Trade Credit, Demand Shocks, and Liquidity Management

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ABSTRACT

The provision of trade credit has been explained both by theories that focus on its role in contracting for transactions between firms and by theories that focus on the advantages of liquidity provision along the supply chain. To test these alternative explanations, we use the 2007-2009 financial crisis as a natural experiment setting and study liquidity provision between firms using a sample of firms with differential demand shocks. We measure differential demand by comparing firms that primarily supply to government customers with those that primarily supply to corporate customers. A difference-in-difference analysis shows little evidence that firms with relatively positive demand provide additional liquidity to their suppliers. Instead, these firms' accounts payable increases in proportion to their raw material inventories, consistent with the theories of trade credit that stress its role in facilitating the transactions of goods. Moreover, high demand firms are likely to have a high opportunity cost of providing liquidity to their trade partners: They become more investment-constrained over the crisis and engage in more acquisition activities once the liquidity crunch dissipates. Thus, we expect trade credit to play a very minor part in the transmission of liquidity in general, and in particular, in periods of low macro-liquidity.

Keywords: Trade Credit; Inventory; Demand Shocks; Financial Crisis

1. Introduction

Trade credit is an important source of short-term capital for non-financial firms. For example, accounts payable, customers' credit extended by their suppliers in the course of trade, accounts for about a quarter of firms' total liabilities in the Compustat universe. Yet, we know comparatively little about how this market functions and what the relative advantages and costs of trade credit are relative to bank financing. In this paper, we use a natural experiment setting provided by the 2007-2009 financial crisis to investigate the role of trade credit, specifically whether it is best understood by the contracting process between buyers and sellers or by the relationship-driven liquidly provision.

Traditional views of trade credit suggest that advantages suppliers have over banks in supplying credit are closely tied to the physical transfer of goods through trade. Lee and Stowe (1993) and Kim and Shin (2012), for example, argue that vendor financing comes bundled with an implicit warranty offered to customers and that this makes trade credit an efficient financial contract. Others argue that sellers have a legal advantage in gaining security over the goods that they supply and are able to realize a higher liquidation value if they seize the collateral, that is, the firm's raw materials (e.g., Frank and Maksimovic (1994)). We term this traditional explanation of trade credit the *asset composition hypothesis* since this explanation ties a firm's accounts payable closely to the flow of goods and the composition of inventories.

Another set of theories posits that trading partners have an informational advantage over financial intermediaries (e.g., Biais and Gollier (1997), Ellingsen (2004), and Fabbri and Menichini (2010)), or that their stake in the health of their partners makes them motivated providers of short-term capital. These theories suggest that firms provide additional financing when their trade partners become constrained, implying that increase in risk should translate into the comparative increase in vendor financing (Wilner (2000) and Cunat (2007)). These theories suggest that the provision of trade credit to distressed or constrained trade partners is motivated to a great extent by the informational advantages stemming from the trade relationship or by firms' self-interest to protect their stakes in the surplus jointly generated. We term this *relationship hypothesis*. Under this hypothesis, liquidity transmission across firms occurs for reasons not directly tied to the transfer of goods.

These two hypotheses suggest very different roles for vendor financing, and lead to different predictions about how firms will treat their suppliers in times when demand drops and insolvency risk increases. The traditional theories predict that in these times firms' accounts payable positions will continue to be closely tied to their levels of raw material inventories. By contrast, theories based on informational or stakeholder motives for trade credit suggest that in hard times firms may provide additional liquidity to their partners, especially if their own situation is comparatively more secure.

These differences in predictions have important implications beyond helping us distinguish between the motivations for trade financing. Under the traditional theories, trade credit will not serve to mitigate the effects of liquidity shocks and protect firms. By contrast, to the extent that stronger firms provide liquidity to their weaker partners through trade credit, trade credit will serve to buffer firms against liquidity shocks. In particular, liquidity provision in times of liquidity crunch would highlight the role of trade credit in the recovery of corporate sector in the absence of a quick financial sector recovery. Our descriptive evidence, however, supports the traditional views: We analyze the relation between trade credit and firms' inventories using estimates from a panel vector autoregression model using annual Compustat data and find that changes in raw material inventories indeed predict the firm's uptake of accounts payable.

We then take our predictions to the 2007-2009 financial crisis setting. Our identification strategy requires exogenous and differential demand shocks that result in different inventory compositions across firms. The recent financial crisis provide a natural experiment setting: The crisis started with a severe macro-level liquidity shock accompanied by observable differential product-market shocks–some firms saw the demand for their products fall, while others saw demand from a reliable and observable customer hold steady and even increase. Indeed, increased U.S. government spending meant that firms that primarily supplied to government departments and agencies faced growing product market demand. These firms had different levels of productions, financing needs and different opportunities for using accounts payable for transferring liquidity to or from their suppliers. We term these firms *government suppliers*. We take a difference-in-difference approach to compare government suppliers in pre-crisis and crisis periods relative to what we call *corporate suppliers*, firms that primarily supply to

corporations. This approach alleviates the concern that the ability to acquire high-demand customers is endogenous.

In our context, the theories that predict a broader financing relationship between suppliers and buyers imply that government suppliers should pay down their accounts payable, while corporate suppliers should increase accounts payable to take advantage of vendor financing. However, we find that government suppliers increased accounts payable relative to their cost of goods sold while increasing output, suggesting that they were, on balance, relying more heavily on vendor financing. Contemporaneously, these firms increased their short-term debt only marginally, which most likely came from liquidity-constrained financial intermediaries. In contrast, corporate suppliers' short-term financing pattern presents a mirror image: They increased their reliance on short-term debt substantially, but simultaneously lowered their reliance on vendor financing.

This finding suggests that short-term trade credit financing was unlikely to be driven by informational advantages or risk sharing with these firms' suppliers. More broadly, our finding suggests that firms that experienced a positive demand shock during the crisis did not act as liquidity providers to their own suppliers. Instead, short-term financing decisions were likely driven by the composition of the firm's short-term assets. Different demand shocks led to different inventory outcomes; trade credit financing was a response to positive demand shocks resulting in the accumulation of raw-material inventory while financial intermediary financing was the likely response to negative shocks that increased finished-goods inventory. These outcomes are consistent with the traditional theories that posit a tight relation between the flow of goods and trade financing.

The contrast in financing outcomes between government and corporate suppliers might suggest that corporate suppliers were unable to obtain financing from their own suppliers and were forced to borrow from financial intermediaries, whereas firms with reliable customers were able to borrow from their suppliers.[1] However, we show that these patterns of short-term financing are most likely driven by differences in the firms' product-market shocks. We find that government suppliers facing strong demand increased accounts payable in proportion to

[1] Murfin and Njoroge (2015) document that large and creditworthy buyers tend to obtain more favorable trade credit terms from smaller suppliers.

their raw material inventory. On the other hand, corporate suppliers facing falling demand increased short-term debt as their finished-goods inventory built up. These patterns are consistent with the models of trade credit financing that suggest that raw-material inventory is usually financed by vendors because of their comparative advantage in financing raw materials whereas finished-goods inventory is more naturally financed by financial intermediaries.

We follow these firms during the financial crisis and its aftermath. Over the crisis period, government suppliers grew faster in terms of revenues than did corporate suppliers. While this growth was accompanied by a smaller drop in capital investment than for corporate suppliers, evidence suggests that government suppliers' investment did not keep up with the increase in their growth opportunities. The index of investment delay constraints derived from Hoberg and Maksimovic (2015) provides direct evidence that government suppliers were increasingly more constrained relative to their investment opportunities during the crisis whereas corporate suppliers' constraints diminished. By the end of the crisis, government suppliers had substantially increased the market share in their industries relative to corporate suppliers. However, the constraint in their ability to obtain long-term financing during the crisis implied that their sales-to-fixed assets ratio was sub-optimal. Their cash holdings also remained lower than their corporate counterparts. We show that as a result, constrained firms were more likely to engage in merger activities post crisis.

Our results illustrate several important points: First, both firms experiencing positive demand shocks and those experiencing negative shocks increased their demand for short-term financing. The former borrowed more from suppliers in order to finance the purchase of raw materials for production, and the latter borrowed more from financial intermediaries in part to finance finished-goods inventory. This suggests that the optimal provision of short-term financing may be more closely tied to the type of shocks faced by firms.

Second, firms experiencing positive demand shocks during the financial crisis did not offer liquidity to other firms through trade channels. On balance, they were net users of cash in the corporate sector. This finding implies that, while such firms have a positive effect on the expected revenues of their supplier firms through the real channel (that is, through by increasing raw material orders), they do not provide indirect additional financing through the

trade credit channel. Thus, trade credit did not substitute for the financial sector in providing liquidity during the crisis.

Third, firms with positive demand shocks became financially constrained during the financial crisis. Thus, during the recession, their opportunity cost of liquidity increased, making them less likely to provide liquidity for their own suppliers or other firms. Fourth, the firms that were doing comparatively well did not fully convert their market share gains into stronger real-asset positions until the general liquidity constraints were reduced. At that time, they increased their fixed assets through acquisitions. Thus, as suggested by Harford (2005), periods of low liquidity created demand for asset reallocations that occurred once liquidity was restored.

Our paper adds to the literature examining the determinants of trade credit provision (e.g., Smith (1987), Petersen and Rajan (1997), Ng, Smith and Smith (1999), and Giannetti, Burkart, and Ellingsen (2011)). In particular, two previous studies examine the role of trade credit as an alternative source of liquidity in the midst of liquidity crunches. Examining six emerging markets during the 1997 Asian crisis and 1994 Mexican crisis, Love et al. (2007) argue that during a financial crisis, all sources of financing become scarce, leading to the shutdown of the liquidity provision channel. Garcia-Appendini and Montoriol-Garriga (2013) examine the 2007–2008 crisis and document that U.S. firms with high pre-crisis liquidity reserves initially extended trade credit for their customers, though they retracted as the crisis progressed. However, since they do not control for asset composition changes associated with demand shocks, they are unable to distinguish trade credit extensions due to changes in demand shocks during the crisis and those caused by liquidity provision.

Our paper is also related to a strand of the international finance literature that follows the work of Calvo, Izquierdo, and Talvi (2006) (CIT) and examines recovery in emerging market crisis episodes characterized as Systemic Sudden Stops (3S episodes) where the liquidity of the financial sector and demand decline sharply.[2] Our evidence suggests that trade credit is unlikely to be effective in financing firms facing negative demand shocks during crises. Instead, we observe that such firms rely on bank financing, particularly short-term debt.

[2]Claessens, Kose, and Terrones (2009; 2012), Abiad, DellAricia, and Li (2011) and Ayyagari, Demirguc-Kunt and Maksimovic (2011) also evaluate 3S episodes.

Finally, our paper complements research examining the economic effect of government spending. Adelino, Cunha, and Ferreira (2015), Chodorow-Reich, Feiveson, Liscow, and Woolston (2012), and Wilson (2012), among others, document that the post-crisis increase in state and local government spending led to creation of more jobs. We show that government spending enables the firms supplying to government to grow and expand their market share during the crisis. We also show that government spending has a spill-over effect along the supply chain. Notable increase in government suppliers' raw-material inventory during the crisis indicates that positive demand shocks were transmitted to their suppliers, generating real effects.

2. Trade Credit, Inventory, and Liquidity Management

2.1. Why do Firms Extend Trade Credit?

Sources of possible short-term financing include increases in short-term debt, usually from financial intermediaries, increases in accounts payable (that is, increases in credit from suppliers), and decreases in accounts receivable (that is, a reduction in financing to customers). Choices over these financing options may depend on the way positive and negative shocks interact with the production process of firms. Government suppliers were subject to a liquidity shock at the same time as their needs for financing–short-term financing of raw-material inventory and long-term financing of new investment capacity–were increasing. Corporate suppliers were facing potentially lower demand and needs to finance finished-goods inventory stemming from slowing sales. That is, firms facing negative shocks are likely to experience a revenue shortfall accompanied by a need to finance inventories of finished goods. By contrast, firms facing a positive demand shock are likely to need to build up production and inventories of raw materials and goods-in-process.[3]

If the two sources of short-term financing–funds from operations and short-term loans–are close substitutes, we would expect both firms with positive shocks and those with negative

[3]Both shocks may also lead to increased desire to finance trade credit to customers, in the first case to support declining sales and in the second case to support increased sales.

shocks to have similar responses to their shocks. Thus, we would observe similar changes in their short-term asset and liability positions. However, if trade and financial intermediary financing have different comparative advantages in financing a specific type of assets or shortfalls, different shocks to operating assets would lead to different short-term financing patterns, holding all else constant.

There are several reasons why we may see a differential comparative advantage of debt or trade financing for different types of short-term assets. As discussed by Frank and Maksimovic (2005), suppliers have a comparative advantage in gaining security over the goods that they supply (that is, raw materials). This advantage disappears as the goods are processed and turned into a final product. Thus, we expect suppliers, rather than banks, to finance inventories, particularly raw materials or input.

A similar prediction can be generated from arguments by Lee and Stowe (1993) and Kim and Shin (2012) that vendor financing is an implicit warranty offered to customers. That warranty is likely to extend until the goods are turned into a final product. To the extent that the warranty is tied to the size of raw-material inventory and work-in-progress, the amount of short-term credit will also depend on the composition of assets. Thus, if the short-term asset composition changes between assets used early in the production cycle and those used late in the production cycle, we would observe a different preferred mix of short-term financing. We term this *asset composition hypothesis*.

