Access to capital, investment, and the financial crisis

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Abstract

During the financial crisis, corporate borrowing and capital expenditures fall sharply. Most existing research links the two phenomena by arguing that a shock to bank lending (or more generally to the corporate credit supply) caused a reduction in capital expenditures. The economic significance of this causal link is tenuous, as we find that (1) bank-dependent firms do not decrease capital expenditures more than matching firms in the first year of the crisis or in the two quarters after Lehman's bankruptcy; (2) firms that are unlevered before the crisis decrease capital expenditures during the crisis as much as matching firms and, proportionately, more than highly levered firms; (3) the decrease in net debt issuance for bank-dependent firms is not greater than for matching firms; (4) the average cumulative decrease in net equity issuance is more than twice the average decrease in net debt issuance from the start of the crisis through March 2009; and (5) bank-dependent firms hoard cash during the crisis compared to unlevered firms.

Theories of impaired access to capital dominate explanations of how losses on subprime mortgages led to the worst recession since the Great Depression and provided the foundation for a wide range of policy measures during the crisis, including the Troubled Asset Relief Program implemented in 2008. The most prominent is the bank lending supply shock theory, which holds that bank losses from "toxic" assets reduced the supply of loans to non-financial firms (see, for instance, Brunnermeier (2009) and Shleifer and Vishny (2010)). With a bank lending supply shock, we expect that capital expenditures and net debt issuance should fall more for bank-dependent firms. A broader theory is that the crisis led to a shock to the supply of credit generally (Gorton (2010)). This theory has similar predictions, but for credit-dependent firms instead of bank-dependent firms only. While much attention has been devoted to these theories of impaired access to capital, a demand shock can explain both a decrease in capital expenditures and a decrease in debt issuance, but without a causal link between the two. This demand shock theory states that a shock to demand, due to the loss of housing wealth, a decrease in consumer credit, and the panic following Lehman's failure, among other reasons, led to a decrease both in firms' desired investment and in their demand for funding to finance investment. Finally, the collateral channel or balance sheet multiplier effect of the corporate finance literature (see Brunnermeier and Oehmke (2012) for a review) predicts that the shock to firms' net worth that took place during the crisis reduced capital expenditures and borrowing for levered firms because they have less collateral against which to borrow. Everything else equal, this effect is stronger for more highly levered firms.

In this paper, we use cross-sectional variation in changes in firm investment and financing policies during the crisis to investigate whether these changes are consistent with the view that a bank-lending shock or a credit supply shock, as opposed to a demand shock, is a first-order determinant of these policies, and whether the balance sheet multiplier made the impact of the crisis worse on levered firms. We consistently find that the data are not supportive of the view that a bank-lending or credit supply shock play a major role in decreasing firms' capital expenditures in the year before the fall of Lehman (i.e., the last two quarters of 2007 and the first two quarters of 2008). Further, our evidence is not

consistent with an economically large balance sheet multiplier effect. More generally, we show that the capital expenditures of firms evolve in strikingly similar ways during the crisis irrespective of how they finance themselves before the crisis. Theories of the crisis that emphasize pervasive effects across firms irrespective of their leverage are more consistent with our evidence. A common shock to the demand for firms' products and an increase in uncertainty about future demand could lead to a pervasive decrease in capital expenditures that would not depend on the financial characteristics of firms; this is what we find.

As we discuss more extensively in the next section, if the bank lending shock is a first-order determinant of firm investment and financing policies during the crisis, we would expect bank-dependent firms to experience a greater decrease in capital expenditures than other firms early in the crisis. Further, these firms should see their borrowing fall early in the crisis, and should mitigate the impact of the bank-lending shock by issuing more equity and/or using their cash holdings to compensate for the missing bank loans. To investigate these predictions, we need to identify bank-dependent firms. Our main group of bank-dependent firms, which we call the bank relationship firms, is a group of firms that borrow twice from the same lead bank in the five years ending in June 2006. We have two additional groups of bank-dependent firms, namely highly levered firms that have bank loans at the end of both 2005 and 2006, and small firms with no credit rating that have bank loans at the end of those same years. The credit supply shock theory implies that firms that rely on credit should be more affected. We use firms that are highly levered before the crisis to test this idea. Both theories of impaired access to capital predict that the firms that do not rely on credit before the crisis should be impacted less by the crisis than those that rely on credit. We use firms that consistently have no leverage in the twelve quarters ending in June 2006, as well as first that have consistent high cash holdings over these quarters, to proxy for firms that are not dependent on credit before the crisis.

The literature uses two different approaches to investigate the evolution of capital expenditures during the crisis. Almeida et al. (2012) use a matching approach to compare the evolution of capital expenditures of treated firms relative to their control group during the crisis. Duchin, Ozbas, and Sensoy (2010) estimate regressions in which they assess the impact of the crisis on a specific group of firms by

interacting an indicator variable for these firms with an indicator variable for the crisis. Using both approaches, we show that, during the first year of the crisis, neither net debt issuance nor capital expenditures fall more for firms that are dependent on bank finance or credit before the crisis than for matching firms. Bank-dependent firms experience a decrease in their net equity issuance during the first year of the crisis, which is inconsistent with them using equity issuance to offset a bank lending shock. There is no evidence that highly levered firms experience a decrease in capital expenditures during the first year of the crisis. In sum, the evidence during the first year of the crisis is not supportive of the impaired access to capital theories. The evidence on the capital expenditures of highly levered firms is also inconsistent with the balance sheet multiplier having a strong impact in the first year of the crisis.

The two quarters after the bankruptcy of Lehman are sharply different from the first year of the crisis and offer another opportunity to test the implications of the theories of impaired access to capital. We consider these two quarters separately because they correspond to a period of widespread panic and represent the peak of the crisis. We refer to them as the post-Lehman period. They are characterized by an extraordinary decrease in net debt issuance as well as by a large decrease in capital expenditures.

Whether looking at raw statistics, matching estimators, or regressions, the decreases in capital expenditures of firms that do not rely on leverage before the crisis and firms that do so heavily are remarkably similar after the bankruptcy of Lehman. Such a result is hard to reconcile with the impaired access to capital theories or with a strong balance sheet multiplier effect, but it suggests that firms were affected by a common shock that equally impacted both firms that are dependent on credit and firms that are not. The obvious candidate for such a shock is the dramatic decrease in the demand for goods that takes place after the bankruptcy of Lehman. Consumption falls sharply during the last quarter of 2008. Over the period for which monthly data is available from the U.S. Census Bureau (1992), retail sales have their worst percentage drop in October 2008, their second worst drop in December 2008, and their third worst drop in November 2008. We would expect the investment capability of firms that are unlevered before the crisis to be unaffected by impaired access to bank loans, or credit more generally. Yet, we find that firms that are consistently unlevered before the crisis do not experience a smaller drop in capital

expenditures over the crisis than matching firms. Further, when we compare the unlevered firms to the bank relationship firms, we find that the unlevered firms experience a percentage decrease in capital expenditures over the post-Lehman period that is one third higher than the percentage decrease in capital expenditures of bank relationship firms (39% versus 29%). A similar result holds for the high cash firms. Such a result cannot be explained by the impaired supply of capital theories and is hard to reconcile with the balance sheet channel as well.

The last period for which we evaluate the theories discussed at the beginning of this introduction is the year that starts in April 2009, which we refer to as the final year of the crisis. By this time, markets are beginning to recover in the sense that the stock market is rebounding from its lowest level and credit spreads are declining from their peak. The panic has subsided, the end of the recession is one quarter away, and stock prices in the financial sector are increasing, having reached their lowest point in March 2009. Despite this positive evolution, capital expenditures fall across all groups of firms in the final year of the crisis. Highly levered, bank-dependent firms and to a lesser extent bank relationship firms, but not small, bank-dependent firms, experience a worse decrease in capital expenditures in the last year of the crisis than their matching firms. In spite of this decrease, the level of investment at bank relationship firms, highly levered firms, and highly levered, bank-dependent firms is higher in the last year of the crisis than any other type of firms. Based on this evidence, one might argue that the bank lending shock eventually had an impact, even though it is not the impact upon which policy makers and the literature have focused. However, the lower capital expenditures of bank-dependent firms occur at a time when their net debt issuance is not significantly different from the net debt issuance of matching firms. In other words, a key piece of evidence is missing for the bank lending supply shock theory, namely, evidence that bank-dependent firms suffer from a greater decrease in net debt issuance than other firms. Further, we find that bank-dependent firms increase their cash holdings sharply during the last year of the crisis, so that, had they not invested in cash, they could have funded the capital expenditures they did not make.

Our paper proceeds as follows. In Section 1, we examine the various theories discussed in this introduction in greater detail, draw out their predictions, and examine what we learn from the existing

literature about these predictions. Section 2 shows that capital expenditures do not fall more severely for bank- or credit-dependent firms before April 2009. In Section 3, we demonstrate that net debt issuance does not fall during the first year of the crisis and that it does not fall more for bank-dependent firms during the crisis than for otherwise similar firms. Section 4 shows that net equity issuance falls by at least as much as net debt issuance before April 2009. In Section 5, we find that the firms that reduce cash holdings during the first year of the crisis are firms that have a greater decrease in net equity issuance, and that firms whose net equity issuance was low or negative before the crisis hoard cash after September 2008, consistent with a corporate flight to quality. We discuss the interpretation of our results and conclude in Section 6.

Section 1. Theories and their predictions

In this section, we review the theories that we mentioned in the introduction. We then conclude with a brief overview of the existing empirical literature and show that, while informative, it does not directly answer the question we focus on in this paper.

Section 1.A. The bank lending supply shock

In 2007, large banks incurred enormous losses on their portfolios of structured finance securities and mortgages. Since banks are highly levered, they cannot simply let leverage increase as the value of equity falls due to losses; instead, they must either raise more capital or sell assets. The major ways that banks can reduce their assets include selling securities, not renewing loans, and not making new loans. Hence, if banks are forced to acquire securities because of liquidity puts or to reduce the size of their assets to prevent excessive leverage, they may cut back on new lending to corporations. Consequently, banks' losses and/or their need to absorb securities onto their balance sheets may cause a bank credit contraction. Brunnermeier (2009) describes this mechanism in connection with the credit crisis, and Bernanke and Blinder (1988) introduce shocks of this type to the credit supply in a macroeconomic model.

