The Misfortune of Non-financial Firms in a Financial Crisis: Disentangling Finance and Demand Shocks

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Abstract

If a non-financial firm does not do well in a financial crisis, it could be due to either a contraction of demand for its output or a contraction of supply of external finance. We propose a framework to assess the relative importance of the two shocks, and apply it to the 2007-2008 crisis. We find robust evidence suggesting that both channels are at work, but that a finance shock is economically more important in understanding the plight of non-financial firms.

Key words: financial crisis, spillover, liquidity constraint, demand contraction

JEL codes: G2, G3

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[George Soros] noted, the financial crisis is beginning to have serious effects on the real economy, adding: "The extent of that is not, in my opinion, yet fully recognised."

Reuters (New York), April 9, 2008

"The claim that disruptions to the banking system necessarily destroy the ability of nonfinancial businesses to borrow from households is highly questionable."

Chari, Christiano, and Kehoe, October 17, 2008

1. Introduction

The subprime crisis that began in August 2007 has been called the worst financial crisis since the Great Depression by George Soros, Joseph Stiglitz, the International Monetary Fund, and other commentators.[1] While headline news tends to be dominated by the plight of investment and commercial banks and insurance companies, non-financial firms have also experienced economic difficulties. Figure 1 shows that their stock prices have exhibited a dramatic decline since the crisis broke out in August 2007.

It is not self-evident, however, that the real economy suffers from a negative finance shock. The fall in the stock prices of non-financial firms could be explained by a fall in the demand for their output. Indeed, those firms that produce consumer discretionary and leisure products and hence are more sensitive to a change in aggregate demand, tend to experience a greater decline in their stock prices. Furthermore, as Bates, Kahle, and Stulz (2007) document, non-financial firms held an abundance of cash prior to the crisis. According to them, "the net debt ratio (debt minus cash, divided by assets) exhibits a sharp secular decrease and most of this decrease in net debt is explained by the increase in cash holdings. The fall in net debt is so dramatic that average net debt for US firms is negative in 2004. In other words, on average, firms could have paid off their debt with their cash holdings." Given the apparent secular upward trend in cash holdings, the net debt ratio was likely even further into the negative territory by mid-2007, right before the start of the full-blown subprime crisis. This at least suggests the possibility of no serious liquidity tightening outside the financial sector. Probably out of this belief, Federal Reserve Chairman Ben S. Bernanke

[1] See http://www.thisismoney.co.uk/investing-and-markets/article.html?in_article_id=437212&in_page_id =3&ct=5; http://economictimes.indiatimes.com/International_Business/Financial_crisis_worst_since_1930s/articleshow/2881608.cms; http://www.guardian.co.uk/business/2008/apr/10/useconomy.subprimecrisis.

called strong corporate balance sheets "a bright spot in the darkening forecast" during his testimony at the U.S. Congress on monetary policy on February 27, 2008. Finally, as recent as in mid-October 2008, Chari, Christiano and Kehoe (2008) suggest that the data do not support the view that the supply of financing to non-financial firms had declined significantly in terms of either bank lending or issuance of commercial papers[2].

Disentangling finance and demand shocks is difficult in the aggregate as they are observationally equivalent. They also feed on each other as a crisis unfolds. To make progress, we propose a simple framework that explores heterogeneity across non-financial firms based on their differential *ex ante* vulnerability to each of the shocks. If there is a supply-of-finance shock, the effect is likely to be more damaging to those firms that are relatively more financially constrained to start with. Similarly, if there is an aggregate demand shock, it is likely to affect more those firms that are intrinsically more sensitive to a demand contraction. Exploring variations across firms may thus open a window into the respective roles of the two shocks in the fortune (or mis-fortune) of non-financial firms.

To determine cross-firm heterogeneity in the sensitivity to an aggregate demand contraction, we propose a measure of (sector-level) sensitivity to a demand shock, based on the stock price response to the 9/11/2001 terrorist attack. [We exclude firms in the airline, insurance, and defense industries because they were directly affected by the 9/11 attack.] To determine cross-firm vulnerability to a supply-of-finance shock, we construct a firm-level index on the degree of *ex ante* financial constraint, following Whited and Wu (2006). We further use an index of intrinsic dependence on external finance developed by Rajan and Zingales (1998) as a robustness check. It is important to note that financial constraint refers to difficulties in raising external finance of all kinds, not merely in borrowing from banks.

As control variables, we add beta, firm size, and book/market ratio from the Fama-French (1992) three factor model, and the fourth factor of momentum suggested by Lakonishok, Shleifer, and Vishny (1994). These factors are often but not always statistically significant. However, our two key regressors: financial constraint and consumer demand sensitivity, are always statistically significant with a correct sign. Our interpretation is that when the financial crisis hits, our two variables may reflect aspects of firm risks that are not

[2] See Cohen-Cole et al (2008) for a rebuttal.

completely captured by the three-factor, or the four-factor, model. As an extension, we further control for exposure to exchange rates and commodity prices.

To address concerns about possible endogeneity of the two key regressors, we make sure that our measures, the degree of a firm's liquidity constraint, and its sensitivity to demand shock, are pre-determined with respect to the financial crisis. In other words, our thought experiment is this: If we classify non-financial firms into different baskets, based on their *ex ante* degree of liquidity constraint, and *ex ante* sensitivity to demand shocks, would this classification help us to forecast the *ex post* stock price performance of these firms? If there is forecasting ability associated with these classifiers, would it carry over beyond what can be explained by the Fama-French three factors and the momentum factor?

We find that the answer to each question is yes. An increase in liquidity constraint by one standard deviation is associated with an additional decline in the stock price of 12.4 percentage points during July 31, 2007 – March 31, 2008. In comparison, an increase in sensitivity to consumer confidence by one standard deviation is associated with a contraction in stock price of 3.4 percentage points during the same period. We can also form four portfolios based on these two dimensions. The portfolio analysis suggests that a supply-of-finance shock is more important quantitatively than a contraction of demand in understanding the plight of non-financial firms.

This paper is linked to the literature on credit crunches (for example, Bernanke and Lown 1991; Borensztein, and Lee 2002; Dell'Ariccia, Detragiache, and Rajan 2008, among others). We differ from the earlier literature by considering demand sensitivity together with liquidity constraint. While our use of the Whited-Wu index as a measure of vulnerability to a finance shock is new, our measure of sensitivity to a demand shock is more novel. This paper is also related to a small but growing literature on the origin and consequences of the subprime problem as a *financial crisis*, including recent work by Mian and Sufi (2008), Reinhart and Rogoff (2008), Dell'Ariccia, Igan and Laeven (2008), and Greenlaw, Hatzius, Kashyap, and Shin (2008). As of now, we have not come across a paper that disentangles the mechanisms by which the subprime financial crisis spills over from the financial sector to the real economy. In this sense, this paper fills an important void.