On the other hand, trade credit provision may arise due to product market relationships independent of firms' operations, which we term *relationship hypothesis*. First, positively shocked firms have incentives to help their suppliers during a liquidity crunch because they share a surplus with their suppliers and it is costly to replace their suppliers. Second, trade partners have an informational advantage over financial intermediaries, as suggested by Biais and Gollier (1997). Suppliers observe the order flows from their customers including the quantity and type of input. In addition, since they likely supply to their customers' competitors, they may be informed about the relative size of operations of their customers. The value of this information is small when the customer is reliable and when contents of the customer's order book are publicly available. Firms with observable, creditworthy customers are likely to

find it relatively cheaper to obtain short-term debt from banks rather than from their suppliers. Thus, we would expect a tilt towards trade-credit financing for firms whose shock is accompanied by an increase in downside risk, holding all else constant. During the crisis, corporate suppliers faced relatively higher uncertainty and probability of distress than government suppliers. Thus, the relationship hypothesis would predict a comparative increase in accounts payable and a relative decrease in short-term debt financing for corporate suppliers relative to government suppliers.

There are two direct ways by which firms with positive shocks can transfer liquidity to other firms. First, positively shocked firms can expedite payments for input purchased from their suppliers. The extent to which this occurs would be measured by a decrease in the ratio of accounts payable to raw material inventories. Second, they can offer more generous credit terms to their customers. Specifically, in our context, the relationship hypothesis predicts that government suppliers will increase their accounts receivable. However, this effect is likely to be attenuated because we would expect government suppliers to extend additional financing only to their corporate customers, not to the government. Thus, our analysis focuses on accounts payable.

These arguments lead to sharply different predictions, which we test below, about the comparative behavior of government and corporate suppliers in the crisis. If the asset composition hypothesis drives the differential mix of short-term financing, then government suppliers, who are growing relatively faster, will need comparatively larger raw-material inventories than corporate suppliers, will have less involuntary finished-goods inventory accumulation, and will thus experience relatively larger increases in accounts payable. The prediction on the relative short-term debt financing by government and corporate suppliers is similar. To the extent that corporate suppliers have general shortfalls in liquidity and a greater need to finance either their customers or final inventories, they will have a relative increase in short-term debt financing. However, given the drying up of long-term financing, this effect may be muted if government suppliers substitute short-term for long-term debt financing to fund their relatively higher growth.

In contrast, if the relationship hypothesis dominates, the provision of trade credit will be driven by the risk-sharing incentives or the comparative advantage of vendors in evaluating the viability of firms. Thus, we would expect to see corporate suppliers to receive greater injection of trade credit than government suppliers. Government suppliers, whose prospects are more certain as a result of having a more creditworthy customer, would gravitate to bank financing, which would become relatively less expensive to these customers, given that they would require less financing by suppliers, who themselves may be financially constrained. Thus, the relationship hypothesis predicts an increase in corporate suppliers' accounts payable and decrease in their short-term debt relative to those of government suppliers.

2.2. Inventory and Financing Decisions: Panel VAR Analysis

We first examine the general association between firms' inventory and financing decisions. We estimate a panel vector autoregression (panel VAR) model using annual Compustat data from 2005 to 2014, for which inventory breakdown information is available. VAR allows us to treat both inventory and financing variables as endogenous. In addition, the panel aspect of the model helps exploit the longitudinal dimension of the data, overcoming the short time series.[4] Table 1 reports estimates of the following model using 9,749 firm-year observations:

$$z_{it} = \Gamma_0 + \Gamma_1 z_{it-1} + f_i + \varepsilon_t, \tag{1}$$

where $z_{it} = \{ln(INVRM_t), ln(INVFG_t), ln(AP_t), ln(STdebt_t)\}'$, Γ is a 4x4 matrix of coefficients, and f_i is a vector of firm fixed effects. We allow for the possibility that firms' inventory decisions affect their financing decisions by using a Choleski decomposition of the ordering of $ln(INVRM_t)$, $ln(INVFG_t)$, $ln(AP_t)$, and $ln(STdebt_t)$. Panel A shows that the responses of finished goods inventory and accounts payable to raw material inventory are positive and significant. The short-term debt responses to raw material and finished goods inventory, however, are insignificant.

[4]Examples of finance research utilizing panel VAR include Gilchrist, Himmelberg, and Huberman (2005) and Love and Zicchino (2006).

Figure 1 shows impulse responses. The last column of the figure plots the effect of a one-standard deviation shock to raw material inventory over a 10-year response interval. The shock increases finished goods inventory and accounts payable immediately. Also, the effect is quite persistent, with a response five years out that is still half its initial magnitude. These results are consistent with variable decompositions of 10-period ahead forecast (Panel B of Table 1). Raw material inventory explains close to a quarter of total variations (22.9%) in accounts payable 10 periods ahead while explaining merely 1.1% of variations in short-term debt.

Together these results point to the fact that over the sample period accounts payable, rather than short term debt, finance much of a firm's raw material inventories. Changes in raw materials predict a firm's uptake of trade credit. As a result, liquidity sharing between vendors and their customers depends on the ratio of accounts payable to raw materials inventory. An increasing ratio indicates that vendors are extending additional credit to their customers, whereas a falling ratio indicates that customers are paying their vendors quickly, thereby transferring liquidity to them. While these results are suggestive, they do not show causality. We turn to this next, using the recent financial crisis as a natural experiment.

3. Empirical Design and Data

3.1. Identification Strategy

Our identification strategy requires differential demand shocks that result in different inventory compositions across firms in times of liquidity crunch. The 2007–2008 crisis and the subsequent liquidity shock precipitated differential demand shocks across firms. Output plummeted (figure 2) and the unemployment rate more than doubled as the crisis progressed.[5] In the face of declining aggregate demand, the U.S. government increased spending, providing additional financing to jump start projects. Figure 3 shows that total government spending

[5]The seasonally-adjusted unemployment rate soared from 4.6% in June 2007 to 9.5% in June 2009.

as a fraction of GDP steepened sharply during the crisis.[6] Government spending during the crisis created a natural experiment setting in which corporate suppliers, which did not receive government contracts, were likely to face a negative demand shock while government suppliers, which received government contracts, were more likely to see demand maintained or increased.

Second, while the two groups of firms had differential product market shocks, they were both subject to the general liquidity shock, which raised needs for inter-firm liquidity transfer. Figure 2 shows that the TED spread (the 3-month LIBOR based on U.S. dollars minus the 3-month Treasury bill), which stayed below 1% in the pre-crisis period, climbed to 2.4% in August 2007, and to as high as 4.6% in October 2008. Similarly, the Federal Reserve Board's Senior Loan Officer's Opinion Survey indicates that banks started tightening lending standards on commercial and industrial loans in 2007:Q3 for medium and large firms and in 2007:Q1 for smaller firms (Mach (2014)). Ivashina and Scharfstein (2010) and Santos (2011) show that banks cut down on loan origination substantially and charged much higher spreads when they originated new loans. The liquidity shock had two effects. First, it made external financing more expensive to obtain. Second, it made it difficult for firms to obtain long-term financing, which we show below.

We employ a difference-in-differences methodology by comparing government suppliers and corporate suppliers during crisis relative to the pre-crisis period. We take the financial and operating conditions of U.S. firms in the pre-crisis period as exogenous with respect to the financial crisis. We assume that the magnitude of the demand shocks was not anticipated by individual firms and that they were exogenous to an individual firm. For our analysis, we define 2007:Q3–2009:Q2 as the crisis period and compare this period to the pre-crisis period of 2005:Q3–2007:Q2. For some analysis, we also extend the window to include the post-crisis period of 2009:Q3–2011:Q2. Note that while NBER defines December 2007–June 2009 as a contractionary period, we view the crisis as starting in 2007:Q3; the signs of a liquidity crunch started appearing in 2007:Q3, and studies examining the recent crisis

[6]New government contracts likely started picking up sooner than suggested by the figure because government contracts tend to translate into actual expenditure with some lags. For example, it took an average of 281 days for unrated government suppliers in our sample to be paid by customers during the crisis, assuming all customers received 100% credit.

generally consider 2007:Q3 as the beginning of the crisis (for example, Duchin, Ozbas, and Sensoy (2010) and Gorton and Metrick (2012)).

We also separately analyze firms that had credit ratings in 2006 and those that didn't. We expect firms that were unrated to have had less access to external financing during the crisis, and we expect to see a larger effect of liquidity constraints and negative demand shocks in those firms. Related, Nilsen (2002) documents that during monetary contractions, rated and unrated firms behaved differently; rated firms used more bank loans while unrated firms increased trade credit. Chava and Purnanandam (2011) find that during the banking shock following the 1998 Russian crisis, unrated firms suffered larger valuation losses and subsequently experienced a higher decline in their capital expenditure and profitability. While the recent crisis was different from monetary contraction episodes in many aspects, tight credit during the crisis was likely to have had differential effects on rated and unrated firms.

To measure differential demand shocks, we rely on the differential response of government and private customers to the crisis. While we cannot observe the exogenous shocks themselves, we can observe sales revenue at the firm level. Figure 4 shows that government suppliers experienced robust growth in their assets over the crisis period. By contrast, the assets of corporate suppliers, while rising at the beginning of the crisis, started to decline when the crisis reached its vertex in mid-2008. This suggests that government suppliers were able to expand, despite the crisis, while corporate suppliers were not. When we examine sales scaled by lagged assets, we observe that this ratio declined a fair bit for corporate suppliers in the crisis period while it was little changed for government suppliers.[7] Similarly, both the return on assets and the ratio of operating cash flow to assets, each standardized using average pre-crisis assets, show increases for government suppliers during the crisis period, but a steep decline for corporate suppliers during the vertex of the crisis in mid-2008.

Another way to validate our identification strategy is to examine how the default risks of *GOV* and *CORP* firms changed during the crisis. Table 2 reports monthly one-year ahead expected default frequencies (EDF), the fraction of a firm's total liabilities that are expected to default in the year ahead. One-year ahead EDF, obtained from Moodys Analytics, is calculated

[7]The ratio dropped about 7% for corporate suppliers, which was statistically significant at the 1% level.

using a structural model based on stock valuations, balance sheet information, and realized asset volatility.[8] Panel A shows that before the crisis unrated *CORP* firms had significantly lower EDF than unrated *GOV* firms. As expected, during the crisis EDF increased significantly for both types of firms. However, the increase during the crisis for *CORP* firms is much more pronounced, to the extent that the EDF of *CORP* firms becomes significantly higher than that of *GOV* firms. About three percent of unrated *CORP* firms' liabilities were expected to default during the crisis on average, three times as high as the fraction observed before the crisis. The pattern for rated firms, shown in Panel B, also indicates larger increases in risk for *CORP* firms between the pre-crisis and crisis periods. These results suggest that government suppliers experienced stronger demand shocks during the crisis.

3.2. Inter-Firm Liquidity Provision during Crisis and Post-Crisis Firm Growth

We examine our question in three steps. First, we exploit the natural experiment setting to examine whether or not firms with positive demand shocks supply liquidity to their suppliers by comparatively reducing accounts payable and increasing short-term debt. Second, we directly measure the financial constraints expressed by firms that have positive and negative real shocks during the crisis. Do positive demand shocks tighten or relax the firm's constraints? Third, we consider the relation between a firm's observed financial constraints and its financial policy. If the nature of product-market shocks predicts firm-level constraints, then an association between observed financial constraints and its provision of liquidity will predict the extent to which firms facing positive shocks will act as de facto financial intermediaries in a financial crisis.

Finally, we investigate how the common liquidity shock affects firms' financing and product-market positioning after the crisis. As noted above, firms differ in the product-market shock they receive around the time of the liquidity shock. Given limited access to financial markets, did the firms that received relatively favorable product-market shocks translate their temporary advantage into a more permanent product-market advantage? Firms also differ in their initial

[8] See Crosbie and Bohn (2003) for more detail on the construction of EDF measures.

credit rating, which affects access to financial markets. To the extent that there is precautionary demand for financial flexibility, we would expect that those firms that had better credit ratings were able to change their long-run competitive position. Did this in fact happen?

3.3. Customer Information

To obtain a sample of firms that were less likely than the average firm to receive a negative shock in the crisis, we consider a sample of firms that had government as a major customer in 2006, namely government suppliers. We assume that neither the magnitude of the firm-level demand shocks from private customers nor the government response was predictable prior to the crisis. We rely on the assumption that a customer-supplier relationship tends to be long-term in nature, that a firm that has an on-going relationship with the government was better placed to win new orders from the government than a firm that did not, and that, in particular, such firm was unlikely to suffer from a negative demand shock which affected a significant portion of the remaining firms.

Firms that have material customers tend to differ from a typical Compustat firm. Fee et. al (2006), for example, show these firms tend to be smaller and to have lower leverage. To provide a control sample for government suppliers, we also identify corporate suppliers, firms that primarily supplied to corporate customers in 2006. The objective of identifying a control group of corporate suppliers is to control for potentially unobservable characteristics that firms with large material customers, whether government or private, may have in common.

We compile the customer information using supplier-customer relationships reported in the Compustat Business Segment Files, and identify firms that primarily supplied to government agencies or corporations in 2006. According to SFAS 14, public firms are required to disclose the names of customers that account for at least 10% of their total sales or whose purchase has a material impact on their businesses. We call these customers "principal customers." In addition, SFAS 131 issued in June 1997 requires disclosure of the amount of sales generated from a principal customer.[9] To identify corporate customers, we manually match the customer

[9]See Appendix C for more details.

names to their corresponding GVKEYs in Compustat by closely following the approach in Fee et al. (2006). For government customers, we manually check whether the customer name is a U.S. government agency. We complement the information using the customer type variable given in the Compustat Business Segment Files. Details on how we hand-collect the customer information are documented in Appendix C.