The bank lending supply shock theory has straightforward predictions for firm investment and financing policies. First, it implies that firms in general will find it more difficult to borrow from banks; thus bank borrowing should fall. However, the impact on total borrowing depends on the ability of firms to find substitute other forms of credit. If there are many substitute forms of credit available, the decrease in bank borrowing would be accompanied by an increase in other forms of borrowing and the effect of the bank credit supply shock would be attenuated. The literature concludes, however, that firms that rely on a bank lending relationship for their borrowing find it difficult and expensive to replace that source of borrowing (see, for instance, Slovin, Sushka, and Polonchek (1993)). Consequently, for bank-dependent firms, the inability to raise funds from their relationship bank is especially costly because alternative sources of credit may not have information that assures them of the firms' creditworthiness. We would expect the bank lending supply shock to be especially important for firms that rely on a bank relationship before the crisis. Of course, if a firm was not going to borrow in the first place, the fact that borrowing has become more difficult will not lead it to borrow less and should not have an impact on its capital expenditures. Consequently, we would not expect to see a direct impact of the bank lending supply shock on firms that do not use credit or on firms that have ample cash reserves.

Finally, suppose that the bank lending supply shock is expected to become worse. In that case, bank-dependent firms would expect to face even greater borrowing difficulties in the future. They would be less willing to use their cash holdings now as they would need them more in the future. As a result, firms could accumulate cash in the short run. The other predictions are unchanged, in that we would still expect capital expenditures to fall, net debt issuance to fall, and net equity issuance to increase.

Section 1.B. The credit supply shock

The bank lending supply shock is specific to the banking system. With this shock, firms would use other forms of credit to mitigate the impact of the bank lending supply shock. However, the recent crisis was one where credit in general was affected, not just bank lending. Gorton (2010) shows how investors' discovery that bonds they thought were safe had become risky led to a panic and to upheaval in the capital

markets. The shock he describes led to a flight to quality, which reduced the supply of many forms of credit and made credit more expensive in general. Caballero and Krishnamurthy (2008) model such a flight resulting from Knightian uncertainty generated by crisis. While a flight to quality increases the cost of capital of firms, it can also make it impossible for firms to borrow since credit markets stop functioning normally. In particular, investors might no longer be able to estimate probability distributions for the payoffs from bonds with default risk and might shy away from investing in them, so that liquidity would disappear and trading would become sparse (Easley and O'Hara (2010)). A flight to quality in bond markets would affect banks loans as it would hinder securitization and trading of loans for banks.

With a credit supply shock, we expect firms that rely on credit to be forced to reduce their capital expenditures. Further, the most highly levered firms should be the ones that experience the largest drop in capital expenditures. In normal times, firms faced with impediments to raising funds might use their cash holdings to replace credit they cannot obtain but, in a crisis, we expect firms to be concerned about uncertainty as well, which might lead them to hoard cash. In normal times, firms would also use equity to partly replace funds they cannot borrow, but the flight to quality might affect equity markets as well and hence hinder equity issuance and make it too costly.

Section 1.C. The demand shock

There are many reasons why the demand for goods would have decreased and why uncertainty about future demand would have increased during the crisis. One of these reasons is that consumer credit experienced a severe contraction. For instance, subprime lending disappeared in 2007 as structured finance issuance collapsed. Another reason is that the main asset of most households is their house, and housing prices were falling. Finally, the post-Lehman panic was associated with a dramatic drop in consumption and a shift towards saving. Not surprisingly, there was a sharp increase in uncertainty as evidenced by the evolution of the VIX and other indices of uncertainty. While some of the increase in the VIX might have reflected panic in the financial sector, some of it surely must have reflected uncertainty about the evolution of the economy as a whole.

A decrease in demand reduces capital expenditures as some growth opportunities are no longer as valuable. As capital expenditures fall, all else equal, firms require less financing, causing debt issuance and equity issuance to also fall. Further, a decline in demand causes the net worth of firms to fall, which worsens the terms on which they can borrow. Finally, a sharp decline in demand can lead firms to make losses, which can again make it harder for them to access debt markets as they may struggle with covenants for their existing debt.

A sharp increase in uncertainty would also lead to a decrease in capital expenditures as it would make it optimal to postpone exercising real options (Bloom (2009)). In addition, such a sharp increase would lead firms to have a lower optimal level of debt and higher cash holdings. All else equal, we would therefore expect firms to have lower debt issuance and to increase their cash holdings.

Section 1.D. The balance sheet multiplier effect

There is a vast literature in finance that explores the implications for financing and investment policies of decreases in the net worth of firms (see Brunnermeier and Oehmke (2012) for a recent review of that literature). When asset values fall, firms have lower net worth and less collateral, making it difficult for them to borrow as much as they previously had (Kiyotaki and Moore (1997)). At the same time, firm leverage increases, aggravating agency problems between creditors and shareholders (Jensen and Meckling (1976) and Holmstrom and Tirole (1997)). For firms with more risky debt, the increase in leverage leads to a debt overhang, which makes equity issuance unattractive for shareholders (Myers (1977)). Consequently, a decrease in net worth as well as a decrease in the value of assets that can be used as collateral can lead to a decrease in debt financing, a decrease in equity financing, and a decrease in capital expenditures as valuable projects are not financed. Some of these effects occur only for levered firms. For instance, the underinvestment problem does not arise for firms with low or no leverage. Other effects arise only for firms with no debt for whom debt issuance is normally the marginal funding source. In particular, an increase in uncertainty may lead to higher information asymmetries, which makes it harder for firms to obtain outside financing. However, overall, we would expect the balance sheet effects

to be small for firms that have considerable debt capacity. There is generally a presumption that firms with no debt have at least some borrowing capacity.

Section 1.E. Evidence from the existing literature

A large and growing literature examines firm investment and financing policies during the crisis. We provide a brief, necessarily incomplete, review of this literature and show that it does not answer the questions we focus on in this paper. We are not aware of papers that investigate directly the balance sheet multiplier effect in the context of the crisis, so there is no review of that literature in this section.

a. Bank lending supply shock

One highly influential paper on bank finance during the crisis is Ivashina and Scharfstein (2010). The paper has three important results. First, it shows that syndicated lending, as measured by agreements reported to Dealscan, started to fall in mid-2007 and dropped dramatically in the last quarter of 2008. Second, the paper shows that firms drew down lines of credit. Third, the authors find that lending fell less for banks that were less affected by the run on short-run lending to banks. Another much discussed paper is Chari, Christiano, and Kehoe (2008). Their paper provides data showing that, as of October 2008, the crisis was not associated with a decline in bank lending. The two papers can be partly reconciled by the fact that Ivashina and Scharfstein focus on lending agreements. A decrease in lending agreements can show up in less lending in the future, as a lending agreement does not necessarily imply that corporations will use the whole lending facility immediately. A third paper on bank lending is the paper by Santos (2011). He finds an increase in borrowing costs at banks and shows that the increase was higher at banks that suffered from larger losses.

Assuming that the bank lending literature tells us that there was an exogenous shock to bank lending, that literature does not tell us how important that shock was for firms. One view is that a firm not receiving a bank loan has no other way to obtain financing, so that not having the bank loan translates directly into a reduction in capital expenditures. Another view is that a firm has alternative ways of

coping with not receiving a bank loan. For instance, the firm can seek funding from a less affected bank, from a non-bank credit source, from the equity market, from suppliers, and so on. Becker and Ivashina (2012) find evidence of substitution from bank loans to bond markets for firms that have access to both sources of finance. Leary (2009) provides evidence of substitution towards the equity market during episodes of bank lending contraction. Iyer, Lopes, Peydró and Schoar (2010) show substitution away from bank lending during the recent crisis for firms in Portugal. Hence, if the reduction in bank lending is the result of an exogenous shock, the economic importance of its impact can only be evaluated through an analysis of firm investment and financing policies.

Another important contribution of the literature is showing that firms drew down their lines of credit in response to the turmoil (e.g. Ivashina and Scharfstein (2010) and Campello, Giambona, Graham and Harvey (2011)). This evidence adds to the literature on the importance of lines of credit. However, a firm that draws down its line of credit does not have less funding than it did before it drew it down. Further, a firm may have drawn down its line of credit simply because it was the cheapest source of finance, as the loan margins of past agreements may not have reflected the changing circumstances of the firm in particular or the dramatic increase in credit spreads that took place in general.

b. Credit supply shock

Several papers provide evidence that is consistent with the impact of a credit supply shock in general, but do not use an experimental design that makes it possible to assess whether the credit supply shock is due to a bank lending supply shock or a more general credit supply shock.

Almeida et al. (2012) demonstrate that firms which had a substantial proportion of their long-term debt maturing immediately after the third quarter of 2007 reduced investment in comparison to other firms over the first three quarters of 2008. Their core results are based on a sample of 86 firms. They show convincingly that firms with debt maturing during a crisis invest differently. However, their evidence does not tell us whether these firms did not renew loans because banks were unable to renew loans or because the firms' prospects had worsened and consequently the terms at which they could

borrow had become so expensive as to deter borrowing. In the former case, the evidence would be supportive of a bank lending supply shock, while in the latter case it would not. Since the matching firms did not experience a comparable decrease in capital expenditures, there must be reasons why fundamental changes affect firms differently depending on whether their debt is maturing or not. However, firms that don't need to renew debt have more flexibility to reduce capital expenditures to conform to changes in the markets and/or in their circumstances (see Denis (2011) for the literature on financial flexibility). They can delay making changes in their investment plans until the economic situation is clearer, as it is expensive to change investment plans.

A number of papers choose to focus on the first year of the crisis because it is more plausible that the shock to credit during that year is not caused by events taking place in the corporate sector. The second paper we focus on is Duchin, Ozbas, and Sensoy (2010), who contrast the investment policies of firms that had high cash holdings before the start of the crisis to other firms during the first year of the crisis. They find that these high cash firms experience less of a decrease in investment during the first year of the crisis but find no difference after the bankruptcy of Lehman. This result suggests that firms that were less dependent on credit were less affected during the first year of the crisis. Hence, while the credit shock might have been a first-order effect during the first year of the crisis, it may not have been later on. However, as they point out, they had only limited data for the period after Lehman when they finished their paper, so their evidence is not final.