The paper proceeds as follows. Section 2 presents our key specification, construction of key variables, and sources of data. Section 3 discusses the main empirical results and a slew of robustness checks and extensions. Section 4 offers concluding remarks.

2. Specification and Key Variables

2.1 Basic specification

Our basic strategy is to check whether a classification of firms by their *ex ante* vulnerability to a supply-of-finance shock and *ex ante* sensitivity to a contraction of demand helps to predict the *ex post* magnitude of their relative stock price movement during the crisis. To be precise, our basic specification is given by the following equation:

$$(1)\quad Stockreturn_{it} = \alpha_0 + \beta_1 DemandSensitivity_i + \beta_2 FinancialConstraint_{i,t-1} + \varepsilon_{it}$$

Note that this is a purely cross-sectional regression, and the key regressors are pre-determined (in 2006). By construction, our specification avoids the complication associated with possible two-way feedbacks between the finance and demand shocks as a crisis progresses. As a basic robustness check, we also add the three factors from Fama and French (1992): firm size (log of assets), the ratio of the market to book values, and beta (the correlation of the firm's stock return with the overall market). In some specifications, we also add a fourth control variable: a momentum factor from Lakonishok, Shleifer and Vishy (1994). The expanded specification is:

$$\begin{aligned}(2)\quad Stockreturn_{it} = {} & \alpha_0 + \beta_1 DemandSensitivity_i + \beta_2 FinancialConstraint_{i,t-1} + \gamma_1 Size_{i,t} \\ & + \gamma_2 Market/Book_{i,t-1} + \gamma_3 Beta_{i,t-1} + \gamma_4 Momemtum_{i,t-1} + \varepsilon_{it}\end{aligned}$$

We follow Whited and Wu (2006) and incorporate the four factors by entering the relevant firm characteristics directly in our regressions rather than entering them indirectly by going through a factor model first. As control variables, these two ways of incorporating the four factors should be equivalent. Entering firm characteristics directly is easier to implement, though the interpretation of the coefficients on these factors is less straightforward.

While subprime loans were sporadically reported as problematic in late 2006 and early 2007, it began to be widely recognized as a crisis in August 2007. We conduct a search of news articles that contain the words "subprime" and "crisis" in all newspapers in the United States, excluding pricing and market data and republished news, and report the results in Figure 2. There was a clear spike in such news in early August 2007. The International Monetary Fund also clearly thought of August 2007 as the starting date of a serious crisis[3]. We therefore implement our main regressions for the period from early August 2007 – end of March 2008. We will also consider other sample periods as extensions or placebo tests.

2.2 Key Data

Percentage change in stock price

The stock price data is from Datastream, with adjustments for dividends and capital actions such as stock splits and reverse splits. Figure 1 presents the stock price index for the S&P 500 and its subcomponents over the period from January 2007 to March 2008. From there, we see that the cumulative decline of stock price index was approximately 14%, with the largest drop coming from the financial sector. However, many non-financial firms also lost value, such as "consumer discretionary" firms.

Financial constraint index

There is an active literature on measuring liquidity constraint. One popular measure is given by Kaplan and Zingales (1997). They use *ex ante* information to judge which firms are liquidity constrained, and then use a regression framework to see which variables can best forecast whether a firm is liquidity constrained. This procedure leads them to define an index of liquidity constraint based on five variables: the ratio of cash flow to capital, Tobin's q, the ratio of debt to capital, the ratio of dividends to capital, and the ratio of cash to capital.

The most up-to-date and theoretically consistent measure is provided by Whited and Wu (2006). They cast the liquidity constraint faced by a firm as the shadow value of raising one extra dollar of external financing - the value of a Lagrange multiplier associated with a lower bound on dividend payouts in a firm's optimization problem. They assume a functional

[3] International Monetary Fund, World Economic Outlook, April 2008.

relationship between the shadow value and a set of nine variables that the existing literature has suggested to be relevant for liquidity constraint. After a GMM estimation, they determine that the following six variables are statistically significant at the ten percent: (i) the ratio of cash flow to assets; (ii) a dummy that takes the value of one if the firm issues positive dividend in that period, and zero otherwise; (iii) the ratio of long term debt to total assets; (iv) the natural log of total assets; (v) the firm's three-digit industry sales growth; and (vi) the firm's sales growth. The other variables are judged to be insignificant by both individual t-tests and a joint significance test. Reassuringly, the signs of the first six coefficients are also consistent with economic theory and intuition. Whited and Wu define a firm's financial constraint as the shadow value of external financing as predicted by these six variables.

We take the coefficient estimates from Whited and Wu's preferred specification (i.e. Column 4 in Table 1 of their paper), use the values of the six variables at the end of 2006, and compute the fitted value of the shadow value equation firm by firm. To be more precise, a firm's financial constraint index is given by the following equation:

$$
\begin{aligned}
(3)\ & Financial\ Constraint_{it} \\
&= -0.091(CashFlow / Asset)_{it} - 0.062 DividendDummy_{it} + 0.021(Debt / Asset)_{it} \\
&\quad - 0.044 \ln(Asset)_{it} + 0.102 IndustryGrowth_{it} - 0.035 FirmGrowth_{it}
\end{aligned}
$$

Firm-level balance sheet data come from Compustat USA. By construction, they are predetermined with respect to the onset of the subprime crisis in the summer of 2007.

Whited and Wu compare their index with another popular measure of financial constraint given by Kaplan and Zingales (1997). In simulated data, they find that the Kaplan-Zingales index does not perform well in selecting firms that are financially constrained by design. In a sense, this is not surprising as Whited and Wu could be regarded as a generalization of the Kaplan-Zingales index, but with a better grounding in the theory and in a more sound structural estimation from the data. As a result, we make the Whited-Wu index our primary measure of financial constraint.

As a robustness check, we also employ an alternative measure proposed by Rajan and Zingales (1998). The RZ index gives a sector-level approximation of a firm's intrinsic

demand for external finance. Following Rajan and Zingales (1998), we define a firm's intrinsic demand for external financing by:

$$(4) \qquad \text{Dependence on external finance} = \frac{[\text{capital expenditures - cash flow}]}{\text{capital expenditures}},$$

where Cash flow = cash flows from operations + decreases in inventories + decreases in receivables + increases in payables. All the numbers are based on US firms, which are judged to be least likely to suffer from financing constraints relative to firms in other countries. The original Rajan and Zingales (1998) paper covers only 40 (mainly 2-digit) sectors. Here, we expand the number of sectors to around 400 4-digit sectors.

To calculate the demand for external financing for US firms, we take the following steps. First, every firm is sorted into one of the 4-digit sectors. Second, we calculate the ratio of dependence on external finance for each firm from 1990-2006. Third, we calculate the sector-level median from firm ratios for each 4-digit sector that contains at least 5 firms, and the median value is then chosen as the index of demand for external financing in that sector.