To measure a firm's dependence on each principal customer, we construct a customer reliance measure ($CUSTREL$), defined as the fraction of a firm's sales that is attributed to a principal customer. In some cases, firms voluntarily report customers who contribute less than 10% of their revenue. To ensure consistency, we only retain firms whose $CUSTREL$ is at least 10%.[10] We classify a sample firm as a government supplier if its biggest principal customer is government, and as a corporate customer if its biggest customer is a corporation.[11] For our main tests, we identify our sample firms using their customer information as of 2006, and follow these firms over time to mitigate the selection bias. In unreported results, we repeat our tests by identifying our sample firms using their customer information every year to incorporate the changes in customer relationships over time. The results are little changed because the customer relationship tends to be longer-term in nature.

A key question in the measurement of the effects of the crisis on firms is the question of standardization. A firm's accounts are interconnected through its balance sheet, so that the total quantity of an asset and liability may change in response to a shock, while the ratio of different accounts may not change, and vice versa. The appropriate scaling depends on the hypothesis being tested. It is customary to measure many of the key indicators of a firm's liquidity by scaling with the firm's contemporaneous assets or sales. This is reasonable when focusing on liquidity in a homogenous demand environment. It is more problematic in cases where firms in two subsamples of interest are facing differential demand shocks. Accordingly, for much of our analyses, we standardize measures of interest by each firm's pre-crisis average assets. This allows us to isolate the effect of the demand shocks on liquidity in a context analogous to an event study. In other cases, when comparing how sales or purchases are

[10] To eliminate reporting errors, we also drop observations where the customer reliance is more than 100%.

[11] It is rare for a firm to have both government and corporate principal customers, with only 2.7% of our sample of unrated firms selling to both government and corporate principal customers in 2006.

financed for different subsamples, we scale by relevant contemporaneous variables such as assets, sales, costs of goods sold, and inventory levels.

3.4. Pre-Crisis Firm Characteristics

For our sample of government and corporate suppliers, we obtain quarterly financial information between 2005:Q3 and 2011:Q2 from the Compustat quarterly database. We exclude utilities and financial firms as well as observations with non-positive values of assets. All our financial variables are winsorized at the 1% and 99% of their distributions. We also obtain S&P borrower credit ratings information (variable name: *SPLTICRM*) from the Compustat ratings database. Appendix A provides the detailed description of how financial variables are constructed.

Panel A of Table 3 summarizes pre-crisis firm characteristics for all sample firms. Panel B split the sample to four subgroups according to sample firms' rating information and customer types as of 2006. A firm is classified as rated if it is rated by S&P in 2006, and unrated otherwise. Unrated firms and rated firms are, respectively, further sorted into government suppliers (*GOV*) and corporate suppliers (*CORP*) according to their customer types. We observe 1,194 firms per quarter on average, of which unrated firms constitute about three quarters. Panel B shows our unrated firms are much smaller on average than Compustat firms: on average, our unrated government and corporate suppliers have assets of $300 million and $511 million, respectively, compared to $1,602 million of Compustat firms. Among unrated firms, government suppliers seem to rely more on one customer. The mean exposure of unrated government suppliers to their largest customers is higher at 47%. Unrated government suppliers have higher leverage, but lower capital expenditures-to-assets ratio (CAPEX/Assets), return on assets (ROA), and operating cash flows to assets ratio (OCF/Assets) than corporate suppliers. Sales and market-to-book (M/B) are roughly the same for unrated government and corporate suppliers.

Generally, the differences between rated government and corporate suppliers follow the same pattern. However, as expected, the rated suppliers as a group are larger and have higher

average sales, leverage, ROA and OCF, but lower M/B than unrated suppliers as a group. Given the importance of ratings and size as a marker for access to financing (Faulkender and Peterson (2006) and Hadlock and Pierce (2010)), we analyze the two types of firms separately and focus our principal analyses on unrated firms.

3.5. Changes in Firm Characteristics during the Crisis

Table 4 shows the changes in firm characteristics from the pre-crisis (2005:Q3–2007:Q2) to crisis (2007:Q3–2009:Q2) period for subsamples sorted on ratings information and customer types as of 2006. Note that, because firm size and sales changed substantially during the crisis, most of the variables are scaled by pre-crisis average assets to allow to track changes over time. We see that there has been an increase in sales and assets by all categories of firms during the crisis, with particularly striking and statistically significant growth for *GOV* firms. In subsequent analyses, we compare the changes for *GOV* and *CORP* firms using a difference-in-difference framework. Also notable are the large increases in *Capex* relative to pre-crisis assets. While *OCF* increased for both *GOV* and *CORP* firms, the increase is particularly notable for *GOV* firms. Consistent with this, *ROA* increased for *GOV* firms, and fell for *CORP* firms. Despite the observed increase in their investments and improved profitability, *GOV* firms' $PPE/Sales$ did not increase. These patterns raise the possibility, which we later investigate, that *GOV* firms may have had difficulty funding their desired expansion, which would be consistent with these firms being financial constrained.

Overall, the patterns above are similar for both unrated and rated *GOV* and *CORP* firms, with the effects of the crisis for rated firms being less strong. These statistics are consistent with *GOV* firms receiving a differentially more favorable product market shock over the crisis period. For unrated firms, the liquidity effect of the financial crisis appears stronger. Rated firms, which are larger and have better access to external financing, appear less affected by the crisis. Accordingly, in our analysis below of the effects on the crisis on firms' short-term financing, we focus on unrated firms, using rated firms for comparison where appropriate.

4. Financing and Growth during the Crisis

4.1. Short-Term Assets and Liabilities

We next consider the effect of the crisis on the short-term assets and liabilities of firms in our sample. Panel A of Table 5 shows the short-term asset and liability accounts scaled by the average quarterly pre-crisis assets. We observe a uniform increase across short-term asset categories (accounts receivables, total inventory, finished-goods and raw-material inventory, and cash) relative to their starting positions. Firms also increased their short-term liabilities (accounts payable and short-term debt). This is consistent with the finding in Table 4 that the ratio of sales to pre-crisis assets increased: More short-term assets and liabilities were required to support the increased level of activity and sales by firms.

A different pattern is observed in panel B of Table 5, where accounts receivable are scaled by current sales. Unrated *GOV* firms increased their accounts receivable to sales somewhat, albeit statistically and economically insignificant, while the accounts receivable of rated firms (*GOV* and *CORP* inclusive) declined. Turning to the financing side, we scale accounts payable using cost of goods sold (*COGS*) rather than sales, as *COGS* captures input costs to finance production better than sales, which have a built-in profit margin.[12] There is a clear distinction between unrated *GOV* and *CORP* firms. Unrated *GOV* firms had a significant increase in accounts payable, whereas unrated *CORP* firms did the opposite, decreasing their accounts payable considerably. Instead, they increased reliance on short-term debt relative to sales more heavily than unrated *GOV* firms. Rated *CORP* firms also cut back on accounts payable significantly while rated *GOV* firms changed little. To the extent that rated firms had comparatively better access to capital markets but *GOV* firms had stronger demand, the results raise the possibility that these short-term financing patterns were caused by differentiated demand shocks. Below, we further investigate whether this difference in short-term financing can be explained by differences in demand shocks.

The relation between demand shocks and short-term financing is further suggested by differential effects of inventories. Unrated *GOV* firms increased their inventories relative to

[12] See Love et al (2007) for more discussions of these issues.

COGS significantly, and this increase was primarily driven by the increase in raw-material inventories, whereas the same ratios for unrated *CORP* firms remained largely unchanged. Cash holdings of *CORP* firms, both unrated and rated, declined significantly, whereas they changed little for rated and unrated *GOV* firms.

In sum, there are significant differences in short-term asset and liability composition relative to contemporaneous sales or *COGS* of *GOV* and *CORP* firms. Evidence of financial constraints is stronger for unrated firms. However, the striking differences in the composition appear to be between *GOV* and *CORP* firms, rather than between rated and unrated firms. This pattern suggests that these differences are driven by demand shocks rather than liquidity constraints. We investigate this further in the next section.

4.2. Short-Term Financing

We now compare short-term financing responses to the crisis of government and corporate suppliers in a regression framework. While the crisis decreased both types of firms' access to external finance, the negative production shock most likely affected *CORP* firms. We use a difference-in-difference approach as follows:

$$y_{it} = \alpha + \beta_1 Crisis_t + \beta_2 GOV_i + \beta_3 Crisis_t \cdot GOV_i + \mathbf{X}'\theta + \varepsilon_{\mathbf{it}}, \tag{2}$$

where the dependent variable is a short-term financing variable of interest for firm i at time t. GOV_i is an indicator variable that takes on the value of one if the firm is a government supplier and zero if a corporate supplier. $Crisis_t$ is an indicator variable that takes on the value of one during the crisis period (2007:Q3–2009:Q2) and zero for the pre-crisis period (2005:Q3–2007:Q2). Industry fixed effects are also included, and standard errors are clustered at the firm-level. In our robustness tests, we add control variables (X), including the lagged values of the log of total assets ($lag(logAssets)$), cash holdings ($lag(Cash/Assets)$), cash flows (lag(OCF/Assets)), and quarterly sales growth ($lagSaleqg$).[13] While the robustness

[13]For cash regressions, we also include lagged net working capital scaled by assets, sigma, and lagged market-to-book ratio.

tests show similar results, we do not report these results due to concerns that some of these control variables may themselves be endogenous.

Table 6 examines the short-term financing behavior of unrated firms. Column (1) indicates that, on average, *GOV* firms had more accounts receivable than *CORP* firms before the crisis. This most likely reflects the governmental procurement practices and the fact that the government is at low risk of default. There are no significant changes to this ratio during the crisis, suggesting that unrated firms are not providing additional financing to their customers per dollar of sales during the crisis, nor are they cutting back on financing. Appendix B reports results for rated firms, which shows that the interaction term is likewise economically or statistically insignificant. Thus, column (1) provides no evidence in support of the *relationship hypothesis* that *GOV* firms provide additional financing to their customers during the crisis.

In column (2), we examine how unrated firms are paying their own suppliers by examining $AP/COGS$. The ratio drops considerably for corporate suppliers during the crisis as shown by a significant and negative loading on CRISIS (–0.049). The coefficient of $CRISIS * GOV$ is positive and statistically significant, indicating that $AP/COGS$ for *GOV* firms increased substantially relative to that of *CORP* firms. GOV firms' pick-up in $AP/COGS$ could arise for one of two reasons. First, *GOV* firms might have used increased market power during the crisis to obtain liquidity from their suppliers, whereas *CORP* firms might be paying their suppliers more quickly. This would suggest a reverse of the *relationship hypothesis* in which firms with positive demand were extracting liquidity from weaker firms. It would also be inconsistent with the *information hypothesis*, because additional trade financing was going to government suppliers, which are less risky and more transparent in a financial crisis. Second, it is possible that government suppliers faced a different shock compared with that faced by corporate suppliers, leading to greater use of trade credit relative to COGS. In particular, if *CORP* firms were facing lower demand, they may have sold output from their finished-goods inventory, whereas *GOV* firms, facing growing demand, are likely to have purchased new inputs that were still being paid. This, by itself, would cause a divergence between the ratios of accounts payable to COGS of the two types of firms. We investigate these possibilities further in the next section.

As a point of comparison to the $AP/COGS$ ratio, we examine $STdebt/Sales$ of unrated firms in column (3). While both *CORP* and *GOV* firms increased short-term debt relative to their sales during the crisis, the increase is much more pronounced for *CORP* firms with the coefficient of 0.193 compared to the increase of only 0.052 (=0.193–0.141) for *GOV* firms. Last, we examine Cash/Assets in column (4). *GOV* firms held less cash relative to assets than *CORP* firms before the crisis. While *CORP* firms ran down their cash reserves more than *GOV* firms did during the crisis, difference in the cash policy between the two groups of firms during the crisis was not statistically significant.

Taken together, a divergence in the short-term financing pattern emerges. Corporate suppliers moved away from accounts payable and significantly increased their reliance on short-term debt instead. Government suppliers, on the other hand, stepped up their usage of accounts payable while increasing short-term debt only marginally. Despite the fact that the increases in EDF (Table 2) are higher for corporate suppliers, we find no evidence that firms facing significantly higher risk increase financing from trade creditors.

4.3. Inventory Breakdown

Next, we examine whether the observed differences in the short-term financing policy between *GOV* and *CORP* firms can be explained by changes in the composition of assets during the crisis. We focus on inventories for two reasons. First, *CORP* and *GOV* firms are differentially affected by demand shocks, which are most likely to be reflected in the changes to their inventories. Second, firms may match the maturity of their assets with that of their liabilities. Thus, particularly in a crisis when access to long-term financing is difficult, it is likely that access to short-term financing will depend on the composition of short-term assets. To better understand the changes to inventory, we break down inventory to raw materials, finished goods, and other inventory.

Column (1) of Table 12 provides evidence that the ratio of raw-material inventory to COGS for unrated *GOV* firms increased during the crisis relative to *CORP* firms. This pattern is consistent with firms increasing purchases of materials in anticipation of expected output

growth.[14] As column (2) shows, there are no comparable divergences in the ratio of *GOV* firms' finished-goods inventory to COGS while *CORP* firms' ratio increase significantly, likely reflecting increasing finished goods inventory due to slowing sales.