Finally, Campello, Graham and Harvey (2010) use survey data in which they ask CFOs of a sample of firms across the world questions about how the crisis affected them. They find that firms report that their plans did change as a result of the crisis and that the changes were more pronounced for firms that were financially constrained. They determine whether a firm is financially constrained by asking CFOs whether their firm was financially constrained during the crisis. Such an approach has costs and advantages. CFOs know the financial situation of their firm but, at the same time, it is hard to evaluate what a CFO's assessment means in the context of the theories discussed in this paper. Suppose that a demand shock leads to a reduction in the net worth of a firm so that credit becomes much more expensive

for that firm. Many CFOs in this situation might conclude that their firm is financially constrained because they find funding too expensive and do not want to raise it under the prevailing conditions. However, with this scenario, the lack of funding is not caused by a credit supply shock.

c. Demand shock

A decrease in demand for credit, all else equal, would lead to a decrease in the price of credit. One might then be tempted to argue that the evidence can only be consistent with a supply shock since the price of credit increased. It is important to note that while credit spreads increased after June 2007, the levels of spreads and yields throughout the first year of the crisis were not so high that they would correspond to an unusual credit crisis. For instance, high yield rates and spreads were lower before the bankruptcy of Lehman than they were in 2002, a year that is not typically associated with a credit crisis. Spreads increase dramatically after Lehman, but then there was also a huge demand shock and a huge increase in uncertainty. A large decrease in demand as well as a large increase in uncertainty necessarily increase credit spreads sharply even if the supply of credit is unchanged. Consequently, increases in credit spreads are not prima facie evidence of a credit supply shock being the dominant factor explaining a decrease in borrowing. Existing evidence using micro-level identification shows that both the consumption collapse and the increase in unemployment can be traced to the accumulation of debt by households before the crisis and to the shock to their housing wealth during the crisis (see Mian, Rao, and Sufi (2011) and Mian and Sufi (2011)).

Section 2. The data

Most empirical work in corporate finance uses annual data. For our purpose, annual data is unsuitable since it would force us to ignore how corporate financial policies evolve during the three phases of the crisis. The first phase is the first year of the crisis following the top of the credit boom; we define the top of the credit boom as the second quarter of 2007 as in Ivashina and Scharfstein (2010), so the first year of the crisis encompasses the third quarter of 2007 through the second quarter of 2008. This dating also

corresponds to the year used by Duchin, Ozbas, and Sensoy (2010). We then focus separately on the last quarter of 2008 and first quarter of 2009 (the post-Lehman period) since these quarters follow the bankruptcy of Lehman in September 2008 and correspond to the panic phase of the crisis. Finally, we refer to the year starting immediately after the post-Lehman period as the last year of the crisis. Since our periods are not calendar years but start respectively in July, October, and April, we use quarterly data collected from the CRSP/Compustat Merged (CCM) Fundamentals Quarterly database for 1983-2010. Throughout the paper, unless we say otherwise, we report results quarterly. In other words, when we report results for a specific period, such as the first year of the crisis, we show the average per quarter across the four quarters of the first year of the crisis.

There are distinct problems with the use of quarterly data. First, many of the Compustat data items are only provided annually, so less detailed data is available on a quarterly basis than on a yearly basis. Second, many industries have seasonal factors. There is little we can do to deal with the lack of data availability, but we can address the seasonality issue. One approach to control for seasonality is to compare quarters to identical quarters in other years. Another approach is to estimate models that specifically control for seasonality.

We examine multiple financial policies, including capital expenditures, net debt issuance, net equity issuance, and cash holdings. Investment is defined as capital expenditures (*capxy*) divided by lagged assets.[1] Net debt issuance is calculated from balance sheet data and includes changes in both long-term debt (*dlttq*) and debt in current liabilities (*dlcq*) during the quarter. Net equity issuance is defined as aggregate equity issuance (*sstky*) minus aggregate equity repurchase (*prstkcy*) divided by lagged assets. The capital structure literature often uses other measures, such as changes in debt or equity above a threshold (see, for instance, Leary and Roberts (2005)) or only public issues (e.g., DeAngelo, DeAngelo, and Stulz (2010); Erel, Julio, Kim, and Weisbach (2010)). In this paper, we focus on the funding obtained by corporations from all sources, not just banks or public markets, since substitution across funding

[1] Many of the quarterly Compustat variables, including *dltisy*, *dltry*, and *capxy*, are reported on a year-to-date basis. For these variables, in the second, third, and fourth quarter of each fiscal year, the quarterly value is calculated by subtracting the lagged value from the current value.

sources could help firms offset the impact of a bank credit contraction. We also want to understand the magnitude of financing flows in comparison to more normal times, so that net issuance close to zero is of interest to us. Cash is cash and marketable securities (*cheq*) divided by assets.

The quarterly data is available beginning in the third quarter of 1983. Most of our investigation uses data until the end of the first quarter of 2010, but in some case we will discuss subsequent data. We delete observations with negative total assets (*atq*), negative sales (*saleq*), negative cash and marketable securities, cash and marketable securities greater than total assets, and firms not incorporated in the U.S. If a firm changes its fiscal-year end, and thus a given data quarter is reported twice in Compustat (for both the old fiscal quarter and the new fiscal quarter) we retain the observation for the new fiscal quarter only. Finally, we eliminate all financial firms (firms with SIC codes between 6000 and 6999) and utilities (firms with SIC codes between 4900 and 4949).

Section 3. Capital expenditures and the financial crisis

In this section, we examine the extent to which the evidence for capital expenditures is consistent with the theories discussed in Section 1. The bank supply shock theory implies that bank-dependent firms should experience a greater decrease in capital expenditures. The credit supply shock theory predicts that credit-dependent firms should have a greater decrease in capital expenditures. With either theory, we would expect a smaller decrease in capital expenditures for firms that are not bank dependent or credit dependent. The demand shock theory implies that all firms are affected and there is no a priori reason why firms that are bank dependent or credit dependent should be affected differentially. Finally, the balance sheet multiplier theory implies that, everything else equal, more highly levered firms should experience a greater decrease in capital expenditures. Note, however, that these theories cannot be distinguished by investigating whether some firms decrease capital expenditures and others do not. With these theories, capital expenditures should eventually decrease for all firms through propagation of the initial shock even if that initial shock does not affect all firms directly. These theories, however, imply that some firms are more affected than others because of their source of funding or their leverage.

To investigate the theories, we construct subsamples of firms that are expected to be informative. Like Duchin, Ozbas, and Sensoy (2010), we want the classification of firms to be determined before the crisis and choose the end of the second quarter of 2006 as the relevant date for our determination. We construct three samples of bank-dependent firms. The first sample focuses on firms with bank relationships. We include all firms that have two or more loan facilities with the same U.S. lead bank in the five years before the end of the second quarter of 2006, according to Dealscan. We view these firms as relying on a bank relationship and therefore call them the bank relationship firms hereafter. The second sample is created as follows. We first select all firms in the top quintile of leverage at the end of the second quarter of 2006. We then use Capital IQ to identify all firms within that quintile that have either a bank loan or a revolver at the end of 2005 and at the end of 2006. For the third sample of bank-dependent firms, we start with firms in the bottom quintile of assets (quintile breakpoints based on NYSE firms) at the end of the second quarter of 2006 and eliminate all firms with a credit rating. We then select the firms that have a bank loan or a revolver both at the end of 2005 and at the end of 2006 to form our sample of small, bank-dependent firms. All the bank-dependent firms are levered firms with bank loans or revolvers and, for the small firms, are firms that have not accessed public markets.

Both measures of bank dependence have strengths and weaknesses. With Dealscan, we can make sure that a firm borrows more than once from the same bank, which is what we would expect with a bank relationship. However, Dealscan focuses on larger firms, so smaller firms that borrow repeatedly from a single bank (but whose loans are not recorded on Dealscan) are not in the bank relationship sample. On the other hand, using the indicator variable constructed from Capital IQ does not tell us whether the loan or revolver is part of a bank relationship. To improve this classification, we require firms to have a bank loan or a revolver two years in a row. As we will see, both approaches lead to fairly consistent results. We compare the highly levered, bank-dependent firms to firms with similar leverage but no bank loan or revolver in either 2005 or 2006. If the credit supply shock is due to a flight to safety rather than a bank loan supply shock, the capital expenditures of these firms should not fall less than the capital expenditures of the highly levered, bank-dependent firms.

Finally, we consider two groups of firms that should not be dependent on bank finance specifically or on credit more generally. First, we create a sample of firms with leverage equal to zero in each quarter during the three years up to and including the end of the second quarter of 2006. Such firms choose to remain unlevered during a period often identified as a credit bubble, and thus chose not to be dependent on credit or bank loans. Second, given the interest in firms with high cash holdings, we create a sample of firms that are in the top quintile of cash holdings in each quarter during the three years up to and including the end of the second quarter of 2006. We require firms to have consistently high cash to avoid firms that have just issued a security to finance an investment program and accumulated cash as a result.

Panel A of Table 1 shows how capital expenditures as a percentage of assets evolved during the crisis for the whole sample as well as for subsamples. Column 1 presents the data for the whole sample. The first result is that average capital expenditures do not fall during the first year of the crisis.[2] The average capital expenditures in the third quarter of 2008 are roughly equal to the average capital expenditures in the third quarter of 2006 (1.43% of assets versus 1.45% of assets, where the latter number is not tabulated) and to the average capital expenditures in the four quarters before the start of the crisis (1.47%). However, capital expenditures fall sharply following the bankruptcy of Lehman and are lower in the first quarter of 2009 by 0.46% of assets than the capital expenditures at the end of the third quarter of 2008. The level of capital expenditures in calendar year 2009 is extremely low – every quarter in 2009 has average capital expenditures lower than the lowest level recorded from 1983 to 2004 (not reported in the Table). This evidence is consistent with the period corresponding to the fall of Lehman being a decisive event in terms of firms' investment policies, since capital expenditures fall by 32% from the third quarter of 2008 to the first quarter of 2009. We evaluate the significance of the change in capital expenditures over this period by comparing it to other identical calendar periods in the sample so as to account for seasonality, and the change is significant at the 1% level. Average quarterly capital expenditures fall from 1.48% in the first year of the crisis to 0.98% in the last year of the crisis, a

[2] This result contrasts with the result in Duchin, Ozbas, and Sensoy (2010). The reason for the difference is that their sample includes firms not incorporated in the U.S. while ours does not.

difference of 0.50% of assets or 34% of capital expenditures in the first year. Whatever impact bank losses and/or the credit market turmoil had on firms during the first year of the crisis, they do not leave a trace in the data for the whole sample that is consistent with a first-order adverse impact.