Conceptually, the Rajan-Zingales (RZ) index measures something related to but not identical to the Whited-Wu index. The RZ index aims to identify sector-level features, i.e. which sectors are intrinsically more dependent on external financing for their business operation. It ignores the question of which firms within a sector are more liquidity constrained. What the RZ index measures could be regarded as a "technical feature" of a sector, almost like a part of the production function. Of course, the RZ and WW indices should also be related: firms located in a sector that is naturally more dependent on external finance are also more likely to be liquidity constrained. Conversely, in a sector that does not need external finance, firms are less likely to be liquidity constrained. The simple correlation between the WW and RZ indices is 0.26.

Demand Sensitivity Index

A second key regressor is an index of a firm's sensitivity to a contraction in consumer demand. There are no existing measures in the literature, so we have to invent one. Ideally, we want this index to reflect the sensitivity of a firm's stock price to a sudden, unexpected change in future consumer demand. At the same time, we do not want the index to be contaminated by a firm's sensitivity to a liquidity shock or other factors.

We propose an index at the sector level based on the stock price reactions of the firms in that sector to the terrorist attack in 2001 (from September 10 to September 28, 2001). The 9/11 shock was large and unexpected. We can verify that there was a big downward shift in consumer confidence and expected future demand, as reflected by a downward adjustment in the forecast of subsequent US GDP growth, by the International Monetary Fund and other professional forecasters, in the aftermath of the shock.[4] Figure 3 shows a sharp drop in consumer confidence right after Sept 11th, which stayed low for the subsequent four months. Figure 4 further shows that the consensus forecast for the 2002 US GDP growth rate also declined sharply by 1.5% after the 9-11 shock, and stayed low for at least three months. The International Monetary Fund, in its special December 2001 issue of the World Economic Outlook, asserted that "the main impact [of the 9/11 shock] is likely to depend primarily on the fall in demand generated by the loss in confidence about the economy". We therefore conclude the changes in stock price during September 10-28, 2001, capture firms' vulnerability to a perceived contraction in consumer demand.

At the same time, because the Federal Reserve took timely and decisive actions, it may be argued that the effect of the 9/11 shock on firms' financial constraint was small or at most short lived. In fact, the Federal Reserve announced on September 17, 2001: "The Federal Reserve will continue to supply unusually large volumes of liquidity to the financial markets, as needed, until more normal market functioning is restored." This is particularly true when comparing the interest rate spread between the period of the 2001 terrorist attack and the corresponding period of 2007. Figure 5 plots the spread between the three-month interest rate banks charge each other (in the euro-dollar market) over the three-month Treasury bills (TED spread) from early August to end of October in both 2001 and 2007. In the first episode, both the level of the real interest rate and the spread (risk premium) returned quickly to a level that was only moderately higher than the pre-9/11 level after an initial spike. This suggests that the market likely regarded the Federal Reserve's actions in the first few days following the terrorist attack as sufficient to restore the market's desired level of liquidity. Indeed, the International Monetary Fund, in its December 2001 supplemental issue

[4] The consensus forecast for the year of 2001 Real GDP growth rate dropped from 1.6% to 1%, after the September 11 attack. Meanwhile, the consensus forecast for the year of 2002 dropped from 2.7% to 1.2%.

of the World Economic Outlook, declared that "concerted policy responses by the US and other authorities to provide such liquidity were effective in quickly restoring market stability and heading off systemic concerns." We therefore conclude that the cumulative stock price change over September 10-28, 2001, is unlikely to also reflect a firm's reaction to a deterioration of credit availability. [In contrast, the subprime crisis news is associated with a much greater increase in the TED spread.]

We further examine the impacts of uncertainty on the stock price. Bloom (2009) argue that the uncertainty component increases significantly right afterward the 9/11 shock. We hence examine the measure of market uncertainty as used in Bloom (2009): the VIX index. The VIX index is the ticker symbol for the Chicago Board Options Exchange Volatility Index since 1987, a popular measure of the implied volatility of S&P 500 index options. A high value corresponds to a more volatile market and therefore more costly options. We find that after 9/11, the VIX index increased from 31.84 on 9/10 to 43.71 on 9/20. But the index declined after 9/20. And by 9/28, it reached 31.93, similar to the pre-crisis level. That is, by 9/28, the uncertainty factor due to the 9/11 shock has significantly subdued. Hence when we compare the stock price from September 10 to 28, 2001 to derive the demand sensitivity, the uncertainty is unlikely to be a major driver.

To construct the index of demand sensitivity, we first compute the change in log stock price for each US firm during September 10-28, 2001. We then look at the mean of log stock price change for each four-digit SIC sector, and use it as the sector-level demand sensitivity. In this exercise, we drop the airlines, defense, and insurance sectors, which were affected directly by the terrorist attack. We also exclude financial sector firms and are left with 759 4-digit sectors in total. We choose our window deliberately. If the window is too short, the index may also reflect a firm's reaction to a perceived tightening of liquidity. If the window is too long, the prospect for US GDP growth might be revised upward so that the index may no longer capture a firm's reaction to a perceived economic downturn.

We perform two additional sniff tests to check if the index is sensible. First, we pick out a sector that intuitively should be relatively sensitive to a demand contraction ("consumer discretionary" such as leisure goods), and another sector that intuitively should be much less so ("consumer staples" such as food and non-durable household goods). We check if the 9/11 index produces values that are consistent with this classification. The 9/11 index indeed

yields a larger value for "consumer discretionary" sector, which is consistent with the notion that the 9/11 index reflects sensitivity to a demand contraction.

As a second sniff test, we compute a revision in analyst forecasts of a firm's earnings for the following year in the months immediately before and after the 9/11 terrorist attack (typically August and October of that year), and check to see if the revisions of earnings forecast are related to our proposed index for sensitivity to a demand contraction. When the proposed demand contraction index is regressed on the revision in earnings forecast, the slope coefficient is positive (0.17) with a t-statistic of 13.5. The exact point estimate may not be that useful, but the positive sign of the coefficient that is statistically significant shows that the 9/11 index is plausibly a measure of sensitivity to a demand contraction.

Other Variables and Summary Statistics

In subsequent statistical analyses, we sometimes add other control variables, such as the three factors from the Fama-French (1992) and the momentum factor. The underlying data come from the CRSP database, including firm-level market beta.

Table 1a reports summary statistics of the key variables. Demand sensitivity, liquidity constraint (the Whited-Wu index), and intrinsic dependence on external finance (the Rajan-Zingales index) are all standardized to facilitate interpretation of subsequent regression coefficients. They all have a unitary standard deviation by construction. Table 1b reports pair-wise correlations among the variables. It is particularly noteworthy that the correlation between the two key regressors, demand sensitivity and financial constraint, is as low as 0.01. Hence they are virtually orthogonal to each other.