In columns (3) and (4), we scale accounts payable by raw-material inventory and finished-goods inventory, respectively. $AP/INVRM$ is of particular interest because any changes in the terms of payment between suppliers and customers are likely to be reflected in this ratio. An increase (decrease) in this ratio indicates that suppliers are providing more (less) financing for the amount of purchases made by their customers. Generally, trade credit terms tend to remain stable over time.[15] However, a severe macro liquidity shock may alter their behavior. Column (3) shows that the interaction term is insignificant, suggesting that there was no difference in the trade credit practices between government suppliers and corporate suppliers during the crisis. This is consistent with Ng, Smith and Smith (1999)'s survey finding that trade credit terms tend to remain stable over time.[16] Rather, *GOV* firms' increases in accounts payable are consistent with increases in purchases of inputs on credit and the build-up of raw-material inventory.

In the final two columns, we examine the relation between short-term debt and the composition of inventory. Examining $STdebt/INVRM$, column (5) shows the interaction term is negative and significant, suggesting that *GOV* firms significantly reduced the ratio of short-term debt to raw-material inventory relative to *CORP* firms during the crisis. Thus, there is no evidence that the increase in raw-material inventory of *GOV* firms were financed by short-term debt. Rather, the evidence suggests that short-term debt moved in line with finished goods inventory: Column (6) shows the relation between short-term debt and finished-goods inventory remained unchanged during the crisis for both *GOV* and *CORP* firms, providing support for the view that short-term debt was used to finance finished-goods inventory.

[14]The sample size drops because data on inventory components have many missing values. In addition, observations with the inventory value of zero are removed from the test to allow to compare results using inventory variables as denominators and those using inventory variables as numerators.

[15]Ng, Smith and Smith (1999)'s survey finding shows firms rarely change trade credit terms in response to changes in economic conditions such as demand and interest rates.

[16]Firms report they rarely change trade credit terms in response to changes in economic conditions such as demand and interest rates.

Overall, we have established that the short-term financing behavior of *CORP* and *GOV* firms differs in response to the crisis. The *GOV* firms' increases in accounts payable are consistent with increases in input purchases on credit and the build-up of raw-material inventory. In contrast, the relative increase of *CORP* firms is in short-term debt financing. This is consistent with a liquidity need caused by a demand shock. In unreported regressions, we find similar responses by rated firms, suggesting that these reactions are indeed caused by responses to demand shocks, and are not driven by differential access to trade credit or financing by financial intermediaries.[17]

4.4. Firm Growth And Long-Term Financing

Next, we examine whether the crisis affected the growth and financing of *GOV* and *CORP* firms differently. The first two columns of Table 8 estimates specification (1) for investment-related dependent variables.[18] Column (1) shows that *GOV* firms' fixed investment measured by $PPE/Sales$ did not increase during the crisis relative to that of *CORP* firms. Column (2) shows investment in capital expenditure took a hit across the board for both *GOV* and *CORP* firms, as indicated by the negative and significant coefficients of *CRISIS*. While $Capex/lagPPE$ dropped for both *GOV* and *CORP* firms, the reduction in capital expenditure was much smaller for unrated *GOV* firms than for *CORP* firms; the coefficient of $CRISIS * GOV$ is positive and significant, consistent with the higher growth rates of *GOV* firms during the crisis.

Evidence so far suggests that government suppliers experienced a robust increase in sales relative to corporate suppliers during the crisis, without a corresponding increase in PPE relative to sales. Long-term financing was difficult to access during the crisis, suggesting that *GOV* firms became financially constrained. Direct evidence on this is shown by employing Hoberg and Maksimovic (2015)'s measure of investment delay constraints. This measure, derived from textual analysis of 10-K reports of US listed firms, scores the MD&A sections of the 10-Ks for discussion of expected delays in investment due to an inability to obtain financ-

[17] Unrated firms generally have difficulties accessing public debt markets, and more so during a crisis.

[18] In unreported tests, we also run regressions including lagged values of M/B and OCF/Assets as control variables.

ing for desired projects. Figure 5 shows that the delay-in-investment text measure increased over time for *GOV* firms but not for *CORP* firms, both rated and unrated, with the rated firms reporting lower mean levels of constraint.[19] Initially, *GOV* firms reported being less constrained than *CORP* firms, but as the crisis evolved, they reported, on average, becoming more constrained. While *GOV* firms had higher positive revenue shocks than *CORP* firms over the crisis, Figure 5 is consistent with these firms not having sufficient funding to fund desired investment in long-term assets. This suggests that *GOV* firms did not have additional liquidity to provide to their own suppliers (who themselves were also experiencing a positive demand shock transmitted through the *GOV* firms). We return to this further in the next section.

The last two columns of Table 8 confirm that *GOV* firms did not access long-term financing differentially compared with *CORP* firms during the crisis. The results show that changes in long-term debt and short-term debt during crisis, which are both scaled by lagged assets, were negative and positive, respectively. The results are similar when control variables (lagged values of market-to-book, ROA, log(sales), and PPE/assets) are included in the estimation. The results imply that both *GOV* and *CORP* firms struggled to access long-term financing during the crisis, with short-term debt partially substituting long-term debt. The interaction term ($CRISIS * GOV$) is insignificant throughout, indicating that *GOV* firms did not obtain more financing over this period despite the larger comparative increase in their revenue. That is, *GOV* firms did not raise additional debt financing in proportion to their increase in sales. Similar results are obtained if changes in debt are scaled by pre-crisis assets. These results show that during the crisis, a positive demand shock did not translate into differential long-term financing or investment policies, most likely due to constraints on external financing.

While both types of firms had difficulty accessing long-term financing, earlier results show *GOV* and *CORP* firms had striking differences in the short-term asset and liability compositions. *GOV* firms increased their ratio of accounts payable to COGS, whereas *CORP* firms relied more on their short-term debt. These differences are consistent with a differential pattern of demand shocks, with *GOV* firms increasing their raw-material usage to meet rising

[19]The delay-of-investment measure picks up financial constraints with respect to new investment, not financial distress. Thus, the measure shows that *GOV* firms became constrained, but it does not measure directly whether they were more or less distressed than *CORP* firms.

demand and *CORP* firms relying more on bank financing for increasing finished-goods inventory stemming from low demand. In the next section, we investigate whether *GOV* firms might still be indirectly channeling liquidity to their own suppliers by changing terms of trade, specifically, the rate of payment made to them.

4.5. Accounts Payable and Raw Material inventory

We first examine the determinants of the ratio of accounts payable to COGS. Panel A of Table 9 estimates specification (1) for subsamples of unrated firms. The first two columns show results for two subsamples sorted on the extent of a firm's reliance on its largest principal customer ($CUSTREL$). For the next two columns, the sample is split based on the size of raw-material inventory relative to COGS. We find a stronger effect for *GOV* firms relative to *CORP* firms during the crisis when firms relied more on their customers and when they had more raw-material inventory. The first finding is predicted by a link between purchases of inputs on credit and positive exogenous demand shocks, the intensity of which is measured by the proportion of output sold to government customers. The second finding supports the hypothesis that the level of raw-materials inventory, which depends on demand shocks, predicts the ratio of accounts payable to COGS.

We next show that there is not a differential relation between accounts payable and raw-material inventory of *GOV* and *CORP* firms during the crisis. Panel B of Table 9 examines how the ratio of accounts payable to raw-material inventory varies across the sample splits drawn from Panel A. The results show no evidence that the financing of raw-material inventory using trade credit is related to a firm's reliance on its customer or the size of raw-material inventory relative to COGS. Thus, the amount of supplier financing per dollar of raw-material inventory does not differ between *GOV* and *CORP* firms, implying that the differences in AP/COGS between *GOV* and *CORP* firms during the crisis do not stem from differential access to trade financing, but are rather due to differences in the level of raw-material inventory during the crisis. Thus, the earlier finding is stable across these different subsamples of firms that the increase in the use of accounts payable by *GOV* firms relative to *CORP* firms during the crisis is driven by relative changes in the level of raw-material inventory resulting from differential

production shocks, and not by differences in the use of trade credit to finance these inventories by *GOV* and *CORP* firms.

5. Financial Crisis and Strategic Outcomes

The previous sections suggest that the direct financial interactions between firms through trade credit during the crisis were driven by the nature of demand shocks experienced by the firms and did not lead to liquidity transfer through the medium of differential credit terms. There is also no evidence that increased demand caused government suppliers more than corporate suppliers to invest in other firms through acquisitions (Table 8, column 4). Thus, there is very limited evidence for compensatory financial interactions between firms to substitute for the drop in market liquidity during the financial crisis. There is, however, evidence of substantial product market effects of the crisis. Figure 6 shows that the relative market shares of *GOV* and *CORP* firms had changed substantially by the end of the crisis period.

This pattern is confirmed in Table 10, which shows that *GOV* firms' market share increased substantially in the crisis period relative to *CORP* firms. The first column considers *MSCRISIS*, the logarithm of the ratio of a firm's average quarterly market share during crisis to the corresponding pre-crisis market shares, where pre-crisis is defined as the period of 2005:Q2–2007:Q2 and crisis as the period of 2007:Q3–2009:Q2.[20] The next column considers *MSCRISIS*2, which is calculated as the logarithm of the ratio of a firm's market share in 2009:Q2 to the corresponding market share in 2007:Q2. Moreover, as shown in Figure 5, by the end of the crisis, unrated *GOV* firms were reporting a large increase in financial constraints–an inability to obtain financing for desired investment projects.[21]

Some studies document that firms with larger cash holdings or better bank access improved their positions during the crisis (Duchin, Ozbas, and Sensoy (2010) and Kahl and Stulz (2013)) or that, more generally, cash holdings predict product market gains (Fresard (2010)). The effect that we identify in this study is different; as shown in Table 4, government suppliers had

[20] A firm's market share is computed as the fraction of the industry sales attributed to the firm, where industry is defined according to Fama and French's 48 industry classification.

[21] In unreported difference-in-difference regressions, we show that these differences are statistically significant.

lower cash holdings than corporate counterparts prior to the crisis, and their cash policy did not differe significantly from that of corporate suppliers during the crisis. However, the altered market shares in the product market and increased constraints of *GOV* firms by the end of the crisis created a potential disequilibrium in the allocation of assets that has been identified by Harford (2005) as leading to reallocations through merger waves when the financial market conditions normalize. While Harford (2005) focuses on whether a potential disequilibrium arising from deregulation of industries leads to future asset reallocations, we examine whether a liquidity crisis does the same. The liquidity crisis, combined with differential shocks for *GOV* and *CORP* firms, provides a natural experiment setting for this hypothesis.

Table 11 tests the proposition that *GOV* firms increase their post-crisis acquisition activities. The table reports regression results on post-crisis acquisition activities for unrated firms. The dependent variable is the value of a firm's post-crisis acquisitions scaled by its pre-crisis assets, where post-crisis is defined as the period from 2009:Q3 to 2011:Q2. Columns (1) and (2) show that unrated firms that gained market share during the crisis indeed increased acquisitions after the crisis. A deeper causal interpretation is provided in column (3) and (4), which show that firms identified as government suppliers in the pre-crisis period increased their acquisition activities three to four years after the crisis. Thus, a consequence of the liquidity crunch of the crisis is a delayed adjustment of capacity to the increased market share once the financial markets' liquidity is restored.

Table 11 provides additional evidence that in the absence of fully functioning financial markets, direct financial interactions across firms have a very limited scope for facilitating efficient transfer of resources. Although, in principle, firms should be able to make acquisitions by simply swapping stocks even when financial markets are under stress, as the crisis continued, there was an increase in reports of financial constraints by *GOV* firms and additional subsequent acquisition activities. This increase in constraints and misallocation is consistent with the lack of increased liquidity provision from government suppliers to their own suppliers previously demonstrated, as it suggests that the opportunity cost of such provisions is too high given government suppliers' own incentives to invest.

6. Robustness Checks

We perform several robustness tests to check the consistency of our results. We test whether the pattern in the data is specific to the crisis period by repeating the regressions for pseudo-crisis periods. Table 13 repeats the regressions in Table 6 for various pseudo-crisis periods. Specification (A) treats 2003:Q3–2005:Q2 as a crisis period and 2001:Q3–2003:Q2 as a pre-crisis period. Specification (B) treats 2004:Q3–2006:Q2 as a crisis period and 2002:Q3–2004:Q2 as a pre-crisis period. Finally, specification (C) considers a pseudo-crisis period of 2005:Q3–2007:Q2 and a pseudo pre-crisis period of 2003:Q3–2005:Q2. All three regressions confirm that the patterns around the pseudo-crisis periods do not mimic the pattern of the actual crisis from 2007 to 2009.

Table 14 provides additional robustness checks. First, we address the concern that the 10% cutoff for the reporting requirement of principal customers may introduce a selection bias. For this exercise, we redefine a principal customer as a customer contributing 20% or more of the sample firm's sales, and reconstruct the sample. The sample size drops to about 8,800 from around 14,000 in Table 6 due to the higher cutoff point. Specification (A) of Table 14 repeats the regressions in Table 6 using this sample, and reports the coefficients of the interaction term, $Crisis * GOV$. Second, we add quarter dummy variables (specification (B)). Third, we cluster standard errors simultaneously at the firm- and time- (quarterly frequency) levels instead of clustering at the firm level (specification (C)). In addition, in unreported results,[22] we perform the following robustness tests: (1) we select a control group of *CORP* firms using principal component matching based on firm size, age, and industry and (2) we use a continuous sample rather than a predetermined sample. That is, we sort sample firms according to their credit ratings and customer types each year rather than as of 2006. In every case listed above, the results are similar to those reported in the tables.