We next consider subsamples in which the theories predict we would find a differential impact of a bank lending or a credit shock. Column 2 shows results for the bank relationship firms. These firms invest more during the last year of the boom than the sample average. Their decrease in quarterly capital expenditures during the first year of the crisis is economically trivial (0.02% of assets or 1.20% of pre-crisis capital expenditures) and insignificant. These bank relationship firms experience a similar decrease in quarterly capital expenditures after the fall of Lehman as the sample as a whole and a similar decrease as firms that do not have a bank relationship. However, the bank relationship firms experience a greater decrease in capital expenditures as both a percentage of assets (-0.62%) and a percentage of pre-crisis capital expenditures (37%) from the last year of the credit boom to the last year of the crisis than firms that do not have a bank relationship; the respective numbers for firms without a bank relationship are -0.42% and 31% (untabulated). All of this additional decrease takes place after the first quarter of 2009. These results show that capital expenditures evolve differently for bank relationship firms, but not until the last year of the crisis. They provide no support for theories suggesting that bank losses have a direct adverse impact on capital expenditures early in the crisis or even before the stock market reaches its bottom. As we will see later, the explanation does not seem to be that firms are affected quickly by the bank credit shock but, because of lags, they take time to reduce capital expenditures. Such behavior would be hard to reconcile with the fact that bank-relationship firms repurchase common stock at a higher rate during the first year of the crisis than during the last year of the boom, since stock repurchases can be stopped instantaneously.

The next column shows data for the highly levered firms. There is no meaningful difference in any period between the change in capital expenditures (as a percentage of total assets) for these firms in comparison to the change in capital expenditures for the whole sample. However, because these firms invest more than the average firm, it is also important to consider the percentage change in their capital

expenditures relative to their pre-crisis level. Strikingly, highly-levered firms experience a lower percentage decrease in capital expenditures from the pre-crisis to the last year (30%) than the average firm (34%). These results are not consistent with the predictions of the credit supply shock theory. In addition, it is difficult to reconcile these results with the predictions of the balance sheet multiplier theory. With that theory, highly levered firms should experience a larger fall in capital expenditures than other firms.

We also split the highly levered firms into those that are dependent on bank loans and those that are not. Column (4) reports the results for the firms that are classified as bank dependent, but we do not tabulate the results for the other firms. Neither group shows a decrease in average quarterly capital expenditures during the first year of the crisis, but the bank-dependent firms experience a worse decrease over the entire crisis by 0.06% of assets, or of 3.82% of pre-crisis capital expenditures, than the highly levered firms that are not bank dependent. Though we do not tabulate the results, we also construct a subset of highly levered firms that are bank dependent and have no credit rating at the end of June 2006. These firms are even more likely to be bank dependent as they have bank loans or a revolver but have not accessed public debt markets. We find that these firms experience a smaller decrease in capital expenditures in the two quarters after Lehman than other highly-levered firms that are not bank dependent. However, these firms also experience a greater decrease in capital expenditures during the last year of the crisis.

Turning next to the small, unrated bank-dependent firms, Column (5) shows that they experience no decrease in capital expenditures during the first year. As with highly levered firms, we report the results for the bank-dependent firms but not the other ones. There is no difference between the two groups in the first year of the crisis, but the small bank-dependent firms experience a greater drop in capital expenditures both after the bankruptcy of Lehman (greater by 0.09% of assets or 2% of capital expenditures in the third quarter of 2008) and from the year before the crisis to the last year of the crisis (greater by 0.08% of assets or 1% of pre-crisis capital expenditures).

We now examine firms that should have been less affected by a bank lending shock in particular or a credit supply shock in general. In Column (6), we find that the capital expenditures of firms consistently without leverage do not fall during the first year, fall immediately after the fall of Lehman at a rate that is not different from the sample as a whole, and fall by 0.40% of assets from the year before the crisis to the last year of the crisis. While capital expenditures fall more for the sample as a whole, it is important to note that firms with no leverage invest less than the average firm in the sample. Consequently, when we look at the percentage reduction in capital expenditures, the reduction is 35% for firms with no leverage, which is higher than for the sample as a whole. Strikingly, firms with no leverage before the crisis experience a percentage reduction in capital expenditures that is higher than the percentage reduction of highly levered firms (30%) and close to the percentage reduction of bank relationship firms (37%). If the balance sheet multiplier is a first-order effect, we would not expect to see such results since the unlevered firms should not be affected by the balance sheet multiplier effect as it is generally understood.

The firms that have consistently high cash holdings (Column (7)) invest at a very low rate before the crisis compared to other firms, as their average quarterly capital expenditures are only 0.80% of assets compared to 1.47% for the sample as a whole. These firms could finance 20 years of capital expenditures with their cash holdings. While they experience no change in capital expenditures during the first year of the crisis, their capital expenditures fall sharply in the aftermath of Lehman's failure, by 34% from the third quarter of 2008 to the first quarter of 2009. In contrast, the capital expenditures of the bank relationship firms over the same period fall only by 29%. From pre-crisis to the last year of the crisis, the capital expenditures of the firms that have consistently high cash holdings fall by 0.18% of assets or by 23% of pre-crisis capital expenditures. The reason why these firms have a smaller decrease in capital expenditures over the whole crisis than around the bankruptcy of Lehman is that they increase capital expenditures in the first year of the crisis by almost 10% relative to the year before the crisis.

We now turn to more formal comparisons that follow the matching approach of Almeida et al. (2012). They employ the Abadie and Imbens (2006) estimator, as implemented by Abadie, Drukker, Herr, and Imbens (2004). The idea behind this estimator is to isolate treated observations (in our application, the

subgroups of interest) and then, from the population of non-treated observations, look for control observations that best "match" the treated ones in multiple dimensions (covariates). In lieu of using a standard propensity score approach, the Abadie-Imbens matching estimator minimizes a measure of distance (the Mahalanobis distance) between all the covariates for firms in the treated group and their matches. The estimator allows control firms to serve as matches more than once, which compared to matching without replacement lowers the estimation bias (but can increase the variance). In our estimations, we select one matched control for each treated firm. The Abadie-Imbens estimator produces "exact" matches on categorical variables. Naturally, the matches on continuous variables will not be exact (though they should be close). The procedure recognizes this difficulty and applies a bias-correction component to the estimates of interest. In addition, the estimator produces heteroskedastic-robust standard errors. Following Almeida et al. (2012), we match on two categorical variables (two-digit SIC code and credit rating) and five non-categorical variables (market-to-book, operating cash flow, cash holdings, size, and leverage ratio).[3] We perform difference-in-differences (DID) estimations in which we compare the changes in the variables of interest across the groups rather than compare the levels of the variables across the treatment and control groups. This controls for the fact that the levels of the treated and control groups could be different prior to the event, and continue to be different after that event. Finally, we report the Abadie-Imbens' average effect of the treatment on the treated (ATT) as well as the traditional difference-in-differences (DID) estimator.

We report the results in Panel B of Table 1. Our focus is the DID and ATT estimators for the three crisis periods. We reproduce some additional information for the treated and control groups. The treated groups are the same as in Panel A, so that we already discussed the relevant information.[4] Column (1) shows the results for the bank relationship firms. We do not include in the control sample firms that borrow twice in Dealscan but from different banks or twice from the same non-U.S. bank. The former are

[3] We modify the matching variables as necessary. For example, when examining cash holdings, we do not match on cash since that would bias us against finding any differences. Likewise when examining subgroups based on cash (leverage), we do not use cash (leverage) as a control variable.

[4] There are slight differences between the treated groups of panel A and panel B since the sample in panel B requires data on the matching variables and requires data in both the pre- and the post-periods to be included.

excluded since these firms might have a bank relationship, but we might not capture it by focusing on the lead bank; the latter are excluded because we want to focus on firms that have a relationship with a U.S. bank. However, we find similar results if we do not exclude the firms that borrow twice from different banks or from non-U.S. banks. Further, the results are similar if we include firms that borrow twice from the same foreign bank in the treated firms. We see first in Column (1) that the matching procedure chooses control firms that, on average, have capital expenditures that are fairly close to the capital expenditures of the treated firms. The bank relationship firms have changes in capital expenditures that are not different from those of their matching firms between the pre-crisis year and either the first year of the crisis or the post-Lehman period. However, capital expenditures of bank relationship firms fall more from the pre-crisis year to the last year of the crisis when we use the matching estimator (ATT) but not the traditional difference-in-differences estimator. This difference is driven by the last year of the crisis.

Using the same approach, we turn next to the highly levered firms. Column (2) shows that in the first year, the capital expenditures of highly levered firms fall less than their control group. There are no significant differences for the other comparison periods. When we split the highly levered firms into a group with bank loans or revolvers and a group without in Column (3), we find no differences between these groups for the first two periods. However, the highly levered, bank-dependent firms have a larger decrease in capital expenditures from the pre-crisis period to the last year. When we match the small, unrated firms with either a bank loan or a revolver to small, unrated firms without a bank loan or a revolver (Column (4)), we find that the bank-dependent firms experience a smaller decrease in capital expenditures than the control firms in each period. This is the opposite result from the one we would expect from the bank supply shock theory.

We consider next the firms with no leverage. We choose controls from the sample of firms with leverage greater than 5% to avoid selecting firms that have trivially low leverage. We find no differences between firms with no leverage and matching firms with leverage greater than 5%. Finally, in Column (6) we investigate the firms with high cash holdings. For this investigation, we omit cash as a covariate. We find no difference in the first year of the crisis, but we find differences for the two other periods that

indicate that high cash firms decrease capital expenditures by less than their controls. For the post-Lehman crisis period, both estimators are significantly different from zero, while for the last year, only the ATT is significantly different from zero.

The bottom line from these matching tests is that there is no evidence that firms that should have been affected more (less) by a bank lending shock or by a credit shock were affected more (less) in the first year of the crisis. However, high cash firms experience a smaller decrease in capital expenditures from the pre-crisis year to either the post-Lehman period or the last year of the crisis than their matching firms. Further, the bank-relationship firms and the highly levered, bank-dependent firms decrease capital expenditures more from pre-crisis to the last year of the crisis than their matching firms, but the small, bank-dependent firms increase capital expenditures relative to their matching firms throughout the crisis. It is important to note that these results are not due to a lack of power: the approach finds differences between treated and control firms in each of the periods, but they are not those predicted by the bank supply shock and the credit supply shock theory in the first period.