3. Empirical Analysis

3.1 Basic Results

We examine percentage change in stock price (or more precisely, difference in log stock price) from July 31, 2007 to March 31, 2008 for US non-financial firms. In Column 1 of Table 2, we have the demand sensitivity index and the liquidity constraint (Whited-Wu) index as the only regressors. Both variables have a negative coefficient and are statistically significant: across firms, those that are more sensitive to a loss in consumer confidence, or

were more liquidity constrained before the subprime crisis, experienced a greater fall in stock price during the subprime crisis. Since both variables are standardized, we can read off the point estimates directly: An increase in *ex ante* sensitivity to demand contraction by one standard deviation is associated with an extra drop in stock price by 3.7 percent. In comparison, an increase in *ex ante* liquidity constraint by one standard deviation is associated with an extra drop in stock price by 11.7 percent. As far as variation across firms is concerned, liquidity constraint appears to be a quantitatively more important explanation than an expected contraction of demand. [The relatively low R-squared does not overly bother us as this is a pure cross-sectional regression, and changes in stock prices are likely to be difficult to explain if the efficient market hypothesis is approximately correct.]

In Column 2 of Table 2, we add the three factors from the Fama-French model as controls. Two of them are statistically significant. Firms with a high book to market ratio experience a greater decline in price. This is consistent with the idea that a higher such ratio represents a greater risk, and a riskier stock will exhibit a bigger price fall in bad times. [If we take the inverse of book/market ratio as a measure of investment opportunities, this means that firms with fewer investment opportunities lose more in stock value.] The firm size variable is not significant. This pattern is also present in the original Whited and Wu (2006) paper. According to their interpretation, liquidity constraint is the underlying reason why size matters for stock returns. Once we properly control for a theory-consistent measure of liquidity constraint, firm size no longer matters. The coefficient on the "beta" variable is positive and significant. Somewhat surprisingly, it says that firms with a larger beta experience a smaller reduction in stock price, other things being equal. In any case, even with the three Fama-French factors controlled for, both demand sensitivity and financial constraint factors are still statistically significant. In Column 3, we add a momentum variable as an additional control. This variable is statistically significant. Stocks that have experienced a fall in price in the recent past are more likely to continue to fall in price in the subsequent periods. Again, controlling these four factors makes little difference to the statistical significance level or the size of the point estimates for demand sensitivity and liquidity constraint. Hence, our key conclusion appears robust: initially more financially constrained

firms suffered a larger drop in stock price. The same is true for relatively more demand-sensitive firms[5].

If the financial crisis disproportionately harm those non-financial firms that are more liquidity constrained and/or more sensitive to a consumer demand contraction, could financial investors earn excess returns by betting against these stocks (relative to other stocks)? This is essentially another way to gauge the quantitative importance of these two factors. We now turn to a "portfolio approach," and track the effects of the two factors over time. Specifically, we follow three steps. First, we classify each non-financial stock (other than airlines, defense and insurance firms) along two dimensions: whether its degree of liquidity constraint at the end of 2006 (per the value of the Whited-Wu index) is above or below the median in the sample, and whether its sensitivity to a consumer demand contraction is above or below the median. Second, we form four portfolios on July 31, 2007 and fix their compositions in the subsequent periods: the HH portfolio is a set of equally weighted stocks that are highly liquidity constrained by the end of 2006 and highly sensitive to consumer demand contraction; the HL portfolio is a set of stocks that are highly liquidity constrained, but relatively not sensitive to a change in consumer demand; the LH portfolio consist of stocks that are relatively not liquidity constrained but highly sensitive to consumer confidence; and finally, the LL portfolio consists of stocks that are neither liquidity constrained nor sensitive to consumer confidence. Third, we track the cumulative returns of these four portfolios over time and plot the results in Figure 6.

Several interesting patterns can be discerned from the graph. First, the HH portfolio clearly has the largest cumulative decline in stock prices over time whereas the LL portfolio has the smallest. Second, the cumulative returns lines for the HH and HL portfolios are close to each other at the bottom of the group, whereas those for LL and LH are next to each other, on top of the group. This means, the quantitative effect of liquidity constraint (in explaining cross-firm difference in stock price declines) is much bigger than that of a loss in consumer confidence. Third, if one were to have formed a mega-portfolio at the beginning of August

[5] *Ex ante*, financial constraint and demand sensitivity could be related. In the data, however, the correlation between the two is relatively low (at 0.01). In any case, we have tried a regression which extends the specification in the last column of Table 2 by adding an interaction term between the two indices. The coefficient on the interaction term turns out to be statistically insignificant.

2007, that shorted the HH portfolio and longed the LL portfolio, one would have earned a return on the order of 30 percent by the end of March 2008.

We cannot say that the quantitative effect of demand contraction on the market as a whole is small because it could reduce the stock prices of all firms in a proportional fashion. However, the difference between the HH and LL portfolios in terms of the percentage fall in stock price is approximately half of the unconditional fall in the overall stock price (about 20 percentage points out of 40 percentage points from early August 2007 to end of March 2008). A conservative estimate is that at least half of the overall price decline is due to a negative shock to the finance supply (for those stocks that were liquidity constrained to start with).

3.2 Evolving Roles of Finance and Demand Shocks

Our primary regressions reported in Table 2 are conducted on the sample period from July 31, 2007 to March 31, 2008. They look into the separate roles of a reduction in the supply of finance and a contraction of the aggregate demand in explaining the cumulative stock price decline during the period. As an alternative, we can trace the roles of these two factors over time by conducting the same regressions over a set of gradually expanding sample periods, adding one month each time to the sample, but always controlling for size, book/market ratio, beta, and momentum. Specifically, we perform the first regression on the period from July 31, 2007 to August 31, 2007, the second regression from July 31, 2007 to September 30, 2007, and so on, until the eighth regression from July 31, 2007 to March 31, 2008. The specification is always the same as in Column 3 of Table 2. A major difference between this exercise and the analysis of the four portfolios discussed above is the control for the three Fama-French factors and momentum. Instead of reporting the detailed results of the eight regressions, we summarize the coefficients on the two key regressors, liquidity constraint and demand sensitivity, in Figure 7. While the point estimates (and the corresponding standard errors in parenthesis) for demand sensitivity are 0.33 (0.23), -0.01 (0.34), -0.12 (0.45), -0.38 (0.57), -0.61 (0.65), -2.03 (0.65), -2.65 (0.73), and -2.72 (0.80) respectively; the point estimates for financial constraint are -1.98 (0.62), -0.07 (0.91), -1.22 (1.23), -2.84 (1.54), -4.84 (1.75), -7.55 (1.76), -8.26 (1.98), and -12.50 (2.18), respectively.