[22] Available from the authors upon request

7. Conclusion

We use the 2007–09 financial crisis as a natural experiment for testing the predictions of trade credit theories stressing its role in facilitating contracting for the flow of goods between firms and theories that stress the role of informational advantages and incentives that trade partners have in transferring liquidity along the supply chain. Specifically, we examining the flow of credit between firms and their suppliers, comparing firms facing differential demand shocks in a period of financial market illiquidity. We measure the differential demand by comparing firms that primarily supply to government with those supplying primarily to corporate customers. Using a sample of unrated public firms, we obtain three key results.

First, our findings provide support for theories of trade credit that stress its use in transactions for inputs rather than providing excess liquidity to suppliers. Theo pattern of trade credit and bank financing is consistent with theories that stress financial relations between vendors and customers rather than theories that stress informational advantages that suppliers have over financial intermediaries. Given that the latter theories do not have much predictive power during times of increased uncertainty, they are not likely to be able to explain the time-series variation in trade credit.

Second, we find little evidence for liquidity transmission through a trade channel whereby firms with relatively high demand provide more liquidity to their own suppliers than firms with lower demand. The main determinant of the usage of trade credit financing is product-market shocks. Firms with relatively strong demand have higher raw-material inventory and rely more on trade credit. However, the amount of credit per unit of raw-material inventory does not appear to change with the firms' demand shocks, indicating that firms were not changing their trade credit payment terms according to their state of demand.

A likely reason for this result is that all firms along a supply chain are hit by demand shocks. Thus, the liquidity shocks that they receive are likely to be correlated, as are short-term investments in raw materials and final goods inventories. This correlation in financing needs limits the scope for liquidity sharing, thereby reducing the value of the trade credit channel in facilitating adjustments to time-varying demand shocks to firms.

Third, the opportunity cost of liquidity for unrated firms with high demand during the liquidity crisis is likely to be high. We show that they report an increasing inability to finance investments and, once the liquidity crisis ends, step up acquisition activities. This suggests that even high demand firms are unable to obtain sufficient self-financing or short-term financing to maintain their desired growth trajectory during the crisis. Thus, they may have little incentive to provide liquidity to other firms.

Overall, we find that the flow of trade credit is highly contingent on the type of demand shocks that firms face. The micro-evidence does not provide support for claims that trade credit flows provide a financing channel that might promote recovery from a crisis by transferring liquidity from firms with positive demand shocks to other firms. Moreover, in this context, the theories that ascribe a monitoring role and sharing role among trade partners for trade credit do not have explanatory power.

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Appendix A: Variable Descriptions

Variable	Description
AP	Quarterly dollar accounts payable (APQ).
AQC	Quarterly dollar acquisition expenses ($AQCY_t - AQCY_{t-1}$).
AQCV	Total value of acquisitions summed over the post-crisis period, scaled by pre-crisis assets.
AR	Quarterly dollar accounts receivable ($RECTQ$).
Assets	Quarterly dollar total assets (ATQ).
Capex	Quarterly dollar capital expenditures ($CAPXY_t - CAPXY_{t-1}$).
Cash	Quarterly dollar amount of cash and short-term investments ($CHEQ$).
COGS	Quarterly dollar cost of goods sold ($COGSQ$).
CRISIS	Indicator variable that takes on unity during the crisis period of 2007Q3 to 2009Q2, and zero in the pre-crisis period of 2005Q3 to 2007Q2.
CUSTREL	Customer reliance computed as the percentage sales accounted for by a principal customer, where a principal customer is defined as a customer contributing at least 10% to the sample firm's annual sales ($SALES$). Source: Business Segment files of Compustat for customer sales; Compustat Annual for $SALES$.
Delaycon	An index of financial constraints on investments, obtained from Hoberg and Maksimovic (2015).
EDF	Monthly average of daily one-year ahead expected default frequencies, the fraction of a firm's total liabilities that are expected to default in the year ahead. EDF, obtained from Moodys Analytics, CreditEdge, is calculated using a structural model based on stock valuations, balance sheet information, and realized asset volatility.
GOV	Indicator variable that takes on unity if a sample firm is classified as a government supplier, and zero if classified as a corporate supplier, where a government (corporate) supplier is a sample firm whose biggest principal customer is a government agency (corporation).
INV	Quarterly dollar total inventory ($INVQ$).
INVFG	Quarter dollar finished-goods inventory ($INVFGQ$).
INVRM	Quarter dollar raw-material inventory ($INVRMQ$).
Leverage	Quarterly ratio of the sum of long-term debt ($DLTTQ$) and current liabilities ($DLCQ$) to assets.
LTdebt	Quarterly dollar long-term debt ($DLTTQ$).
M/B	Quarterly market-to-book ratio computed as the market value of assets (ATq – CEQq + PRCCq*CSHOq) divided by the book value of assets (ATQ).
MS	Quarterly market share computed as the fraction of the industry sales in the Compustat universe attributed to the firm, where industry is defined according to Fama-French's 48 industry classification.
MSCRISIS	Logarithm of the ratio of a firm's quarterly market share averaged over the crisis (2007Q3–2009Q2) to the corresponding average quarterly pre-crisis (2005Q2–2007Q2) market share.
MSCRISIS2	Logarithm of the ratio of a firm's market shares in 2009Q2 to the corresponding market share in 2007Q2.
NWC	Quarterly net working capital ($WCAPq - CHEq$).
OCF	Quarterly dollar income before depreciation ($OIBDPQ$).
Post-Crisis	The period from 2009Q3 to 2011Q2.
Pre-Crisis	The period from 2005Q3 to 2007Q2.

(cont'd in the next page)

Variable	Description
Pre-Crisis Assets	Quarterly asset values averaged over the pre-crisis period.
PPE	Quarterly dollar property, plant and equipment expenses net of depreciation ($PPENTQ$).
Profit Margin	Quarterly sales ($SALEQ$) minus cost of goods sold ($COGSQ$), scaled by $COGSQ$.
R&D	Quarterly dollar research and development expenses ($XRDQ$) with missing value set to zero.
ROA	Quarterly return on assets computed as income before extraordinary items (IBY) scaled by assets (ATQ).
Sales	Quarterly dollar sales ($SALEQ$).
Saleqg	Quarterly sales growth computed as current sales minus previous quarter sales, scaled by previous quarter sales.
Sigma	Industry cash flow volatility
STdebt	Short-term debt measured as quarterly current liabilities ($DLCQ$).

**Note: Lagged variables are preceded by the prefix "Lag". Source: Compustat Quarterly unless otherwise stated.*

Appendix B: Regression Results on Short-Term Financing for all firms and rated firms

This table reports regression results on various measures of short-term financing variables for all firms (panel A) and rated firms (panel B). Results for unrated firms are reported in table 4. The dependent variables are accounts receivable scaled by sales ($AP/Sales$) in column (1), accounts payable scaled by cost of goods sold ($AP/COGS$) in column (2), short-term debt scaled by sales ($STdebt/Sales$) in column (3), and cash scaled by assets ($Cash/Assets$) in column (4). *CRISIS* is an indicator variable that takes on unity during the crisis period (2007Q3–2009Q2), and zero during the pre-crisis period (2005Q3–2007Q2). *GOV* is an indicator variable that takes on unity if the sample firm is classified as a government supplier, and zero if classified as a corporate supplier. Sample firms are sorted into *rated*/*unrated* and *GOV*/*CORP* according to their credit ratings and customer types as of 2006. All regressions include industry fixed effects. Standard errors, clustered at the firm-level, are reported in brackets. All variables are described in Appendix A.

Panel A: All Firms

	(1)	(2)	(3)	(4)
VARIABLES	AR/Sales	AP/COGS	STdebt/Sales	Cash/Assets
CRISIS	-0.002	-0.059***	0.168***	-0.018***
	[0.007]	[0.020]	[0.028]	[0.004]
GOV	0.115***	-0.153***	0.101**	-0.048***
	[0.027]	[0.048]	[0.047]	[0.016]
CRISIS*GOV	0.011	0.132***	-0.130**	0.011
	[0.017]	[0.043]	[0.050]	[0.009]
Constant	0.795***	1.388***	0.826**	0.208***
	[0.147]	[0.429]	[0.421]	[0.065]
Observations	17,357	18,415	18,011	18,414
R-squared	0.104	0.113	0.035	0.294

Panel B: Rated Firms

	(1)	(2)	(3)	(4)
VARIABLES	AR/Sales	AP/COGS	STdebt/Sales	Cash/Assets
CRISIS	-0.019**	-0.095***	0.064**	-0.008*
	[0.009]	[0.030]	[0.028]	[0.004]
GOV	0.068	-0.234***	-0.013	-0.051***
	[0.046]	[0.081]	[0.029]	[0.017]
CRISIS*GOV	0.005	0.077**	-0.072**	0.014**
	[0.017]	[0.034]	[0.031]	[0.007]
Constant	0.819***	0.426***	0.015	0.045***
	[0.004]	[0.015]	[0.014]	[0.002]
Observations	3,906	4,334	4,287	4,333
R-squared	0.149	0.235	0.041	0.258

Appendix C: Customer Information

We consider a sample firm's customer as the government if the sample firm reports its customer name (variable name: *CNMS*) as the U.S. or federal government, a state or local government in Compustat Business Segment Files. Some firms simply report its customer as government agencies or projects without specifying the exact identities of the government agencies. We then check whether the reporting firm is a U.S. company and the customer type (variable name: $CTYPE$) is $GOVDOM$. For government customers, $CTYPE$ can take on one of four possible types, $GOVDOM$, $GOVSTATE$, $GOVLOC$, and $GOVFRN$, which refer to domestic, state, local and foreign government, respectively. For a U.S. firm, $GOVDOM$ refers to the U.S. government and $GOVFRN$ to a foreign government. Similarly, we check whether a firm reporting *CNMS* as $Municipalities$ and $CTYPE$ as $GOVLOC$ is a U.S. firm to confirm that its customer is a U.S. municipality.

Among our sample of government suppliers, 98.5% sell to the U.S. government and only 1.5% sell to foreign governments. Among our unrated government suppliers, only 1.1% sells to foreign governments. The sheer majority of U.S. government customers are federal agencies, with only 1.9% of our unrated suppliers cater to the U.S. state or local government agencies. Examples of state government include Arizona Department of Corrections, Arkansas Department of Revenue, California Department of Water Resources, State of Texas, etc. Examples of local government are Chicago Housing Authority, the cities and counties such as City of Toledo, Wayne county of Michigan, etc., or a government agency.

Among the named government agencies: (i) 48.3% of the reported firm-year relationships are with the Department of Health and Human Services and its related agencies which include Medicare and Medicaid, National Institute of Allergy and Infectious Disease, National Institute of Health, SAMHSA, and Veterans Health Administration facilities; (ii) 40.3% are with the Department of Defense and defense-related units which include the U.S. Air Force, Army, Border Patrol, Coast Guard, Homeland Security, Intelligence Agency, Marine, Military, National Security, NASA, and the Navy; (iii) 2% are with the Department of Energy; (iv) 0.9% are with the Department of Education; and (v) the remaining 8.5% are with other U.S. government agencies which include the Department of Agriculture, Commerce, Interior,

State, Transport, Veterans Affairs, Federal Bureau of Prisons, Federal Emergency Management Agency, Federal Job Corps, Federal Reserve Bank, General Services Administration, Internal Revenue Services, Public Street Lighting and Highway Lighting, Social Security Administration, and U.S. Environmental Protection Agency, Forest Service, Immigration and Customers Enforcement, National Park Service, Postal Service, and the U.S. Treasury.

In June 1997, SFAS 131 was issued which requires firms to disclose the sales to each principal customer, but not the name of the customer. To the extent that small and riskier firms that are more likely to be affected by their customers' actions choose not to disclose their customer names (Ellis et al., 2012), our estimates represent the lower bound of the true impact of customers actions on dependent suppliers. As a result, there is a significant number of firms in the Business Segment Files that are missing the *CNMS* variable but report the dollar amounts of sales (*CSALE*) to these customers. However, over our sample period, we do not have cases where *CTYPE* indicates a governmental customer type and *CNMS* is unreported.

To identify sample firms that supply to corporate customers, we start with the information in the Compustat Business Segment Files. As firms only report the names of their major customers, we manually match the customer names to their corresponding GVKEYs in Compustat by closely following the approach in Fee et al. (2006). For customer names that are abbreviated, we use visual inspection and industry affiliation in our matches. For unmatched customers, we further search their corporate web sites or the Directory of Corporate Affiliation database to determine whether the customer is a subsidiary of a listed firm, and assign the parent GVKEY where applicable. To ensure accuracy of our matches, we retain only customers that are unambiguously matched to GVKEYs.

Table 1
Panel VAR Analysis

This table reports estimation results of the following panel VAR model using annual Compustat data between 2005 and 2014:

$$z_{it} = \Gamma_0 + \Gamma_1 z_{it-1} + f_i + \varepsilon_t, \tag{3}$$

where z_{it} = $\{ln(INVRM_t)$, $ln(INVFG_t)$, $ln(AP_t)$, $ln(STdebt_t)\}'$, Γ is a 4x4 matrix of coefficients, and f_i is a vector of firm fixed effects. Panel A reports the coefficients of the panel VAR system. t-statistics are reported in brackets. Panel B reports variable decomposition of 10-period ahead forecast.