An alternative approach is to use regressions in which the treated firms are identified by a dummy variable and the dummy variable is interacted with dummy variables for the various crisis periods. Such an approach is used by Duchin, Ozbas, and Sensoy (2010). With this approach, we would observe independent variables during the crisis, which creates more of an endogeneity issue than the matching approach. Nevertheless, we estimate (but do not tabulate) regressions to investigate whether they lead to different conclusions than the matching approach.[5] With regressions, we compare the subsets of interest to the population since the regression adjusts for differences in characteristics. The results are consistent with the matching approach with two exceptions. First, in the matching approach, we find that highly levered firms invest more than matching firms in the first year of the crisis. With the regression approach, we do not find this result but find that they have significantly negative abnormal capital expenditures in

[5] Using quarterly data, we regress capital expenditures to assets in period *t* on four lags of market-to-book and four lags of operating cash flow. We include an indicator variable for the treated group and indicator variables for the pre-crisis period, the crisis period, the post-Lehman period, and the last year of the crisis. We add the interaction of the treated group indicator variable with the other indicator variables. We use firm fixed effects and include seasonal indicator variables.

the two quarters after the bankruptcy of Lehman. Second, small bank-dependent firms are never different from other small firms. All the other results are consistent with the results from the matching approach.

In summary, there is no convincing evidence that firms that are more bank dependent or more credit dependent before the crisis experience an abnormal decrease in capital expenditures during the first year of the crisis. All firms experience a sharp drop in capital expenditures after the bankruptcy of Lehman, but the bank-dependent firms that suffer from a larger drop than matching firms (the bank relationship firms and the highly levered, bank-dependent firms) do so only in the last year of the crisis. The decrease in capital expenditures as a percentage of pre-crisis capital expenditures immediately after the bankruptcy of Lehman is similar across highly levered firms, bank relationship firms, firms with no leverage, and firms with high cash holdings. The high percentage decrease in capital expenditures of the high cash holding firms immediately after Lehman's bankruptcy is hard to reconcile with the view that these firms did not cut capital expenditures as much as other firms because they were not credit-constrained. None of this evidence is indicative of the balance sheet multiplier effect having had a first-order effect.

Section 4. Did credit contract more for bank-dependent firms?

In this section, we examine whether bank-dependent firms experience a greater decrease in net debt issuance than similar firms without bank loans. We proceed as in Section 3, first showing univariate comparisons in Panel A of Table 2. Column (1) shows the sample as a whole. Net debt issuance during the first year of the crisis is the same as during the last year of the boom. However, net debt issuance plummets after the bankruptcy of Lehman. The overall decrease from the last year of the boom to the last year of the crisis is 1.17%; since net debt issuance is only 0.80% per quarter during the last year of the boom, the drop in net debt issuance is 146% of the pre-crisis net debt issuance. Net debt issuance is negative for the sample as a whole in the last quarter of 2008 and all of 2009.

The next column examines our bank relationship firms. They experience no significant change in net debt issuance during the first year. As for the sample as a whole, their net debt issuance plummets post-Lehman and continues falling in 2009. Bank relationship firms borrow more than other firms in the pre-

crisis period so, as a percentage of assets, their net debt issuance falls more than for the sample as a whole. When we consider the change from the year before the crisis to the last year of the crisis as a percentage of pre-crisis net debt issuance, however, the net debt issuance of bank relationship firms falls by only three percentage points more than for the sample as a whole (149% versus 146%).

The story is similar for the highly levered firms in Column (3), but their net debt issuance falls more through the crisis, whether as a percentage of assets (1.63%) or as a percentage of pre-crisis net debt issuance (171%), than for the sample as a whole or for the bank relationship firms. When we separate highly levered firms into bank-dependent firms and other firms (untabulated), we find that the bank-dependent firms have a much higher drop in net debt issuance from before the crisis to the last year of the crisis (1.81% of assets versus 1.07% of assets). However, the firms that do not have bank loans or revolvers have lower average net debt issuance during the two quarters following the bankruptcy of Lehman (-1.99%, versus -0.78% for the bank-dependent firms). Further, untabulated results show that the cumulative net debt issuance in the six quarters following the fall of Lehman is lower for firms that are not bank dependent than for bank-dependent firms (total of -6.30% versus total of -4.38%). The results for small, bank-dependent firms in Column (5) mirror those of the highly levered, bank-dependent firms. We do not reproduce the results for firms expected to be unaffected by a bank lending shock or a credit supply shock. These results are not interesting because they are largely mechanical and not worth discussing. To wit, a firm with no debt cannot experience negative net debt issuance.

In Panel B of Table 2, we examine whether the net debt issuance of bank-dependent firms differs from the net debt issuance of matching firms as of the end of the second quarter of 2006. Column (1) shows the results for the treated group of bank relationship firms. There is no difference in net debt issuance between the treated firms and the control firms over any of the three periods. Turning to the highly levered firms, we find that they have a steeper fall in net debt issuance after the fall of Lehman than their matching firms. Otherwise, they are not distinguishable. Such evidence is consistent a credit supply shock and with the effect of the balance sheet multiplier. When we compare the highly levered, bank-dependent firms to their matching firms, we find that there is no evidence that their net debt

issuance falls more than the net debt issuance of their matching firms in the first and last periods and weak evidence it falls less in the two quarters in the second period, i.e., the period that follows the bankruptcy of Lehman. We also find no difference between the small, bank-dependent firms, and the other ones. Because of the issues raised in the previous paragraph, we do not show the results for the no leverage and high cash holding firms.

As in the previous section, we estimate regressions but do not report them. In estimating these regressions, we use the model of Fama and French (2008) but apply it to quarterly data. We therefore add seasonal indicator variables. We start the sample period for estimation in the second quarter of 2006. The results are generally consistent with those of the matching estimation. For highly levered firms, net debt issuance is already abnormally low in the first year of the crisis, but it is abnormally high in the last year of the crisis. Investment-grade firms have abnormally high net debt issuance in the first year of the crisis and in the two quarters after Lehman's bankruptcy. All other results are consistent.

It is useful to understand how our results differ from those of Ivashina and Scharfstein (2010). They examine the change in debt agreements in the syndicated loan market using DealScan. DealScan reports loans to large borrowers. Their sample does not include the smaller firms in our sample because their loans are unlikely to be syndicated. Ivashina and Scharfstein find that new loans to large borrowers fall by 47% during the peak of the financial crisis relative to the third quarter of 2008 and by 79% relative to the credit boom. When we focus on the last quarter of 2008 and the first quarter of 2009, the drop in net debt issuance is even more dramatic since, for the sample as a whole, average net debt issuance is negative in the last quarter of 2008 and in the first quarter of 2009. Consequently, the average drop in net debt issuance relative to the peak of the boom exceeds 100%. We find the same during the last year of the crisis. Ivashina and Scharfstein (2010) observe a drop in new loans of slightly more than 22% in the first year of the crisis. They do not report whether the drop is statistically significant. In Panel A of Table 2, we find no statistically significant drop in net debt issuance in the first year for any of our subsamples. However, the subgroup of highly levered firms that had a bank loan at the end of 2005 experience an

insignificant drop in net debt of issuance of 25.25%, which is very similar to the drop observed by Ivashina and Scharfstein (2010).

Several papers, including Ivashina and Scharfstein (2010), point out the importance of drawdowns during the crisis and argue that they can help explain the fact that aggregate data on debt shows little evidence of a decrease in 2008 (see Chari, Christiano, and Kehoe (2008)). In untabulated results, we create a random sample of 300 firms in existence before the crisis and investigate their use of credit lines. Sufi (2009) also uses a random sample approach to study credit lines in general and our results on the use of credit lines by firms are similar to his. For our random sample, peak drawdowns (corresponding to 1.72% of assets) are in the last quarter of 2007. In contrast, drawdowns in the fourth quarter of 2008 are only 1.03% of assets.

Overall, the results in this section show that, consistent with bank-dependent firms not decreasing capital expenditures in the first year of the crisis, bank-dependent firms do not experience a decrease in net debt issuance in the first year of the crisis. After September 2008, net debt issuance of most subgroups of firms falls sharply, but not more so for bank-dependent firms. While we find that highly levered firms have a larger decrease in net debt issuance than other firms after the failure of Lehman, we do not find that they reduce capital expenditures more. The greater decrease in net debt issuance by highly levered firms is consistent with the impact of a credit supply shock or of a balance sheet multiplier effect, but if that is the case, firms have effective ways of coping with any credit rationing they face. A better explanation would seem to be the demand shock since the demand shock does not predict that these firms reduce capital expenditures more than other firms. Note that a firm with a high leverage target must finance a greater portion of its capital expenditures with debt. Hence, when capital expenditures fall, the net debt issuance of this firm will fall more than the net debt issuance of a firm with a low leverage target, even if the capital expenditures of all firms were to fall by the same amount.

Section 4. Is there a substitution effect towards equity?

We know from the literature that bank-dependent firms confronting a credit supply shock can partially mitigate the impact of the shock by issuing equity (Leary (2009)). However, we also know that firms suffering from a debt overhang because of an adverse shock do not generally find it advantageous for their shareholders to issue equity (Myers (1977)). Further, a flight to quality that increases risk premia across all asset classes makes equity issuance less attractive. Consequently, in this section we investigate whether there is a substitution towards equity issuance by bank-dependent firms or instead a broad-based decrease in equity issuance.

Table 3 provides the results on net equity issuance. As in the earlier sections, we start with the sample as a whole. The results in Column (1) are striking. Net equity issuance falls by 53% in the first year of the crisis. It then falls by an additional 32% of its pre-crisis level after the fall of Lehman. However, in the last year of the crisis, net equity issuance bounces back dramatically and is significantly higher than the year before the crisis. Compared to the last year of the credit boom, the cumulative decrease in net equity issuance until the end of the first quarter of 2009 (defined as the sum of net equity issuance to assets over that period) is more than twice than the cumulative decrease in net debt issuance (3.96% versus 1.82%).

Turning to the bank-relationship firms, we see in Column (2) that on average bank-relationship firms are net equity repurchasers through the first two phases of the crisis. However, the increase in their net equity issuance is extremely limited compared to firms that are not bank dependent such as the no leverage firms, so that if there is a substitution effect at work during the last year of the crisis, it is small. Since bank relationship firms increase their net repurchases in the first year of the crisis, no case can be made that there is any substitution towards equity in that year. Moreover, it seems odd for these firms to spend cash on repurchases if they believe that they are financially constrained on average in the first year of the crisis or expect to become so. The highly levered firms experience a steep reduction in net equity issuance during the first two crisis periods, but their net equity issuance bounces back sharply in the last year. During the first year of the crisis, net equity issuance falls by more than net debt issuance, but not in

the two quarters after the fall of Lehman. The highly levered bank-dependent firms in Column (4) follow the same pattern. While we tabulate the results for only the bank-dependent firms, the highly levered firms that are not bank dependent issue more equity than the bank-dependent firms in the two quarter after the fall of Lehman (0.85% of assets versus 0.15% of assets). The small firms (results untabulated) have an extremely sharp reduction in net equity issuance. For the small, bank-dependent firms in Column (5), it is again the case that the reduction in net equity issuance is greater than the reduction in net debt issuance in the first year of the crisis.