Several features of the data are worth noting. First, in the first month of the sample (July 31, 2007 – August 31, 2007), the coefficient on liquidity constraint is negative, but the

coefficient on demand sensitivity is zero. By searching news reports, we find that this was the time when the subprime woes were first thought of as a widespread crisis. American Home Mortgage filed for bankruptcy on August 6, 2007. The news broke on August 16 that Countrywide Financial Corporation had to take out an emergency loan of $11 billion to narrowly escape bankruptcy. Financial institutions outside the United States such as BNP Paribas started to reveal large exposure to US subprime losses. A major presidential candidate, Hillary Clinton, proposed a bailout fund for homeowners at risk of foreclosure on August 7, 2007. Perhaps more significantly, the Federal Reserve Board lowered the discount rate by 50 basis points to 6.25 percent, while President Bush announced a limited bailout of homeowners on August 31, 2007. However, there was only a very modest adjustment in the consensus forecast of US GDP growth rate in that month (see Figure 2a). Apparently, while the subprime woes were recognized as a shock to the financial system, it was not widely expected then that they would have a major negative impact on the US economy.

Curiously, during the second sample period (July 31, 2007 – September 30, 2007) neither coefficient is different from zero. It is possible that market participants interpreted the actions taken by the Federal Reserve and the President as being sufficient to prevent a spillover of the crisis from the financial sector to the real economy given what market participants thought they knew about the extent of the subprime problem. However, bad news did not stop coming in August. The British bank Northern Rock experienced a bank run in mid-September, 2007. Former Federal Reserve Chairman Alan Greenspan joined the fray by declaring that the fall of housing prices was likely going to be "larger than most people expect." More and more financial institutions started to reveal bad news about exposure to subprime loan products in September, November, and the first quarter of 2008. The Federal Reserve took a succession of actions including lowering policy interest rates and expanding liquidity provisions over this period. The Federal Government also took several initiatives (for example, the creation of the Hope Now Alliance, the announcement to encourage a voluntary and temporary freeze of mortgage payments, and the attempt to modernize the Federal Housing Authority). At the same time, the market began to reassess the seriousness of the subprime problem and its impact on the real economy. In Figure 7, the market reaction to these developments manifests itself in incrementally more negative coefficients on the key regressors over time. This is shown most clearly in the case of liquidity constraint. The

coefficient became -1.2 in October and increased in absolute value steadily month by month, until reaching -12.5 by the end of March 2008. In relative terms, a loss of consumer confidence was not perceived to be a major factor until December 2007. Even then, the coefficient on sensitivity to demand contraction was always smaller than that on liquidity constraint in every subsequent sample period, reaching -2.72 by the end of March 2008.

A deterioration of financial constraint faced by non-financial firms in the first quarter of 2008 is consistent with a Senior Loan Officer Survey conducted in April 2008.[6] About 55% of domestic US banks, up from about 30% in the January survey, reported to have tightened lending standards on loans to large and medium-sized (non-financial) firms over the preceding three months. Moreover, about 70% of the banks—up from about 45% in the January survey—indicated that they had increased the spread of loan rates over their cost of funds. They noted that concerns about their current or expected capital positions had contributed to more stringent lending policies over the preceding three months.

To summarize, the realization that credit crunch and demand contraction could damage the real economy outside the financial sector looks like a gradually unfolding drama. Throughout the sample period, tightening liquidity constraints are a leading actor, always perceived to be more important, while demand contraction is a supporting actor, playing a quantitatively smaller role in explaining cross-firm differences in stock performance.

3.3 Alternative Measure of Financial Dependence

For our story to be persuasive, we have to make sure that the key measure of liquidity constraint is valid and informative. We therefore conduct several additional checks. The Whited-Wu index has been used as a measure of liquidity constraint at the firm level in all the regressions so far. As an alternative, we follow Rajan and Zingales (1998) and adopt a sector-level measure of a firm's intrinsic demand for external finance. As noted in the data section, the underlying idea behind Rajan and Zingales (1998) is different from Whited-Wu (2006); the simple correlation between the Rajan-Zingales (RZ) index and the Whited-Wu (WW) index is 0.26. This means that the RZ index can potentially provide an informative

[6] http://www.federalreserve.gov/boarddocs/snloansurvey/200805/

and independent check on the notion that financial constraint plays a major role in explaining the effect of the subprime crisis on non-financial firms. While the original RZ index was constructed for 40-some sectors at the SIC 2-digit level, we expand it to cover about 400 sectors at the SIC-4-digit level (following the same conceptual framework).

In Column 1 of Table 3, we report the regression in which the WW index is replaced by the RZ index. As we can see, both the RZ index and the demand sensitivity index have negative coefficients that are statistically significant at the 1% level. In particular, those firms that naturally rely more on external finance for business operation experience a bigger fall in stock prices during the financial crisis period. An increase in the RZ index by one standard deviation is associated with a bigger decline in stock price, by 3 percentage points.

Because the RZ and the WW indices measure somewhat different aspects of a firm's dependence on external finance, we can also include both in a regression and explore the role of their interaction. This is done in Column 2 of Table 3. It turns out that each of the two indices and an interaction term between the two all produce negative coefficients that are significant at least at the 5% level. In other words, firms that were liquidity constrained at the beginning of the sample period fared worse in their stock prices following the outbreak of the subprime crisis. This effect is magnified for firms that were both liquidity constrained and located in sectors that are naturally more dependent on external finance.

In Columns 3 and 4 of Table 3, we add the Fama-French three factors (firm size, book/market ratio, and beta) and the momentum factors, respectively, to the above regression. Clearly, even after controlling for these four factors, liquidity constraint, intrinsic dependence on external finance, and their interactions (as well as sensitivity to demand shock) continue to have negative coefficients that are significant at the 1% level. This provides some additional support for our contention that there really was a serious financial shock that negatively impacted non-financial firms in a statistically and economically significant way.

3.4 Placebo Tests

We use firm-level stock price reaction to the September 11, 2001 terrorist attack (the change in log stock price from September 10-September 28, 2001) as a measure of a firm's sensitivity to demand contraction in the subsequent subprime period. We cited evidence that there was an expectation of recession after the attack as indicated by a sharply more

pessimistic forecast of US GDP growth by the International Monetary Fund and by professional commercial forecasters subsequent to the 9/11 shock that lasted well beyond September 28, 2001. Since the 9/11 attack directly and physically affected many financial institutions in the Wall Street, and the New York Stock Exchange was even closed for a few days, it is reasonable to ask whether our 9/11 index could also partly reflect a firm's sensitivity to a tightening liquidity constraint. If it is, then this could contaminate our interpretation of the results reported in Table 2. We previously argued in the data section that any effect on cost of capital and availability of external finance from the 9/11 attack was temporary and short-lived (as shown in Figure 3). By the choice of our time window (September 10-28, 2001), the 9/11 index (or the variation across firms in stock price responses) is not likely to be severely contaminated by firms' sensitivity to financial constraint.