Panel A: pVAR Estimates

	$ln(INVRM_t)$	$ln(INVFG_t)$	$ln(AP_t)$	$ln(STdebt_t)$
$ln(INVRM_{t-1})$	0.424	0.184	0.124	-0.205
	[6.290]	[3.380]	[2.590]	[-1.490]
$ln(INVFG_{t-1})$	0.003	0.508	0.024	0.097
	[0.090]	[11.090]	[0.790]	[1.150]
$ln(AP_{t-1})$	0.201	0.075	0.667	0.290
	[3.880]	[1.310]	[14.090]	[1.900]
$ln(STdebt_{t-1})$	0.010	-0.003	0.002	0.347
	[1.290]	[-0.350]	[0.310]	[10.620]

Panel B: Variance Decomposition of 10-Period Ahead Forecast

Response	Impulse Variable			
Variable	$ln(INVRM)$	$ln(INVFG)$	$ln(AP)$	$ln(STdebt)$
$ln(INVRM)$	0.898	0.009	0.091	0.002
$ln(INVFG)$	0.174	0.793	0.032	0.000
$ln(AP)$	0.229	0.059	0.712	0.000
$ln(STdebt)$	0.011	0.011	0.021	0.958

Table 2
Changes in Expected Default Frequencies

This table reports monthly one-year ahead expected default frequencies (EDF), the fraction of a firm's total liabilities that are expected to default in the year ahead. EDF is calculated using a structural model based on stock valuations, balance sheet information, and realized asset volatility. Panels A and B report EDFs of unrated firms and rated firms, respectively, averaged over the pre-crisis period (2005Q3–2007Q2) and the crisis period (2007Q3–2009Q2) for *CORP* and *GOV*, separately. Diff(CORP – GOV) is the differences in EDF values between CORP and GOV and Diff (Crisis – Pre-Crisis) is the difference between crisis and pre-crisis periods. t-statistics are reported in parenthesis. Sample firms are sorted into $rated/unrated$ and $GOV/CORP$ according to their credit ratings and customer types as of 2006. Appendix A provides more variable descriptions.

Panel A: Unrated Firms

	CORP	GOV	Diff(CORP – GOV)
Pre-Crisis	1.076	1.300	-0.223 (-4.44)
Crisis	3.070	2.457	0.613 (5.05)
Diff (Crisis – Pre-Crisis)	1.993 (34.08)	1.157 (10.12)	

Panel B: Rated Firms

	CORP	GOV	Diff(CORP – GOV)
Pre-Crisis	0.595	0.309	0.286 (4.45)
Crisis	2.312	1.478	0.834 (4.25)
Diff (Crisis – Pre-Crisis)	1.717 (17.25)	1.169 (8.77)	

Table 3
Pre-Crisis Firm Characteristics

This table reports quarterly firm characteristics averaged over the pre-crisis period of 2005Q3 to 2007Q2. Panel A reports the firm characteristics for all firms in our sample while Panel B partitions our sample firms into *rated*/*unrated* and *GOV*/*CORP* according to their credit ratings and customer types as of 2006, and report the firm characteristics for each subsample. DIFF measures the difference between *GOV* firm characteristics and *CORP* firm characteristics. Reliance (*CustREL*) on sample firms' largest customers is reported as of fiscal year 2006. All variables are described in Appendix A.

Panel A: All Firms

Variable	Mean	Median	Std Dev
Customer Reliance (*CustREL*)	0.318	0.230	0.223
Assets ($ millions)	1,545	224	4,007
Sales ($ millions)	408	53	1,160
Leverage	0.215	0.144	0.253
Capex/Assets	0.016	0.007	0.025
ROA	-0.014	0.008	0.082
OCF/Assets	0.009	0.026	0.071
M/B	2.296	1.748	1.717
Number of firms per quarter	1,194		

Panel B: Subsamples

		Sample Firms	
Variable	Customer Types	Unrated Firms	Rated Firms
Customer Reliance (*CustREL*)	GOV	0.474	0.330
	CORP	0.304	0.213
	DIFF	-0.170	-0.118
	t-stat	-9.82	-5.91
Assets ($ millions)	GOV	300	6,004
	CORP	511	4,651
	DIFF	211	-1,353
	t-stat	5.09	-4.08
Sales ($ millions)	GOV	103	1,675
	CORP	119	1,236
	DIFF	15	-440
	t-stat	1.30	-4.46
Leverage	GOV	0.196	0.366
	CORP	0.168	0.335
	DIFF	-0.028	-0.031
	t-stat	-3.94	-2.76
Capex/Assets	GOV	0.011	0.011
	CORP	0.016	0.019
	DIFF	0.005	0.008
	t-stat	6.92	7.10
ROA	GOV	-0.028	0.009
	CORP	-0.020	0.011
	DIFF	0.009	0.002
	t-stat	3.31	1.30
OCF/Assets	GOV	-0.004	0.034
	CORP	0.001	0.037
	DIFF	0.005	0.003
	t-stat	1.97	2.92
M/B	GOV	2.470	1.699
	CORP	2.439	1.822
	DIFF	-0.031	0.123
	t-stat	-0.57	2.95
Number of firms per quarter	GOV	198	66
	CORP	709	217

Table 4
Changes in Firm Characteristics During Crisis

This table reports quarterly firm characteristics averaged over the pre-crisis period of 2005Q3 to 2007Q2 and the crisis period of 2007Q3 to 2009Q2, respectively, for four subsamples. Sample firms are sorted into *rated*/*unrated* and *GOV*/*CORP* according to their credit ratings and customer types as of 2006. DIFF measures the difference between the pre-crisis firm characteristics and the crisis-period firm characteristics. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively. All variables are described in Appendix A.

		Unrated Firms		Rated Firms	
Variable	Period	GOV	CORP	GOV	CORP
Assets ($ millions)	Pre-Crisis	300	511	6,004	4,651
	Crisis	400	629	7,685	5,740
	DIFF	100***	118***	1681***	1090***
	%change	33.33	23.07	28.00	23.44
Sales/Pre-Crisis Assets	Pre-Crisis	0.326	0.261	0.283	0.263
	Crisis	0.432	0.299	0.347	0.300
	DIFF	0.106***	0.039***	0.064***	0.037***
	%change	32.52	14.94	22.63	14.07
Leverage	Pre-Crisis	0.191	0.166	0.367	0.338
(scaled by pre-crisis assets)	Crisis	0.261	0.248	0.464	0.436
	DIFF	0.070***	0.082***	0.097***	0.097***
	%change	36.65	49.40	26.45	28.70
Capex/Pre-Crisis Assets	Pre-Crisis	0.010	0.015	0.011	0.018
	Crisis	0.015	0.018	0.014	0.023
	DIFF	0.005***	0.003***	0.003***	0.005***
	%change	50.00	20.00	27.42	27.78
ROA	Pre-Crisis	-0.028	-0.020	0.008	0.009
(scaled by pre-crisis assets)	Crisis	-0.012	-0.028	0.013	0.000
	DIFF	0.016***	-0.008***	0.005**	-0.009***
	%change	57.10	-40.00	66.09	-100.00
OCF/Pre-Crisis Assets	Pre-Crisis	-0.002	0.002	0.034	0.037
	Crisis	0.016	0.006	0.043	0.039
	DIFF	0.018***	0.004**	0.009***	0.002*
	%change	900.00	200.00	26.73	5.44
M/B	Pre-Crisis	2.470	2.439	1.699	1.822
	Crisis	2.075	1.891	1.478	1.489
	DIFF	-0.396***	-0.548***	-0.221***	-0.334***
	%change	-16.03	-22.47	-13.01	-18.33
PPE/Sales	Pre-Crisis	1.272	2.113	1.132	2.247
	Crisis	1.191	2.412	1.101	2.487
	DIFF	-0.081	0.298***	-0.031	0.241*
	%change	-6.36	14.10	-2.77	10.71

Table 5
Changes in Short-term Financing

This table reports quarterly short-term financing measures averaged over the pre-crisis period of 2005Q3 to 2007Q2 and crisis period of 2007Q3 to 2009Q2, respectively, for four subsamples. Sample firms are sorted into *rated*/*unrated* and *GOV*/*CORP* according to their credit ratings and customer types as of 2006. DIFF measures the difference between the pre-crisis firm characteristics and the crisis-period firm characteristics. Panel A scales financing measures by average pre-crisis assets, quarterly asset values averaged over the pre-crisis period. Panel B scales financing measures by various contemporaneous values. *AR* and *AP* are the accounts receivable and accounts payable, respectively, while *STdebt* is the short-term debt. *INV*, *INVRM*, and *INVFG* are the total inventory, raw-material inventory and finished-goods inventory, respectively. All variables are described in Appendix A.

Panel A: Variables Scaled by Average Pre-Crisis Assets

		Unrated Firms		Rated Firms	
Variable	Period	GOV	CORP	GOV	CORP
AR/Pre-Crisis Assets	Pre-Crisis	0.225	0.153	0.178	0.140
	Crisis	0.306	0.178	0.213	0.155
	DIFF	0.081***	0.025***	0.035***	0.015***
	%change	35.96	16.37	19.65	10.73
AP/Pre-Crisis Assets	Pre-Crisis	0.101	0.090	0.072	0.099
	Crisis	0.127	0.101	0.090	0.108
	DIFF	0.026***	0.011***	0.018***	0.010***
	%change	25.74	12.19	24.86	10.15
STdebt/Pre-Crisis Assets	Pre-Crisis	0.052	0.047	0.025	0.034
	Crisis	0.066	0.066	0.029	0.048
	DIFF	0.014***	0.019***	0.004	0.014***
	%change	27.37	40.52	15.90	40.88
INV/Pre-Crisis Assets	Pre-Crisis	0.148	0.142	0.099	0.119
	Crisis	0.194	0.161	0.130	0.135
	DIFF	0.046***	0.019***	0.031***	0.016***
	%change	31.13	13.37	31.28	13.45
INVRM/Pre-Crisis Assets	Pre-Crisis	0.079	0.067	0.046	0.040
	Crisis	0.108	0.074	0.054	0.043
	DIFF	0.029***	0.007***	0.008**	0.004**
	%change	36.92	10.43	17.28	10.09
INVFG/Pre-Crisis Assets	Pre-Crisis	0.058	0.070	0.028	0.067
	Crisis	0.067	0.082	0.046	0.075
	DIFF	0.008*	0.012***	0.019***	0.008***
	%change	13.79	17.10	68.64	11.97
Cash/Pre-Crisis Assets	Pre-Crisis	0.235	0.290	0.075	0.109
	Crisis	0.302	0.324	0.101	0.116
	DIFF	0.067***	0.034***	0.026***	0.007
	%change	28.53	11.72	34.82	6.30

Panel B: Variables Scaled by Contemporaneous Denominators

		Unrated Firms		Rated Firms	
Variable	Period	GOV	CORP	GOV	CORP
AR/Sales	Pre-Crisis	0.757	0.634	0.654	0.569
	Crisis	0.771	0.634	0.641	0.549
	DIFF	0.013	0.000	-0.013	-0.021**
	%change	1.76	0.00	-1.99	-3.69
AP/COGS	Pre-Crisis	0.566	0.837	0.387	0.783
	Crisis	0.664	0.790	0.379	0.690
	DIFF	0.098***	-0.047**	-0.008	-0.093***
	%change	17.32	-5.62	-2.07	-11.88
STdebt/Sales	Pre-Crisis	0.287	0.254	0.105	0.164
	Crisis	0.335	0.442	0.095	0.229
	DIFF	0.048	0.188***	-0.010	0.065***
	%change	16.76	74.08	-9.31	39.70
INV/COGS	Pre-Crisis	0.997	1.023	0.538	0.848
	Crisis	1.112	1.052	0.567	0.835
	DIFF	0.115**	0.029	0.029	-0.014
	%change	11.54	2.83	5.39	-1.61
INVRM/COGS	Pre-Crisis	0.522	0.483	0.268	0.277
	Crisis	0.617	0.502	0.263	0.258
	DIFF	0.095***	0.019	-0.006	-0.019
	%change	18.20	3.93	-2.24	-6.86
INVFG/COGS	Pre-Crisis	0.384	0.484	0.167	0.483
	Crisis	0.448	0.534	0.203	0.496
	DIFF	0.064*	0.050***	0.036**	0.013
	%change	16.66	10.32	21.51	2.80
Cash/Assets	Pre-Crisis	0.233	0.289	0.076	0.110
	Crisis	0.219	0.264	0.083	0.101
	DIFF	-0.014	-0.024***	0.007	-0.008*
	%change	-6.01	-8.31	9.74	-7.30