In Column (6), the firms with no leverage before the crisis experience a drop in quarterly net equity issuance of 1.24% of assets, or 67% of pre-crisis quarterly net equity issuance, in the first year of the crisis. Such a dramatic drop cannot be explained by the direct impact of a credit crisis on these firms. Finally, the high cash holding firms experience an equally dramatic decrease in net equity issuance. The net equity issuance of these firms is extremely high on average the year before the crisis at 4.17% of assets per quarter. It falls to 1.85% in the first year of the crisis.

As for previous sections, we estimate matching models and regression models for the decrease in net equity issuance (but do not tabulate them). The results are generally consistent with the statistics we have discussed. However, the control firms have different net equity issuance than the treated firms in a number of instances. For instance, the bank relationship firms have negative net equity issuance in the pre-crisis, but they are matched with firms that have a positive net equity issuance. It is not clear, however, what we could learn from matching estimators in this section. There is no hypothesis that we know of that predicts that firms that rely on bank relationships would repurchase more equity in the presence of a bank lending shock. No case can possibly be made that the highly levered, bank-dependent firms substitute their funding towards equity issuance as their net equity issuance plummets. Bank-dependent firms increase their net equity issuance in the last year of the crisis compared to the last year before the crisis, but their net equity issuance is small in that year compared to the net equity issuance of firms with no leverage or high cash firms. We also estimate regressions. In the first year of the crisis, the regressions suggest that bank relationship firms repurchase less than they would have otherwise, which

might be viewed as a substitution effect, but again these firms are still repurchasing. In the last year of the crisis, both the no leverage firms and the high cash holdings firms have high abnormal stock issuance, while the bank relationship firms have negative abnormal stock issuance.

Section 5. Did cash holdings fall?

In the presence of an unexpected bank lending or credit shock, we would expect firms to use their cash balances to mitigate the adverse impact of the shock. Thus, Panel A of Table 4 examines the cash balances of our various subsamples. The data for the whole sample in Column (1) shows that cash holdings as a percentage of assets fell significantly during the first year of the crisis. As we saw earlier, net debt issuance did not fall that year, so a decrease in debt issuance cannot explain the decrease in cash holdings. Net debt issuance did fall sharply after the bankruptcy of Lehman, and column (1) shows that cash holdings also continued to fall in the post-Lehman period. However, cash holdings increase sharply afterwards, so that they are roughly similar during the last year of the crisis (21.85%) and the year before the crisis (21.96%). On net, therefore, the crisis did not impact cash holdings for the sample as a whole.

It could be that bank-dependent firms saw a much more dramatic evolution of cash holdings. In Column (2), we find that they do, but not in the way that we would expect if they were spending cash to offset low net debt issuance. The bank-relationship firms have significantly higher cash holdings in the last year of the crisis than in the year before the crisis. The increase in cash holdings is extremely substantial, as it represents 1.96% of assets or 24% of the cash holdings before the crisis. Importantly, we showed earlier that bank relationship firms invest less than matching firms during the last year of the crisis. However, during that year, they accumulate cash at a rate of 0.41% of assets per quarter. Essentially, had they used the funds they used to accumulate cash for capital expenditures instead, their capital expenditures would not have decreased.

The highly levered firms in Column (3) experience no significant change in cash holdings during the crisis. When we split these firms between those that have a bank relationship versus those that do not (not tabulated), we find in Column (4) that the firms with a bank relationship experience a significant increase

in cash holdings of 1.37% of assets (or 17% of pre-crisis holdings) from the year before the crisis to the last year of the crisis. There is a sharp difference between the evolution of cash holdings for small, bank-dependent firms and the other small firms. As before, we tabulate only the results for the small, bank-dependent firms. In Column (5), we see that the small, bank-dependent firms have a similar amount of cash in the last year of the crisis than in the pre-crisis period, while the other small firms have a reduction in their cash holdings of roughly 4% of assets.

In light of earlier papers, such as Ivashina and Scharfstein (2010), that emphasize credit line drawdowns in the panic of 2008, it is important to examine whether the increase in cash is mostly driven by increases in the last quarter of 2008 for bank-dependent firms. It is not. Average cash holdings of bank relationship firms are higher during the last year of the crisis than the cash holdings at the end of the third quarter of 2008 by 2.46% of assets; the increase relative to the end of the fourth quarter of 2008 is 1.79% of assets. Similarly, cash holdings of highly levered bank-dependent firms are 9.28% on average during the last year of the crisis, corresponding to an increase of 1.41% of assets compared to the end of the third quarter of 2008 and of 1.44% of assets compared to the end of the fourth quarter of 2008.

We now turn to the firms that would have been less affected by a credit shock or a bank lending shock. Column (6) shows that the cash holdings of firms with no leverage fall steadily through the crisis, so that at the end of the crisis their holdings are 6.18% lower as a percentage of assets and 14% lower than their pre-crisis cash holdings. However, the no leverage firms hoard cash sharply after the bankruptcy of Lehman, so that they increase cash the most as a percentage of assets in the two quarters after Lehman. The change in cash holdings is even more dramatic for firms with consistently high cash holdings. Their cash holdings fall throughout the crisis and they have lower cash holdings in the last year of the crisis by 9.67% of assets or 15% of pre-crisis cash holdings.

Panel B of Table 4 examines the matching results. We find that bank relationship firms are not different from their matching firms in any period. Likewise, the highly levered or small bank-dependent firms also do not differ depending on whether they have bank loans or a revolver. Firms with no leverage

reduce their cash holdings compared to their control firms every period. Regression analysis produces similar results.

In summary, firms that do not rely on credit before the crisis decrease their cash holdings sharply during the crisis. These firms also experience a steep reduction in their net equity issuance, so they could simply be using their cash to offset the lack of funding from equity. In contrast, credit-dependent firms do not reduce their cash holdings from the year before the crisis to the last year of the crisis. There is no evidence that bank-dependent firms reduce their cash holdings more than other firms to offset an involuntary decrease in their borrowing.

Section 7. Conclusion

We investigate what the financial and investment policies of firms during the crisis imply about theories of impaired access to capital and whether these policies are consistent with the predictions of the conventional view of the crisis, which gives great importance to the role of a bank lending supply shock. We find that the evidence raises important questions about the view that a bank lending supply shock specifically or a credit supply shock more generally is a dominant causal factor for financial and investment policies of firms during the crisis. Our evidence is not supportive of a first-order effect for the balance sheet multiplier or collateral channel either. Common factors that have a similar effect on firms with different financial circumstances before the crisis seem much more important.

If the bank lending supply shock is the dominant factor, we would expect bank-dependent firms to have lower net debt issuance, a greater decrease in cash holdings, an increase in net equity issuance, and a greater drop in capital expenditures than firms that are not bank dependent. Instead, we find that net debt issuance increases during the first year of the crisis for most types of firms examined, including firms that are dependent on banks for their borrowing. While net debt issuance falls sharply after September 2008, it does not fall more for bank relationship firms or for highly levered bank-dependent firms compared to other highly levered firms. Net equity issuance decreases during the crisis until April 2009, which is not consistent with a substitution effect. Over the whole crisis, bank relationship firms increase their cash

holdings significantly, as do the highly levered bank-dependent firms. Finally, bank-dependent firms do not decrease capital expenditures during the first year of the crisis and do not decrease them more than their matching firms in the two quarters after the fall of Lehman. While some bank-dependent firms decrease their capital expenditures more than matching firms during the last year of the crisis, they do not seem to do so because of a lack of funding – these firms increase their cash holdings by an amount that exceeds their reduction in capital expenditures.

We focus on the economic importance of the impaired access to capital theories for public non-financial firms using data that reflects the impact of policy actions. We have nothing to say about what the impact of the bank lending supply contraction would have been absent such actions. Further, we have nothing to say about the impact of reduced credit availability on consumers. Such reduced credit availability would affect firms through the demand shock in our analysis and could be the result of losses at banks, among other factors. In the flow-of-funds data, household debt fell in 2008 for the first time since 1977, the first year this data is available. Finally, we do not have data for private firms. The literature has documented important differences between the financial and investment policies of these firms compared to public firms (see, for instance, Gao, Harford, and Li (2012) for cash holdings).

A priori, our results on the strength of the bank lending supply shock seem inconsistent with the popular narrative of the crisis. One would expect banks' large losses to have forced them to lend less to restore their target leverage. However, there are many reasons why losses at banks may have had a limited direct impact on non-financial corporations. First, the banks that incurred large losses may have had other ways to cope with these losses besides denying credit to U.S. industrial firms, such as selling assets or borrowing from the Fed. Second, while U.S. households increased their leverage dramatically in the 2000s, industrial public firms did not. In particular, median net debt was negative before the crisis, so that the typical firm could have repaid its debt from its cash holdings. Third, firms have many ways of funding investment other than using a bank loan. They can use their cash, borrow from non-bank financial intermediaries, issue public debt, issue equity, sell assets, obtain more trade credit, and so on. Consequently, the impact of a shock to one source of financing is limited if firms can easily access

substitutes sources of funding. Fourth, loans to public firms have steadily become a less important source of funding for the capital expenditures of industrial firms and a less important activity for banks. Finally, the credit crisis followed what many have considered to be a credit bubble. To the extent that firms time debt issuance, they would have issued more debt during the credit bubble and would have had less of a demand for debt afterwards.

It is also useful to note that the merger and acquisitions market and the private equity market collapsed very early in the crisis. These markets had been the source of a large demand for loans. Even if the collapse of these markets was the direct result of the shock to bank credit supply, the huge reduction in loans used to finance corporate control deals left more room for banks to finance capital expenditures. For instance, according to Dealogic, leveraged buyouts totaled $375.1 billion in 2007, but fell to $61.1 billion in 2008.[6] The dramatic drop in leveraged buyouts represents a sharp decrease in borrowing that does not show up in our data on public companies.

Surprisingly, net equity issuance falls sharply in the first year of the crisis when net debt issuance does not fall. We find that the cumulative decline in financing cash flows from reduced net equity issuance exceeds the cumulative loss from decreased net debt issuance for bank-dependent firms during the first year of the crisis. Further, this decrease in net equity issuance occurs for firms with large cash holdings as well as for firms with no leverage before the crisis, so it cannot be explained by a debt overhang. The decrease in net equity issuance is consistent with a decrease in expected cash flows, a loss of investment opportunities, and an increase in the cost of equity as investors became more risk averse. Evidence by Campbell, Giglio, and Polk (2012) shows that the cost of equity increase is much less important in explaining stock returns than the decrease in expected future cash flows for the market as a whole.