We now perform a placebo test that examines this directly. Specifically, we measure a firm's liquidity constraint by the Whited-Wu index, using the values of the constituent variables at the end of 2000. [This is exactly parallel to the index used in Table 2, except that the constituent variables of the Whited-Wu index in that case are based on their end-of-2006 values.] We ask whether this direct measure of liquidity constraint helps to explain the magnitude of stock price declines during September 10, 2001-September 28, 2001, the period used to construct the index for demand sensitivity. The results are presented in Table 4. We find that financial constraint is not statistically significant: Differential degrees of liquidity constraint across firms (in 2000) do not explain cross-firm differences in stock price reactions after the 9/11 shock. This increases our confidence that the 9/11 index is not likely to be contaminated by firm's sensitivity to liquidity constraint itself.

Our principal claim is that the subprime crisis affects the real sectors in the economy through a combination of a tightening liquidity constraint and a contraction of consumer demand. How do we know these two factors only became important after the subprime trouble began to be recognized as a large-scale crisis in August, 2007?

We now conduct a different placebo test, replicating the key regressions in Table 2, but on a sample period prior to the subprime trouble being recognized as a generalized crisis. Table 5 reports these regressions for the period June 30 to July 31, 2007 (firm-level financial constraints are still measured based on end-2006 values of the Whited-Wu index). Neither

financial constraint nor demand sensitivity is statistically significant. A lack of statistical significance on the Whited-Wu index suggests that it was not a general predictor of future firm value before August 2007. A lack of statistical significance on the demand sensitivity variable confirms the information in Figures 2a and 2b: As there was no general expectation of a demand contraction, there was no reason as yet then for stocks that were more sensitive to a demand contraction to do worse than other stocks. This also reinforces our confidence that the 9/11 index appears to capture firms' sensitivity to a change in consumer demand. We replicate the same exercise for an earlier period (January 1, 2007 – May 31, 2007), and find the same pattern (of no statistical significance for demand sensitivity or liquidity constraints). This leads us to conclude that the data patterns in Table 2 are really those associated with the subprime crisis period, and not with other factors present in earlier periods.

3.5 Exposures to Exchange Rate and Commodity Price Movements

Since the subprime crisis broke out in August 2007, there have been other developments in the economy that could affect stock prices *ex post*. Most prominently, the US dollar depreciated against the euro and the Japanese yen by 15 and 18 percent, respectively, during July 31, 2007 – March 31, 2008; the world oil price increased by close to 40 percent during the same period. The dollar depreciation would presumably increase the profit of export-oriented firms but reduce that of those that rely heavily on imported inputs. Similarly, the energy price hike would likely increase the profit of energy producers but reduce that of most other companies.

Recall that both the liquidity constraint and demand sensitivity indices are measured using data collected prior to the subprime crisis period. Since we are interested in understanding whether an *ex ante* classification of firms by their degree of liquidity constraint and sensitivity to demand contraction could help predict their *ex post* stock price movement during the subprime crisis period, we may argue that the Fama-French three factors plus the momentum factor have already summarized all the other *ex ante* information relevant for stock returns. In other words, the specifications in Tables 2 and 3 are already sufficient; there is no need to incorporate *ex post* firm exposures to exchange rate and commodity price movements as additional controls.

Nonetheless, there could be coincidental correlations between our *ex ante* measure of liquidity constraint (or demand sensitivity) and the *ex post* realized movement in exchange rates and commodity prices. As another robustness check, we now attempt to control for a firm's exposures to currency and commodity price movement. An immediate difficulty that we face is a lack of systematic information on firm revenue and cost by currency, or on a firm's exposure to commodity price movement. We follow Adler and Dumas (1984) and Dominguez and Tesar (2001 and 2006) by constructing our own indices for exposure to exchange rates and commodity prices, based on a three-step procedure. In Step 1, we measure the relationship between weekly stock prices and major exchange rates and commodity prices in the three calendar years prior to the subprime crisis. More precisely, for each firm, we regress its weekly stock returns on the S&P 500 market return, percentage changes in the euro-dollar exchange rate and the yen-dollar exchange rate, and percentage changes in three commodity groups' spot price indices (energy, agricultural products, and metals) during the period from 2004 to 2006.[7] We collect the five estimated coefficients on the exchange rates and the commodity prices for each firm. In step 2, we multiply these coefficients individually with the realized percentage changes for these exchange rates and commodity price indices over July 31, 2007 – March 31, 2008.[8] These are firm-level *ex post* exposures to major currencies and commodity prices. In step 3, we add these five exposure variables as additional controls in our main regressions. Note that in the first step, an oil producer would likely have a positive coefficient on the energy price index, whereas a firm that uses oil as an input would likely to have a negative coefficient. As a result, all exposure variables are expected to enter Step 3 with a positive sign.

We report the regression result (Step 3 above) in the first column of Table 6. Of the five new control variables, the coefficient on energy price exposure is positive and statistically significant: energy producers, relative to energy users, experienced a smaller drop in stock prices (or even an increase in stock prices) during July 31, 2007 – March 31, 2008. The coefficients on the two exchange rates and the agriculture price exposure are not

[7] For more details on the S&P commodity spot price indices, see http://www2.goldmansachs.com/services/securities/products/ sp-gsci-commodity-index/tables.html.

[8] From July 31, 07 to March 31, 08, the price of agriculture and energy rose by 36% and 29% respectively, while the price of metal declined by 0.7%.

different from zero statistically. This could mean that most firms in the sample did not have much exposure to these factors. Alternatively, it could mean that most firms had already undertaken adequate hedging strategies, including buying currency futures and options, so that *ex post* realized movements in exchange rates and agricultural prices did not have a material impact on their profit. The coefficient on metal price exposure has a negative sign. We do not have a good explanation except to note that this turns out not to be robust in subsequent specifications (reported in the last two columns of Table 6).

We now come to our two key regressors: liquidity constraint and demand sensitivity. Both continue to have a negative coefficient that is statistically significant at the 1 percent level. In fact, the size of the point estimates is virtually unaffected by the inclusion of the exposures to major exchange rates and commodity prices.

In Column 2 of Table 6, we add the Rajan-Zingales measure of intrinsic dependence on external finance, and its interaction with the Whited-Wu measure of liquidity constraint. As in Table 3, liquidity constrained firms experienced a bigger fall in stock prices, especially for those located in sectors that are intrinsically more reliant on external finance.

In constructing our firm-level exposures to major exchange rates and commodity prices, we notice that some of the coefficients in firm-by-firm regressions (in Step 1 discussed above) are not different from zero statistically. As an alternative way to construct our exposure variables, we assign these coefficients to be zero and redo our regressions. The regressions with the alternative definition of the exposures are reported in Columns 3 and 4 of Table 6. The coefficient on the energy exposure variable is still positive and significant, with the point estimate 20 percent larger than before. The two exchange rate exposures are still insignificant. This time, the metal price exposure becomes insignificant but the agriculture price exposure becomes negative and significant. Other than these, there are no material changes to the regression results. In particular, firms that are more liquidity constrained or more sensitive to demand contraction continue to exhibit a larger decline in their stock prices during the subprime crisis period.

