)	(0.20)	(0.88)	(0.14)
VIX	0.0080	-0.0104	0.0103	0.0061	0.0001	-0.0001
	(0.04)	(0.00)	(0.00)	(0.07)	(0.98)	(0.97)
Constant	-1.2212	-0.7532	-3.5439	-3.1586	-1.5435	-0.0789
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.30)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
chi2	9344	6733	14846	1882	8767	13223
p	0.00	0.00	0.00	0.00	0.00	0.00

Table 8: Effects of changes in bank credit on the working capital policies of bank-dependent and non-dependent firms using different measure of bank dependency

This table reports results from the estimation of Papke and Wooldridge's (2008) quasi-likelihood (nonlinear) regression for the corporate financial policies associated with cash management., the extension of trade credit, inventory investment, the extension of reverse trade credit, trade credit use, and the use of reverse trade credit. Included in each regression model is the instrumented predicted change in aggregate commercial and industrial loans using only write-offs on farm loans and residential loans as instruments. The indicator variable, *Bank Dependent*, equal to one if firms are small (three lowest deciles of book assets following Leary (2009)., young (three lowest deciles in firm age), and pay no dividends. Variable definitions for dependent and explanatory variables are provided in Appendix A. P-values are associated with the null hypothesis that the coefficient equals zero and are within parentheses. Standard errors are bootstrapped to address the issues discussed in Hardin and Schmiediche (2003).

	Cash	Receivables	Inventory	Other CA	Trade Credit	Other CL
Predict %ChgLoans	0.0121	-0.0103	0.0043	-0.0021	-0.0002	-0.0002
	(0.00)	(0.00)	(0.09)	(0.40)	(0.92)	(0.92)
Bank Dependent2	0.4652	0.0490	0.0202	0.0425	0.3642	0.2451
	(0.00)	(0.01)	(0.48)	(0.08)	(0.00)	(0.00)
Predict%ChgLoans*	0.0039	-0.0035	-0.0030	-0.0066	-0.0008	-0.0054
Bank Dependent2	(0.09)	(0.06)	(0.24)	(0.00)	(0.71)	(0.01)
Ln(CF volatility)	-0.0716	-0.0771	-0.0791	-0.0122	-0.1103	-0.0902
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Tangibility	-0.9258	-0.3952	-0.2593	-0.1802	-0.2430	-0.5043
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Profit margin	0.0343	-0.0346	-0.0140	-0.0007	-0.0039	0.0120
	(0.00)	(0.00)	(0.00)	(0.70)	(0.01)	(0.00)
Sales Growth	0.0156	-0.0335	-0.0950	-0.0283	0.0388	-0.0346
	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
R&D Intensity	0.0883	-0.0851	-0.0691	-0.0075	-0.0198	0.0147
	(0.00)	(0.02)	(0.00)	(0.17)	(0.00)	(0.00)
SGA	0.0947	-0.1762	-0.0697	0.0163	0.0103	0.0396
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fixed Claims	-0.0368	0.0482	0.0385	0.0380	-0.0237	-0.0231
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Real GDP Growth	0.0353	-0.0153	-0.0071	0.0065	-0.0036	0.0081
	(0.00)	(0.00)	(0.29)	(0.31)	(0.54)	(0.18)
VIX	0.0068	-0.0112	0.0094	0.0057	-0.0015	-0.0008
	(0.08)	(0.00)	(0.01)	(0.09)	(0.64)	(0.81)
Constant	-1.1707	-0.6070	-3.3698	-3.0729	-1.3285	-0.0091
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.90)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
chi2	9386	5657	13923	1654	6864	12790
p	0.00	0.00	0.00	0.00	0.00	0.00

Appendix A: Variables Definitions

Name	Description
Cash	Cash and marketable securities (che) divided by total assets (at).
Receivables	Receivables (rect) divided by total assets (at)
Inventory	Inventory(invt) divided by total assets (at)
Other CA	Other current assets (aco) divided by total asssets (at)
Trade credit	Accounts Payable (ap) divided by total liabilities (lt).
Other CL	Other current liabilities (lco) divided by total liabilities (lt)
Profit margin	Operating income before depreciation divided by sales.
Tangibility	Ratio of net property, plant, and equipment to total assets.
Fixed claims	The ratio of total liabilities (lt) to total assets (at).
Sales growth	% change in sales from prior to end of current fiscal year
CF vol	De Veirman and Levin (2011) cash flow volatility measure based on the residuals from a regression on a firm's operating cash flow adjusted for size, industry and macroeconomic factors.
Real GDP Growth	Inflation adjusted GDP growth for a year
VIX	The average of the CBOE volatility index (VIX) over a fiscal year.
Bank Dependent	A firm is bank dependent if it is in the bottom three deciles of firm size and pays no dividends.
Predict %Chg	Is the predicted percentage change in commercial and industrial loans by banks (FDIC) in the U.S.
Industry fixed effects	We used industry dummies based on a firm's two SIC code. In robustness, checks we also used industry dummies based on their S&P GIC sector codes.

Note: *Compustat* is the data source for all accounting based variables. *Compustat*'s mnemonics for each of the above financial accounts are within parentheses.

Highlights for "Bank Credit and Corporate Working Capital Management"

- New evidence that emphasizes changes in the mix of U.S. firms.
- Bank dependent firms are different in their working capital practices.
- Bank dependent firms respond differently to changes in bank credit.