Finally, in further support of the importance of the demand shock theory, we find that the proportional decrease in capital expenditures of no leverage firms and of high cash firms after the Lehman

[6] See "Final 2008 data confirm: 'Little but tumbleweeds' in LBO arena," Deal Journal, January 7, 2009, The Wall Street Journal.

bankruptcy is higher than the proportional decrease in capital expenditures for highly levered firms and similar to the proportional decrease of bank relationship firms. These results as well as most of our other results seem difficult to reconcile with the view that a bank lending shock or a credit supply shock are first-order determinants of firm investment and financial policies during the crisis.

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Table 1, Panel A: Quarterly Capital Expenditures

Panel A shows changes in capital expenditures as a percentage of assets during the crisis for subgroups of firms formed before the crisis. Bank Relation includes all firms that had two or more loan facilities with the same U.S. lead bank in the five years before the end of the second quarter of 2006, according to Dealscan. High Leverage includes firms in the top quintile of leverage at the end of the second quarter of 2006. High Lev, Bank Dependent firms are high leverage firms that Capital IQ identifies as having either a bank loan or a revolver at the end of 2005 and at the end of 2006. Small, Bank Dependent includes all firms with assets below the 20th percentile of assets for NYSE firms at the end of the second quarter of 2006, that are unrated and that Capital IQ identifies as having either a bank loan or a revolver at the end of 2005 and at the end of 2006. Investment Grade are firms with an investment grade rating using the S&P long-term rating (*splticrm*) available on Compustat. No Leverage firms are firms that have leverage equal to zero in each quarter during the three years up to and including the end of the second quarter of 2006. High cash firms are in the top quintile of cash holdings in each quarter during the three years up to and including the end of the second quarter of 2006.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Whole sample	Bank Relation	High Leverage	High Lev, Bank Dep.	Small, Bank Dep.	No Leverage	High Cash
Post crisis vs pre crisis							
1. Avg (2006Q3-2007Q2)	0.0147	0.0167	0.0158	0.0157	0.0147	0.0111	0.0080
2. Avg (2007Q3-2008Q2)	0.0148	0.0165	0.0165	0.0166	0.0143	0.0120	0.0087
3. Avg (2008Q4-2009Q1)	0.0114	0.0132	0.0128	0.0133	0.0112	0.0083	0.0063
4. Avg (2009Q2-2010Q1)	0.0098	0.0105	0.0110	0.0108	0.0096	0.0072	0.0062
Difference (2 - 1)	0.0001	-0.0002	0.0007	0.0009	-0.0004	0.0009	0.0007
Ttest	0.7175	0.6865	0.2739	0.2227	0.4498	0.1487	0.1993
Difference (4 - 1)	-0.0049	-0.0062	-0.0048	-0.0049	-0.0051	-0.0040	-0.0018
Ttest	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0022
Post Lehman vs pre Lehman							
2009Q1	0.0098	0.0113	0.0108	0.0109	0.0095	0.0069	0.0054
2008Q4	0.0131	0.0150	0.0149	0.0157	0.0130	0.0098	0.0072
2008Q3	0.0143	0.0160	0.0154	0.0161	0.0141	0.0113	0.0082
Difference (2009Q1 - 2008Q3)	-0.0046	-0.0047	-0.0047	-0.0051	-0.0046	-0.0044	-0.0028
Paired Dif. (2009Q1 - 2008Q3)	-0.0049	-0.0049	-0.0054	-0.0057	-0.0048	-0.0047	-0.0033
Ttest 2008Q3=2009Q1*	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

Table 1, Panel B: Quarterly Capital Expenditure

Panel B shows difference-in-differences results using the matching approach of Almeida et al. (2012). The table presents estimates of the changes in average quarterly investment rates, as a percentage of assets, from the pre-crisis period to each of the three different crisis phases (first year of crisis, post Lehman, and last year of crisis). DID is the traditional differences in differences estimator. Matching estimator (ATT) is the Abadie-Imbens bias-corrected average treated effect matching estimator. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms based on the following set of firm characteristics (exceptions noted in the paper): market-to-book ratio, operating cash flow, size, cash holdings, leverage ratio, 2-digit SIC industry, and credit ratings. ***, **, and * denote significance at the one percent, five percent, and ten percent level, respectively, using Heteroskedasticity-consistent standard errors. Definitions of the groups are in Panel A.

Table 1 , Panel B: Capital expenditures

Precrisis (2006Q3-2007Q2) vs First year (2007Q3-2008Q2)						
	(1)	(2)	(3)	(4)	(5)	(6)
Treated firms	Bank Relation	High Leverage	High Lev, Bank Dependent	Small, Bank Dependent	No Leverage	High Cash
precrisis	0.01660	0.01649	0.01628	0.01487	0.01236	0.00909
postcrisis	0.01606	0.01670	0.01653	0.01411	0.01273	0.00971
pre - post	0.00054	-0.00021	-0.00025	0.00076	-0.00037	-0.00062
Control firms						
precrisis	0.01737	0.01895	0.01649	0.01544	0.01342	0.01101
postcrisis	0.01589	0.01707	0.01793	0.01289	0.01286	0.01037
pre - post	0.00148	0.00188	-0.00144	0.00254	0.00056	0.00064
diff-in-diff	-0.00094	-0.00209 **	0.00119	-0.00179 *	-0.00093	-0.00127
Matching estimator (ATT)	-0.00084	-0.00208 **	0.00114	-0.00237 **	-0.00121	-0.00129
Nobs.	783	517	400	699	298	235
Precrisis (2006Q3-2007Q2) vs Post Lehman (2008Q4-2009Q1)						
Treated: pre - post	0.00434	0.00465	0.00420	0.00439	0.00391	0.00198
Control: pre - post	0.00412	0.00471	0.00483	0.00593	0.00463	0.00438
diff-in-diff	0.00023	-0.00006	-0.00064	-0.00154	-0.00072	-0.00240 *
Matching estimator (ATT)	0.00157	0.00001	-0.00078	-0.00268 *	-0.00167	-0.00304 **
Nobs.	718	446	347	612	269	197
Precrisis (2006Q3-2007Q2) vs Last Year (2009Q2-2010Q1)						
Treated: pre - post	0.00702	0.00693	0.00711	0.00655	0.00570	0.00308
Control: pre - post	0.00555	0.00842	0.00110	0.00859	0.00606	0.00454
diff-in-diff	0.00148	-0.00150	0.00601 **	-0.00205	-0.00036	-0.00146
Matching estimator (ATT)	0.00236 *	-0.00149	0.00650 **	-0.00273 **	-0.00067	-0.00213 *
Nobs.	705	424	331	587	262	186

Table 2, Panel A: Quarterly Net Debt Issuance

Panel A shows changes in net debt issuance as a percentage of assets, during the crisis for subgroups of firms formed before the crisis. Bank Relation includes all firms that had two or more loan facilities with the same U.S. lead bank in the five years before the end of the second quarter of 2006, according to Dealscan. High Leverage includes firms in the top quintile of leverage at the end of the second quarter of 2006. High Lev, Bank Dependent firms are high leverage firms that Capital IQ identifies as having either a bank loan or a revolver at the end of 2005 and at the end of 2006. Small, Bank Dependent includes all firms with assets below the 20th percentile of assets for NYSE firms at the end of the second quarter of 2006, that are unrated and that Capital IQ identifies as having either a bank loan or a revolver at the end of 2005 and at the end of 2006. Investment Grade are firms with an investment grade rating using the S&P long-term rating (*splticrm*) available on Compustat. No Leverage firms are firms that have leverage equal to zero in each quarter during the three years up to and including the end of the second quarter of 2006. High cash firms are in the top quintile of cash holdings in each quarter during the three years up to and including the end of the second quarter of 2006.

	(1)	(2)	(3)	(4)	(5)
	Whole sample	Bank Relation	High Leverage	High Lev, Bank Dep.	Small, Bank Dep.
Post crisis vs pre crisis					
1. Avg (2006Q3-2007Q2)	0.0080	0.0085	0.0095	0.0111	0.0077
2. Avg (2007Q3-2008Q2)	0.0085	0.0092	0.0076	0.0083	0.0075
3. Avg (2008Q4-2009Q1)	-0.0021	-0.0027	-0.0107	-0.0078	-0.0033
4. Avg (2009Q2-2010Q1)	-0.0037	-0.0042	-0.0067	-0.0070	-0.0062
Difference (2 - 1)	0.0005	0.0007	-0.0020	-0.0027	-0.0003
Ttest	0.4426	0.5460	0.3531	0.2121	0.8570
Difference (4 - 1)	-0.0117	-0.0127	-0.0163	-0.0181	-0.0139
Ttest	0.0001	0.0001	0.0001	0.0001	0.0001
Post Lehman vs pre Lehman					
2009Q1	-0.0040	-0.0046	-0.0106	-0.0076	-0.0039
2008Q4	-0.0001	-0.0008	-0.0108	-0.0080	-0.0027
2008Q3	0.0079	0.0078	0.0048	0.0045	0.0089
Difference (2009Q1 - 2008Q3)	-0.0119	-0.0124	-0.0154	-0.0122	-0.0128
Paired Dif. (2009Q1 - 2008Q3)	-0.0119	-0.0128	-0.0145	-0.0116	-0.0127
Ttest 2008Q3=2009Q1*	0.0001	0.0001	0.0001	0.0033	0.0002

Table 2, Panel B: Quarterly Net Debt Issuance

Panel B shows difference-in-differences results using the matching approach of Almeida et al. (2012). The table presents estimates of the changes in average quarterly net debt issuance, as a percentage of assets, from the pre-crisis period to each of the three different crisis phases (first year of crisis, post Lehman, and last year of crisis). DID is the traditional differences in differences estimator. Matching estimator (ATT) is the Abadie-Imbens bias-corrected average treated effect matching estimator. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms based on the following set of firm characteristics (exceptions noted in the paper): market-to-book ratio, operating cash flow, size, cash holdings, leverage ratio, 2-digit SIC industry, and credit ratings. ***, **, and * denote significance at the one percent, five percent, and ten percent level, respectively, using Heteroskedasticity-consistent standard errors. Definitions of the groups are in Panel A.