As an extension, we have also attempted to control for firm-level exposure to interest rate changes. It is possible that different firms may respond differently to a given rise in the interest rate, for reasons unrelated to their liquidity constraints. We account for this using a methodology similar to the approach to control for a firm's exposure to exchange rates and

commodity prices. Specifically, we first estimate a firm-level sensitivity to these factors by regressing weekly stock returns on the market return, changes in the two exchange rates, changes in the three commodity price indices, and then changes in the interest rate (proxied by 3-month Treasury bills) during the period from 2004 – 2006. Using the estimated coefficients and the actual realized change in the interest rate during July 31, 2007 – March 31, 2008, we can compute a firm-specific exposure to interest rate change (and similarly, exposures to changes in exchange rates and commodity prices). Incorporating the interest rate exposure in specifications like those in Table 6 reveals no material effect on the estimates or the significance levels of the coefficients on either the demand elasticity or the liquidity constraint variable (regression results not reported to save space).

3.6 Additional Robustness Checks and Extensions

We construct an alternative index of sensitivity to a demand shock that purges the influence of the four factors: firm size, book/market, beta, and momentum. In other words, we first regress change in log stock prices during September 10-28, 2001 on the four factors (which is reported in the first column of Table 4). We then use the residual to construct an alternative index of a firm's sensitivity to demand shocks. We redo all the regressions in Tables 2 and 3 but find the results to be virtually unaffected. To be precise, the coefficients on demand sensitivity and financial constraint are negative and statistically significant at the 1 percent level. The point estimates are slightly smaller than, but not statistically different from, those in Tables 2 and 3.

We vary the time window used to construct the demand sensitivity index from September 10-28, 2001 to September 10 – October 12, 2001. With this modified index, the coefficient on demand sensitivity in a specification similar to Column 3 in Table 2 becomes smaller in absolute value (from -3.37 to -2.58), but it does not materially affect the estimate on the liquidity constraint measure (not reported).

The demand sensitivity index is measured at the 4-digit sector level. As a robustness check, we also construct it at the three and two-digit levels, respectively. The three-digit level index is constructed as the mean of the index at the four-digit level, and the two-digit level index as the mean of the index at the three-digit level. Because different sectors have uneven number of sub-sectors, these alternative constructions also effectively reassign weights to the

firms. We re-run all regressions in Table 2 and find similar results. For example, when using the three-digit level index in a regression similar to that in the last column of Table 2, the estimated coefficient on demand sensitivity is -2.21, with a standard error of 0.84. In other words, the point estimate is a bit smaller, but still significant at the 1 percent level.

We note in the introduction that many firms had larger cash holdings in recent years than in the past. Some may point to this and argue that a liquidity constraint is not likely to be a significant factor during the current subprime crisis. However, the level of cash holding is in principle endogenous. For example, it could be a response to increased risk associated with more volatile cash flows (as pointed out by Bates, Kahle, and Stulz 2007). We add a firm's "cash and short-term investments" as an additional control to a specification otherwise identical to Column 3 of Table 2. The associated coefficient turns out to be negative and statistically significant at the 1 percent level, with a point estimate of -12.8, and a standard error of 3.90. In other words, those firms with a higher cash stock actually experienced a larger drop in stock prices. This is consistent with the view that a higher level of cash holding is a sign of a riskier cash flow: when a crisis hits, these firms are likely to fare worse. Reassuringly, the coefficients on both liquidity constraint and demand sensitivity continue to be negative and statistically significant at the 1 percent level. In fact, the point estimates are very close to those in Table 2.

4. Conclusion

In this paper, we propose a methodological framework to study the underlying mechanisms by which a financial-sector crisis may affect the real sector, and apply it to the case of the current financial crisis. In particular, we are interested in documenting and quantifying the importance of tightening liquidity constraints and the deterioration of consumer confidence on non-financial firms. We ask the question: could an *ex ante* classification of the firms based on their degrees of liquidity constraint and sensitivity to demand contraction *prior to* the subprime crisis help to predict their *ex post* stock price performance *during* the crisis period? We find the answer to be a resounding yes. Both channels are at work; liquidity constraints appear to be more significant quantitatively in explaining cross firm differences in the magnitude of stock price declines. A conservative

estimate is that a tightening supply of financing is likely to explain at least half of the actual drop in stock prices for firms that were liquidity constrained to start with.

In order to reach these conclusions, we propose a novel methodology that distinguishes a shock to the supply of finance from a firm sensitivity to demand contraction. We measure a firm's sensitivity to demand contraction by its stock price reaction to the September 11, 2001 terrorist attack (change in log stock price from September 10, 2001 to September 28, 2001). We measure a firm's liquidity constraint by the Whited-Wu (2006) index, valued at the end of 2006. We conduct extensive robustness checks to ensure that these indicators are valid and informative. For example, we verify that the 9/11 index is not contaminated by the impact of a liquidity constraint itself. While liquidity constraint and demand sensitivity, as measured by these two indicators, have statistically significant power in predicting stock price movement during the subprime crisis period, placebo tests suggest that they do not predict stock price movement in a period shortly before the subprime crisis broke out. An alternative measure of a firm's dependence on external finance proposed by Rajan and Zingales (1998) and valued based on information during 1990 – 2006 also has predictive power about stock price movement during the subprime crisis period.

Correctly diagnosing the transmission channels for a financial crisis to affect the real economy has implications for designing appropriate policy responses to the crisis. For the subprime mortgage crisis, our analysis suggests that policies that aim primarily at restoring consumer confidence and increasing demand, such as a tax rebate to households, will probably be insufficient to help the real economy; policies that could relax liquidity constraints faced by non-financial firms are likely to be indispensable. Our methodology should also be useful in other contexts where effects of a financial shock to the real economy need to be measured. We leave these applications for future work.

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Table 1a: Summary Statistics

Variable	**# Obs**	**Median**	**Mean**	**St Dev**	**Min**	**Max**
Percentage change in stock price *(July 31, 2007 – March 31, 2008)*	2760	-22.2	-30.1	44.7	-180.7	48.6
Demand Sensitivity *(Reaction to the 9-11 news)*	2789	1.42	1.56	1.00	-0.83	4.10
Financial Constraint *(Whited-Wu index)*	2789	-2.31	-2.24	1.00	-4.19	0.21
External finance dependence *(Rajan-Zingales index)*	2687	0.17	0.54	1.00	-0.39	3.55
Constraint (WW)*Dependence (RZ)	2687	-0.35	-0.96	2.11	-14.88	1.63
Firm size (log assets)	2789	5.81	5.77	2.16	-1.89	13.45
Book/Market Ratio	2722	0.76	1.20	2.54	0.01	76.5
Beta	2495	1.03	1.08	0.74	-2.54	4.27
Momentum	2506	4.54	2.58	30.88	-162.09	306.95