Table 6
Regression Results on Short-term Financing

This table estimates the following specification for unrated firms:

$$y_{it} = \alpha + \beta_1 Crisis_t + \beta_2 GOV_i + \beta_3 Crisis_t \cdot GOV_i + \mathbf{X}'\theta + \varepsilon_{\mathbf{it}},$$

where the dependent variables are various measures of short-term financing variables including accounts receivable scaled by sales ($AP/Sales$) in column (1), accounts payable scaled by cost of goods sold ($AP/COGS$) in column (2), short-term debt scaled by sales ($STdebt/Sales$) in column (3), and cash scaled by assets ($Cash/Assets$) in column (4). *CRISIS* is an indicator variable that takes on unity during the crisis period of 2007Q3 to 2009Q2, and zero during the pre-crisis period of 2005Q3 to 2007Q2. *GOV* is an indicator variable that takes on unity if the sample firm is classified as a government supplier, and zero if classified as a corporate supplier. The sample firms are classified as government suppliers or corporate suppliers, and as rated or unrated according to their status in 2006. All regressions include industry fixed effects. Standard errors, clustered at the firm-level, are reported in brackets. Results for rated firms and all firms are reported in appendix B. All variables are described in Appendix A. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
Variable	AR/Sales	AP/COGS	STdebt/Sales	Cash/Assets
CRISIS	0.002	-0.049**	0.193***	-0.022***
	[0.009]	[0.024]	[0.035]	[0.005]
GOV	0.133***	-0.123**	0.136**	-0.045**
	[0.031]	[0.056]	[0.060]	[0.018]
CRISIS*GOV	0.017	0.147***	-0.141**	0.008
	[0.022]	[0.055]	[0.065]	[0.011]
Constant	0.781***	1.528***	0.962**	0.235***
	[0.182]	[0.467]	[0.475]	[0.071]
Observations	13,385	14,011	13,654	14,011
R-squared	0.115	0.108	0.041	0.282

Table 7
Inventory Breakdown

This table regresses various measures of inventory for unrated firms. Dependent variables are raw-material inventory scaled by cost of goods sold ($INVRM/COGS$), finished-goods inventory scaled by costs of goods sold ($INVFG/COGS$), accounts payable scaled by raw-material inventory ($AP/COGS$) and scaled by finished-goods inventory ($AP/INVFG$), respectively, and short-term debt scaled by raw-material inventory ($STdebt/INVRM$) and scaled by finished-goods inventory ($STdebt/INVFG$), respectively. *CRISIS* is an indicator variable that takes on unity during the crisis period of 2007Q3 to 2009Q2, and zero during the pre-crisis period of 2005Q3 to 2007Q2. *GOV* is an indicator variable that takes on unity if the sample firm is classified as a government supplier, and zero if classified as a corporate supplier. All regressions include industry fixed effects. Standard errors, clustered at the firm-level, are reported in brackets. All variables are described in Appendix A. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	INVRM/COGS	INVFG/COGS	AP/INVRM	AP/INVFG	Stdebt/INVRM	STdebt/INVFG
CRISIS	0.021	0.053***	1.706**	0.596	1.844***	0.134
	[0.017]	[0.017]	[0.855]	[0.412]	[0.529]	[0.232]
GOV	0.071	-0.063	-1.188	2.913**	0.792	2.401***
	[0.049]	[0.052]	[1.405]	[1.299]	[0.723]	[0.888]
CRISIS*GOV	0.075*	0.014	-0.720	2.988	-2.411***	-0.348
	[0.039]	[0.049]	[1.145]	[1.820]	[0.768]	[0.936]
Constant	0.292	0.480**	8.763*	18.998	0.234	11.712
	[0.262]	[0.203]	[4.899]	[21.467]	[0.755]	[13.283]
Observations	6,877	7,045	6,877	7,045	6,729	6,900
R-squared	0.154	0.075	0.111	0.060	0.067	0.081

Table 8
Firm Investment and Leverage

This table examines investment and changes in leverage of unrated firms during the crisis. The first two columns regress investment measures, $PPE/Sales$ and $Capex/lagPPE$. The last two columns regress $\Delta LTdebt/lagAssets$ (long-term debt minus lagged long-term debt, scaled by lagged assets) and $\Delta STdebt/lagAssets$ (short-term debt minus lagged short-term debt, scaled by lagged assets). *CRISIS* is an indicator variable that takes on unity during the crisis period of 2007Q3 to 2009Q2, and zero during the pre-crisis period of 2005Q3 to 2007Q2. *GOV* is an indicator variable that takes on unity if the sample firm is classified as a government supplier, and zero if classified as a corporate supplier. All regressions include industry fixed effects. Standard errors, clustered at the firm-level, are reported in brackets. All variables are described in Appendix A.

	Investment		Changes in Leverage	
Variable	PPE/Sales	Capex/lagPPE	ΔLTdebt/lagAssets	ΔSTdebt/lagAssets
CRISIS	0.234**	-0.024***	-0.006***	0.003***
	[0.104]	[0.003]	[0.001]	[0.001]
GOV	0.205	-0.003	-0.001	0.003**
	[0.314]	[0.007]	[0.002]	[0.001]
CRISIS*GOV	-0.303	0.013**	0.001	-0.002
	[0.280]	[0.007]	[0.002]	[0.002]
Constant	1.296	0.113***	0.003	0.001
	[0.809]	[0.032]	[0.005]	[0.006]
Observations	13,934	13,308	13,533	13,384
R-squared	0.290	0.041	0.009	0.003

Table 9
Subsample Analysis on Accounts Payable

This table presents various subsample regression results for unrated firms. The dependent variables are $AP/COGS$ in Panel A and $AP/INVRM$ in Panel B. In the first two columns, we sort unrated firms into two groups based on their sales-based reliance ($CUSTREL$) on their largest customers as of fiscal year 2006. In the last two columns, unrated firms are sorted according to $INVRM/COGS$, where $INVRM/COGS$ is the raw-material inventory scaled by cost of goods sold. *CRISIS* is an indicator variable that takes on unity during the crisis period of 2007Q3 to 2009Q2, and zero during the pre-crisis period of 2005Q3 to 2007Q2. *GOV* is an indicator variable that takes on unity if the sample firm is classified as a government supplier, and zero if classified as a corporate supplier. All regressions include industry fixed effects. Standard errors, clustered at the firm-level, are reported in brackets. All variables are described in Appendix A.

Panel A: $AP/COGS$ as Dependent Variable

	CUSTREL		INVRM/COGS	
Variable	> median	< median	> median	< median
CRISIS	-0.071*	-0.022	-0.022	0.027
	[0.043]	[0.027]	[0.039]	[0.027]
GOV	-0.116	-0.209***	-0.049	-0.032
	[0.086]	[0.067]	[0.079]	[0.064]
CRISIS*GOV	0.193**	0.094*	0.186**	0.054
	[0.079]	[0.051]	[0.088]	[0.093]
Constant	1.711***	1.063**	0.975***	0.648***
	[0.600]	[0.485]	[0.096]	[0.090]
Observations	7,018	6,993	3,438	3,439
R-squared	0.155	0.092	0.119	0.065

Panel B: $AP/INVRM$ as Dependent Variable

	CUSTREL		INVRM/COGS	
Variable	> median	< median	> median	< median
CRISIS	3.763**	0.069	-0.032	3.505**
	[1.813]	[0.665]	[0.062]	[1.665]
GOV	-0.759	-3.232***	-0.046	-0.634
	[2.301]	[0.957]	[0.133]	[2.798]
CRISIS*GOV	-2.436	0.34	0.051	-0.804
	[2.099]	[0.761]	[0.114]	[2.640]
Constant	8.158	2.883***	1.255***	11.492***
	[5.246]	[0.000]	[0.137]	[4.129]
Observations	3,163	3,714	3,438	3,439
R-squared	0.166	0.158	0.092	0.121

Table 10
Changes in Market Shares

This table reports regression results on the market shares of unrated firms. The first column utilizes *MSCRISIS*, the logarithm of the ratio of the average quarterly market share during the crisis (2007Q3–2009Q2) to average quarterly pre-crisis (2005Q2–2007Q2) market share, where market share is computed as the fraction of the industry sales attributed to the firm. The second column compares market share at the end of pre-crisis and market share at the end of crisis by using *MSCRISIS*2, the logarithm of the ratio of market share in 2009Q2 to market share in 2007Q2. *GOV* is an indicator variable that takes on unity if the sample firm is classified as a government supplier, and zero if classified as a corporate supplier. Robust standard errors are reported in brackets. All variables are described in Appendix A.

	Dependent Variable	
Variable	MSCRISIS	MSCRISIS2
GOV	0.115**	0.162***
	[0.046]	[0.054]
Constant	0.031	-0.000
	[0.020]	[0.027]
Observations	776	739
R-squared	0.009	0.011

Table 11
Post-Crisis Acquisition Activities

This table reports regression results on post-crisis acquisition activities for unrated firms. The dependent variable is the value of post-crisis acquisitions scaled by the firm's pre-crisis assets (*AQCV*), where post-crisis is defined as the period from 2009Q3 to 2011Q2. *MSCRISIS* is computed as the logarithm of the ratio of the average quarterly market share during the crisis (2007Q3–2009Q2) to average quarterly pre-crisis (2005Q2–2007Q2) market share, where market share is computed as the fraction of the industry sales attributed to the firm. *GOV* is an indicator variable that takes on unity if the sample firm is classified as a government supplier, and zero if classified as a corporate supplier. Robust standard errors are reported in brackets. All variables are described in Appendix A.

Variable	(1)	(2)	(3)	(4)
MSCRISIS	0.058***	0.047***		
	[0.013]	[0.013]		
GOV			0.035**	0.041**
			[0.017]	[0.018]
M/B		0.001		0.003
		[0.003]		[0.003]
OCF/Assets		0.384***		0.473***
		[0.072]		[0.073]
Constant	0.071***	0.069***	0.066***	0.060***
	[0.006]	[0.008]	[0.007]	[0.008]
Observations	758	734	758	734
R-squared	0.026	0.047	0.007	0.039

Table 12
Pre-Crisis Liquidity

This table regresses various measures of accounts payable and inventory for unrated firms. Dependent variables are (1) accounts payable scaled by cost of goods sold, (2) raw-material inventory scaled by cost of goods sold, (3) finished-goods inventory scaled by costs of goods sold, (4) accounts payable scaled by raw-material inventory, (5) accounts payable scaled by finished-goods inventory, (6) short-term debt scaled by raw-material inventory, (7) short-term debt scaled by finished-goods inventory. *CRISIS* is an indicator variable that takes on unity during the crisis period of 2007Q3 to 2009Q2, and zero during the pre-crisis period of 2005Q3 to 2007Q2. *LIQ* is pre-crisis liquidity reserves measured by 2006 Q2 cash and marketable securities scaled by assets. All regressions include industry fixed effects. Standard errors, clustered at the firm-level, are reported in brackets. All variables are described in Appendix A. *, **, and *** represent statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variable	AP/COGS	INVRM/COGS	INVFG/COGS	AP/INVRM	AP/INVFG	Stdebt/INVRM	STdebt/INVFG
CRISIS	-0.013	0.057***	0.042*	2.410*	0.664	1.737**	-0.338
	[0.033]	[0.022]	[0.025]	[1.246]	[0.801]	[0.746]	[0.360]
LIQ	0.303	-0.075	0.033	6.620**	-1.085	-1.624	-4.475***
	[0.187]	[0.109]	[0.100]	[2.758]	[1.642]	[1.259]	[1.133]
CRISIS*LIQ	0.039	-0.060	0.023	-2.843	1.545	-1.239	1.337
	[0.114]	[0.082]	[0.087]	[2.964]	[2.990]	[1.901]	[0.920]
Constant	0.687***	0.511***	0.461***	3.088***	4.252***	2.359***	3.240***
	[0.049]	[0.031]	[0.032]	[0.810]	[0.578]	[0.398]	[0.474]
Observations	13,102	6,601	6,733	6,601	6,733	6,453	6,588
R-squared	0.125	0.159	0.076	0.112	0.054	0.067	0.091

Table 13
Placebo Crisis

This table repeats the regressions in table 4 for various pseudo crisis periods and report the coefficient of the interaction term, $CRISIS * GOV$. Specification (A) considers a pseudo crisis period of 2003Q3–2005Q2 and a pseudo pre-crisis period of 2001Q3–2003Q2. Specification (B) considers a pseudo crisis period of 2004Q3–2006Q2 and a pseudo pre-crisis period of 2002Q3–2004Q2. Specification (C) treats 2005Q3–2007Q2 as a crisis period and 2003Q3–2005Q2 as a pre-crisis period. The dependent variables are accounts receivable scaled by sales ($AP/Sales$) in column (1), accounts payable scaled by cost of goods sold ($AP/COGS$) in column (2), short-term debt scaled by sales ($STdebt/Sales$) in column (3), and cash scaled by assets ($Cash/Assets$) in column (4). *CRISIS* is an indicator variable that takes on unity during the pseudo crisis period, and zero during the pseudo pre-crisis period. *GOV* is an indicator variable that takes on unity if the sample firm is classified as a government supplier, and zero if classified as a corporate supplier. All regressions include industry fixed effects standard errors are clustered at the firm-level. All variables are described in Appendix A.

Coefficients of CRISIS*GOV				
	(1)	(2)	(3)	(4)
Specification	AR/Sales	AP/COGS	STdebt/Sales	Cash/Assets
A. Pseudo-crisis: 2003Q3–2005Q2				
	-0.691	-0.090	0.337	-0.008
	[0.587]	[0.385]	[0.607]	[0.011]
B. Pseudo-crisis: 2004Q3–2006Q2				
	-0.247	-0.628	-1.013	0.003
	[0.357]	[0.717]	[0.841]	[0.011]
C. Pseudo-crisis: 2005Q3–2007Q2				
	1.295	-0.352	1.059	0.003
	[1.197]	[0.928]	[1.001]	[0.010]

Table 14
Additional Robustness Checks

This table repeats the regressions in table 4 for three different specifications and report the coefficient of the interaction term. Specification (A) considers a sample where a principal customer is defined as a customer contributing at least 20% of the sample firm's sales. Specification (B) includes quarter fixed effects. Specification (C) clusters standard errors simultaneously at the firm and time (quarterly frequency) level. Dependent variables are accounts receivable scaled by sales ($AP/Sales$) in column (1), accounts payable scaled by cost of goods sold ($AP/COGS$) in column (2), short-term debt scaled by sales ($STdebt/Sales$) in column (3), and cash scaled by assets ($Cash/Assets$) in column (4). *CRISIS* is an indicator variable that takes on unity during the crisis period of 2007Q3 to 2009Q2, and zero during the pre-crisis period of 2005Q3 to 2007Q2. *GOV* is an indicator variable that takes on unity if the sample firm is classified as a government supplier, and zero if classified as a corporate supplier. All regressions include industry fixed effects standard errors are clustered at the firm-level unless specified otherwise. All variables are described in Appendix A.