Precrisis (2006Q3-2007Q2) vs First year (2007Q3-2008Q2)				
	(1)	(2)	(3)	(4)
Treated firms	Bank Relation	High Leverage	High Lev, Bank Dependent	Small, Bank Dependent
precrisis	0.00910	0.01118	0.01191	0.00824
postcrisis	0.00912	0.00789	0.00891	0.00821
pre - post	-0.00002	0.00329	0.00300	0.00002
Control firms				
precrisis	0.00779	0.01165	0.01654	0.00746
postcrisis	0.00880	0.01063	0.00592	0.00399
pre - post	-0.00100	0.00102	0.01062	0.00347
diff-in-diff	0.00099	0.00227	-0.00762	-0.00345
Matching estimator (ATT)	0.00405	0.00241	-0.00508	-0.00442
Nobs.	775	514	397	688
Precrisis (2006Q3-2007Q2) vs Post Lehman (2008Q4-2009Q1)				
Treated: pre - post	0.01183	0.02071	0.01984	0.01085
Control: pre - post	0.01442	0.01209	0.03324	0.00873
diff-in-diff	-0.00259	0.00862 **	-0.01341	0.00211
Matching estimator (ATT)	0.00187	0.00895 *	-0.01468 *	-0.00149
Nobs.	705	444	345	598
Precrisis (2006Q3-2007Q2) vs Last Year (2009Q2-2010Q1)				
Treated: pre - post	0.01318	0.01788	0.01904	0.01235
Control: pre - post	0.00964	0.01666	0.01297	0.01338
diff-in-diff	0.00354	0.00122	0.00607	-0.00103
Matching estimator (ATT)	0.00645	0.00113	0.00692	-0.00252
Nobs.	696	425	331	569

Table 3 Quarterly Net Equity Issuance

Panel A shows changes in net equity issuance, as a percentage of assets, during the crisis for subgroups of firms formed before the crisis. Bank Relation includes all firms that had two or more loan facilities with the same U.S. lead bank in the five years before the end of the second quarter of 2006, according to Dealscan. High Leverage includes firms in the top quintile of leverage at the end of the second quarter of 2006. High Lev, Bank Dependent firms are high leverage firms that Capital IQ identifies as having either a bank loan or a revolver at the end of 2005 and at the end of 2006. Small, Bank Dependent includes all firms with assets below the 20th percentile of assets for NYSE firms at the end of the second quarter of 2006, that are unrated and that Capital IQ identifies as having either a bank loan or a revolver at the end of 2005 and at the end of 2006. Investment Grade are firms with an investment grade rating using the S&P long-term rating (*splticrm*) available on Compustat. No Leverage firms are firms that have leverage equal to zero in each quarter during the three years up to and including the end of the second quarter of 2006. High cash firms are in the top quintile of cash holdings in each quarter during the three years up to and including the end of the second quarter of 2006.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Whole sample	Bank Relation	High Leverage	High Lev, Bank Dep.	Small, Bank Dep.	No Leverage	High Cash
Post crisis vs pre crisis							
1. Avg (2006Q3-2007Q2)	0.0103	-0.0018	0.0125	0.0084	0.0144	0.0184	0.0417
2. Avg (2007Q3-2008Q2)	0.0048	-0.0043	0.0075	0.0038	0.0067	0.0060	0.0185
3. Avg (2008Q4-2009Q1)	0.0015	-0.0018	0.0032	0.0015	0.0006	0.0028	0.0100
4. Avg (2009Q2-2010Q1)	0.0115	0.0012	0.0106	0.0058	0.0110	0.0169	0.0379
Difference (2 - 1)	-0.0054	-0.0025	-0.0050	-0.0045	-0.0076	-0.0124	-0.0232
Ttest	0.0001	0.0001	0.0025	0.0022	0.0001	0.0001	0.0001
Difference (4 - 1)	0.0013	0.0030	-0.0019	-0.0026	-0.0034	-0.0015	-0.0038
Ttest	0.0910	0.0001	0.2814	0.1054	0.0260	0.6499	0.3947
Post Lehman vs pre Lehman							
2009Q1	0.0029	-0.0010	0.0042	0.0015	0.0016	0.0064	0.0164
2008Q4	0.0001	-0.0027	0.0022	0.0014	-0.0004	-0.0008	0.0037
2008Q3	0.0021	-0.0040	0.0031	0.0008	0.0045	0.0009	0.0106
Difference (2009Q1 - 2008Q3)	0.0008	0.0031	0.0011	0.0007	-0.0029	0.0054	0.0058
Paired Dif. (2009Q1 - 2008Q3)	0.0010	0.0032	0.0010	0.0008	-0.0020	0.0049	0.0065
Ttest 2008Q3=2009Q1*	0.2733	0.0001	0.6439	0.3074	0.1743	0.1789	0.2217

Table 4, Panel A: Quarterly Cash to Assets

Panel A shows changes in cash holdings, as a percentage of assets, during the crisis for subgroups of firms formed before the crisis. Bank Relation includes all firms that had two or more loan facilities with the same U.S. lead bank in the five years before the end of the second quarter of 2006, according to Dealscan. High Leverage includes firms in the top quintile of leverage at the end of the second quarter of 2006. High Lev, Bank Dependent firms are high leverage firms that Capital IQ identifies as having either a bank loan or a revolver at the end of 2005 and at the end of 2006. Small, Bank Dependent includes all firms with assets below the 20th percentile of assets for NYSE firms at the end of the second quarter of 2006, that are unrated and that Capital IQ identifies as having either a bank loan or a revolver at the end of 2005 and at the end of 2006. Investment Grade are firms with an investment grade rating using the S&P long-term rating (*splticrm*) available on Compustat. No Leverage firms are firms that have leverage equal to zero in each quarter during the three years up to and including the end of the second quarter of 2006. High cash firms are in the top quintile of cash holdings in each quarter during the three years up to and including the end of the second quarter of 2006.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Whole sample	Bank Relation	High Leverage	High Lev, Bank Dep.	Small, Bank Dep.	No Leverage	High Cash
Post crisis vs pre crisis							
1. Avg (2006Q3-2007Q2)	0.2196	0.0806	0.1230	0.0791	0.1668	0.4519	0.6511
2. Avg (2007Q3-2008Q2)	0.2101	0.0770	0.1214	0.0794	0.1592	0.4075	0.5906
3. Avg (2008Q4-2009Q1)	0.2006	0.0841	0.1144	0.0789	0.1533	0.3821	0.5460
4. Avg (2009Q2-2010Q1)	0.2185	0.1002	0.1271	0.0928	0.1711	0.3901	0.5544
Difference (2 - 1)	-0.0095	-0.0036	-0.0016	0.0003	-0.0077	-0.0444	-0.0605
Ttest	0.0062	0.2226	0.7976	0.9171	0.2185	0.0020	0.0006
Difference (4 - 1)	-0.0011	0.0196	0.0041	0.0137	0.0042	-0.0618	-0.0967
Ttest	0.7503	0.0001	0.5174	0.0078	0.5185	0.0001	0.0001
Post Lehman vs pre Lehman							
2009Q1	0.2016	0.0859	0.1128	0.0790	0.1525	0.3838	0.5400
2008Q4	0.1996	0.0823	0.1161	0.0787	0.1540	0.3805	0.5519
2008Q3	0.1947	0.0756	0.1142	0.0745	0.1494	0.3697	0.5452
Difference (2009Q1 - 2008Q3)	0.0069	0.0102	-0.0014	0.0045	0.0031	0.0141	-0.0051
Paired Dif. (2009Q1 - 2008Q3)	0.0077	0.0099	0.0006	0.0028	0.0054	0.0236	0.0056
Ttest 2008Q3=2009Q1*	0.0001	0.0001	0.8432	0.2536	0.0432	0.0001	0.3902

Table 4, Panel B: Quarterly Cash to Assets

Panel B shows difference-in-differences results using the matching approach of Almeida et al. (2012). The table presents estimates of the changes in average quarterly cash holdings, as a percentage of assets, from the pre-crisis period to each of the three different crisis phases (first year of crisis, post Lehman, and last year of crisis). DID is the traditional differences in differences estimator. Matching estimator (ATT) is the Abadie-Imbens bias-corrected average treated effect matching estimator. Control firms are a subset of the non-treated firms selected as the closest match to the treated firms based on the following set of firm characteristics (exceptions noted in the paper): market-to-book ratio, operating cash flow, size, cash holdings, leverage ratio, 2-digit SIC industry, and credit ratings. ***, **, and * denote significance at the one percent, five percent, and ten percent level, respectively, using Heteroskedasticity-consistent standard errors. Definitions of the groups are in Panel A.

Precrisis (2006Q3-2007Q2) vs First year (2007Q3-2008Q2)					
	(1)	(2)	(3)	(4)	(5)
Treated firms	Bank Relation	High Leverage	High Lev, Bank Dependent	Small, Bank Dependent	No Leverage
precrisis	0.08124	0.09869	0.06897	0.14466	0.42092
postcrisis	0.07768	0.09055	0.06493	0.13197	0.37247
pre - post	0.00356	0.00815	0.00404	0.01269	0.04844
Control firms					
precrisis	0.16013	0.14860	0.16034	0.24000	0.17729
postcrisis	0.15496	0.13920	0.13923	0.22665	0.16935
pre - post	0.00517	0.00940	0.02112	0.01335	0.00794
diff-in-diff	-0.00161	-0.00125	-0.01708	-0.00066	0.04050 ***
Matching estimator (ATT)	0.00233	-0.00122	-0.01865	0.00169	0.03843 ***
Nobs.	784	518	401	699	299
Precrisis (2006Q3-2007Q2) vs Post Lehman (2008Q4-2009Q1)					
Treated: pre - post	-0.00255	0.01070	0.00532	0.01205	0.06422
Control: pre - post	0.00182	0.01395	0.02545	0.01609	0.01439
diff-in-diff	-0.00436	-0.00325	-0.02013	-0.00404	0.04982 ***
Matching estimator (ATT)	0.00183	-0.00180	-0.02225	-0.00059	0.04542 ***
Nobs.	719	448	348	613	269
Precrisis (2006Q3-2007Q2) vs Last Year (2009Q2-2010Q1)					
Treated: pre - post	-0.01884	-0.00300	-0.00760	-0.00604	0.05347
Control: pre - post	-0.01741	-0.00004	-0.00290	0.00688	-0.00163
diff-in-diff	-0.00143	-0.00296	-0.00470	-0.01291	0.05511 ***
Matching estimator (ATT)	0.00584	-0.00232	-0.00772	-0.00979	0.05138 ***
Nobs.	706	427	332	589	262