Coefficients of CRISIS*GOV				
	(1)	(2)	(3)	(4)
Specification	AR/Sales	AP/COGS	STdebt/Sales	Cash/Assets
A. 20% cutoff sample				
	0.024	0.203**	-0.297**	0.006
	[0.029]	[0.083]	[0.120]	[0.013]
B. Quarter dummy variables included				
	0.017	0.147***	-0.140**	0.008
	[0.022]	[0.055]	[0.065]	[0.011]
C. St. errors clustered simultaneously at firm and time				
	0.017	0.147***	-0.141**	0.008
	[0.015]	[0.046]	[0.055]	[0.007]

Figure 1. Impulse Responses for Panel VAR

The figure plots impulse responses for one-lag panel VAR of $ln(INVRM)$, $ln(INVFG)$, $ln(AP)$, and $ln(STdebt)$. Horizontal axis shows 10-year response interval.

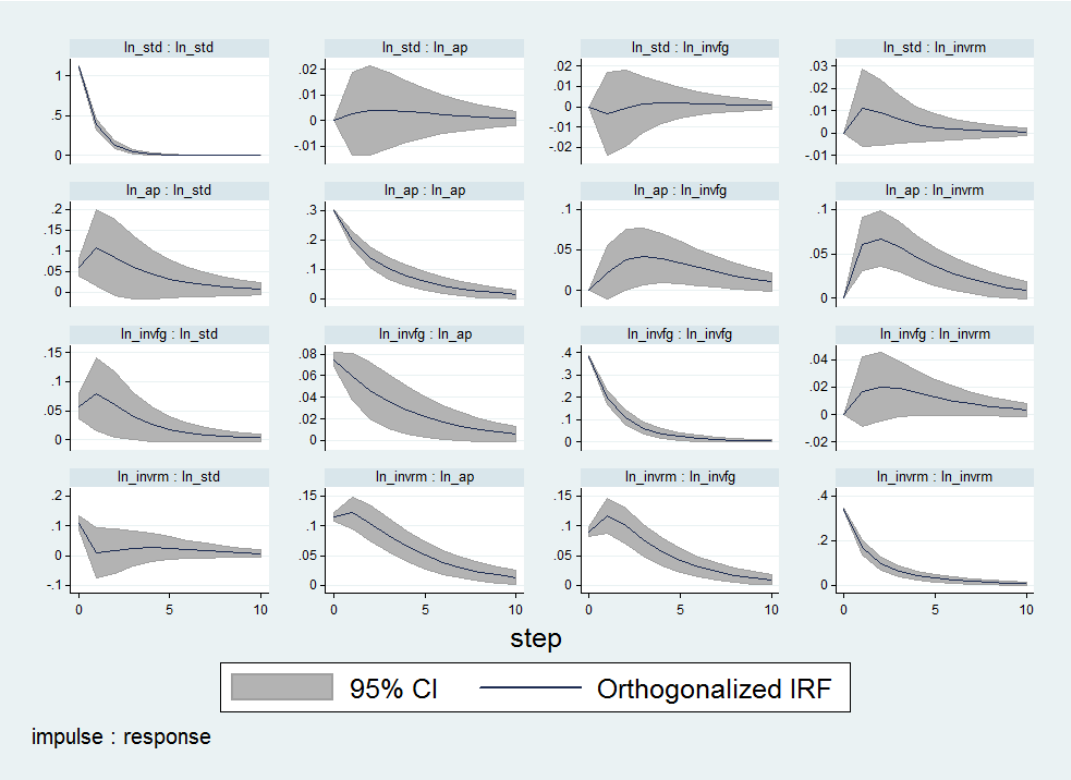

Figure 2. Crisis Statistics

This figure plots daily values of the TED spread (left) and quarterly values of real GDP (right). The TED Spread (percent) is calculated as the spread between 3-Month LIBOR based on US dollars and 3-Month Treasury Bill. Real GDP ($ trillions) is a seasonally adjusted annual rate. Source: Federal Reserve Bank of St. Louis.

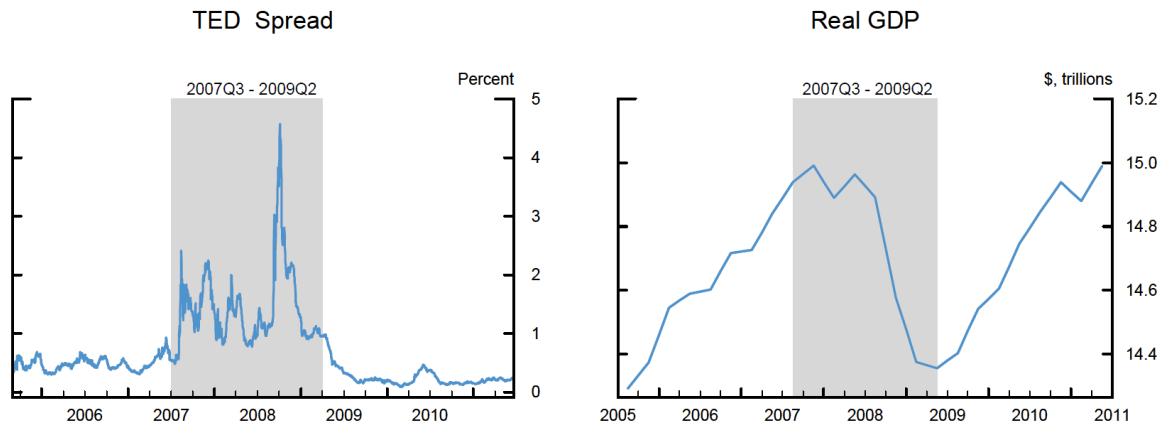

Figure 3. Government Expenditure/GDP

This figure plots the ratio of total government expenditure to nominal GDP. Both total government expenditure and GDP are seasonally adjusted quarterly values. Source: Bureau of Economic Analysis.

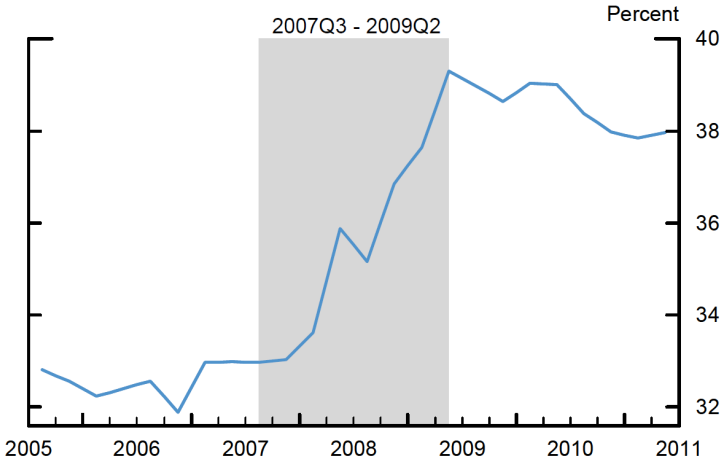

Figure 4. Sample Firm Characteristics

The figure plots average quarterly values of various firm characteristics of unrated firms. ROA and OCF are scaled by pre-crisis assets. All variables are described in Appendix A.

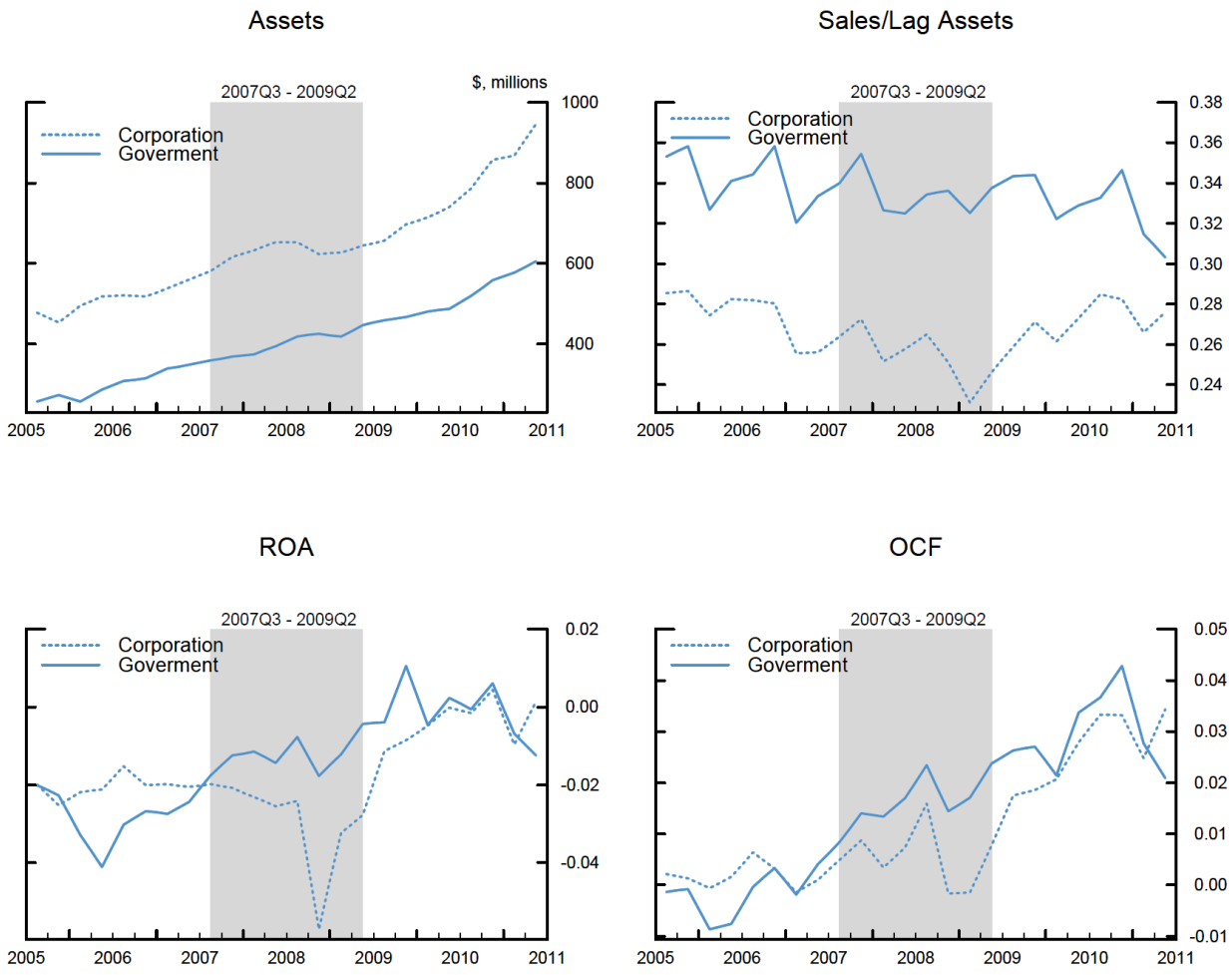

Figure 5. Investment Constraints

This figure plots average quarterly values of delaycon for unrated firms and rated firms, respectively, where delaycon is an index of investment delay constraints, derived from Hoberg and Maksimovic (2015).

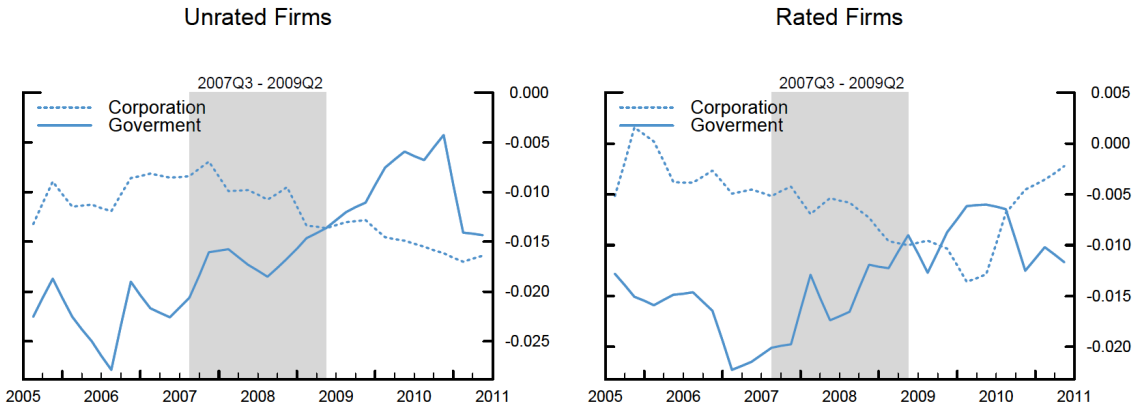

Figure 6. Market Share and Acquisition Activities

This figure plots the quarterly values of unrated firms' average market share (left) and average acquisition value scaled by average pre-crisis assets (right), where pre-crisis assets are quarterly asset values averaged over the pre-crisis period.