Table 1b: Correlation among Variables

	Stock Return	Demand Sensitivity	Financial Constraint	External Finance	WW* RZ	Firm size	Book/ Market	Beta
Demand Sensitivity	-0.07							
Financial Constraint-WW	-0.26	0.01						
External Finance Dependence (RZ)	-0.07	-0.09	0.26					
Constraint (WW)*Dependence (RZ)	-0.02	0.07	0.02	-0.85				
Firm Size	0.22	0.00	-0.92	-0.21	-0.02			
Book/Market	-0.15	0.05	-0.11	-0.15	0.11	0.17		
Beta	0.11	0.09	-0.27	-0.04	0.01	0.30	-0.05	
Momentum	0.17	0.03	-0.10	-0.12	0.08	0.07	0.03	0.03

Table 2. Change in Stock Price during the Subprime Crisis
(July 31, 2007 – March 31, 2008)

	1	2	3
Demand Sensitivity	-3.69***	-3.27***	-3.37***
	[0.85]	[0.88]	[0.87]
Financial Constraint-WW	-11.67***	-13.72***	-12.35***
	[0.82]	[2.33]	[2.32]
Firm size		-0.31	0.10
		[1.15]	[1.14]
Book/Market ratio		-6.24***	-6.37***
		[0.64]	[0.63]
Beta		3.13**	3.01**
		[1.25]	[1.24]
Momentum			0.20***
			[0.03]
Constant	-52.35***	-52.75***	-51.93***
	[2.48]	[3.13]	[3.10]
Observations	2761	2410	2410
R-squared	0.07	0.12	0.14

Notes: Standard errors in brackets; ***, **, and * denote p-value less than 1%, 5%, and 10%, respectively. Stock return, financial constraint, and demand sensitivity are winsorized at the 2% level.

Table 3: Alternative Measure of Financial Dependence

LHS variable = Change in Stock Price during the Subprime Crisis 7/31/07-3/31/08

	1	2	3	4
Demand Sensitivity	-4.00***	-3.87***	-3.30***	-3.41***
	[0.92]	[0.89]	[0.91]	[0.90]
External Finance Dependence	-3.03***	-3.18*	-6.55***	-5.74***
(RZ index, based on 90-06)	[0.90]	[1.84]	[2.02]	[2.00]
Financial Constraint		-10.94***	-11.81***	-10.81***
(WW index, 2006 value)		[0.98]	[2.53]	[2.51]
Financial Constraint		-1.60**	-2.66***	-2.56***
*External Finance Dependence		[0.81]	[0.86]	[0.85]
Firm size			-0.17	0.15
			[1.18]	[1.17]
Book/Market ratio			-6.48***	-6.53***
			[0.65]	[0.64]
Beta			3.25**	3.11**
			[1.28]	[1.26]
Momentum				0.19***
				[0.028]
Constant	-23.07***	-50.33***	-48.00***	-47.92***
	[1.80]	[3.01]	[3.56]	[3.52]
Observations	2660	2660	2327	2327
R-squared	0.01	0.08	0.13	0.15

Notes: Standard errors in brackets; ***, **, and * denote p-value less than 1%, 5%, and 10%, respectively. Stock return, financial constraint, external finance dependence and demand sensitivity are winsorized at the 2% level.

Table 4: Placebo Tests - Does Liquidity Constraint Explain Changes in Stock Prices During September 10-28, 2001?

	1	2
Firm size	-0.17	-0.45
	[0.13]	[0.34]
Book/Market ratio	-0.38***	-0.38***
	[0.074]	[0.08]
Firm beta	-5.49***	-5.33***
	[0.48]	[0.49]
Momentum	2.57***	2.51***
	[0.54]	[0.55]
Financial constraint		-0.59
(Whited-Wu index, 2000 value)		[0.68]
Constant	-7.21***	-7.14***
	[0.82]	[0.83]
Observations	4678	4563
R-squared	0.04	0.04

Notes: Standard errors in brackets; ***, **, and * denote p-value less than 1%, 5%, and 10%, respectively. Stock return, financial constraint, external finance dependence and demand sensitivity are winsorized at the 2% level.

Table 5: Placebo Tests - Stock Price Changes Before the Subprime Crisis
(June 30-July 31, 2007)

	1	2	3
Demand Sensitivity	-0.26	0.03	0.05
	[0.22]	[0.23]	[0.23]
Financial Constraint	0.06	-0.56	-0.37
(Whited-Wu index)	[0.22]	[0.62]	[0.62]
Firm size		-0.06	-0.01
		[0.31]	[0.30]
Book/Market ratio		-0.95***	-1.00***
		[0.17]	[0.17]
Beta		-1.03***	-1.04***
		[0.33]	[0.33]
Momentum			0.02***
			[0.01]
Constant	-5.15***	-4.69***	-4.72***
	[0.64]	[0.82]	[0.82]
Observations	2760	2409	2409
R-squared	0	0.02	0.02

Notes: Standard errors in brackets; ***, **, and * denote p-value less than 1%, 5%, and 10%, respectively.

Table 6: Adding Exposures to Exchange Rate and Commodity Price Movement

Stock price change during the Subprime Crisis, 7/31/07-3/31/08

	1	2	3	4
Demand Sensitivity	-3.02***	-2.98***	-3.22***	-3.18***
	[0.87]	[0.90]	[0.87]	[0.90]
Financial Constraint (WW index)	-12.01***	-10.75***	-12.40***	-11.06***
	[2.31]	[2.51]	[2.31]	[2.51]
Firm size	0.27	0.24	-0.08	-0.09
	[1.13]	[1.16]	[1.13]	[1.16]
Book/Market ratio	-6.32***	-6.42***	-6.39***	-6.50***
	[0.63]	[0.64]	[0.63]	[0.64]
Beta	1.10	1.32	1.51	1.64
	[1.29]	[1.32]	[1.30]	[1.32]
Momentum	0.19***	0.18***	0.20***	0.19***
	[0.03]	[0.03]	[0.03]	[0.03]
Exposure to Euro	16.46	16.95	-10.6	-7.87
	[12.0]	[12.2]	[18.5]	[18.9]
Exposure to Yen	2.30	-0.37	4.65	-1.55
	[10.6]	[10.8]	[18.1]	[18.5]
Exposure to Energy	0.67***	0.65***	0.82***	0.83***
	[0.15.]	[0.15]	[0.19]	[0.19]
Exposure to Metal	-15.23**	-14.13**	-4.87	-3.52
	[6.12]	[6.27]	[8.68]	[8.91]
Exposure to Agriculture	-0.16	-0.18	-0.38**	-0.42**
	[0.11]	[0.11]	[0.19]	[0.19]
Financial Constraint (RZ index)		-5.01**		-5.21***
		[1.99]		[1.99]
Financial Constraint*		-2.49***		-2.53***
External Finance Dependence				
		[0.84]		[0.84]
Constant	-51.47***	-48.22***	-50.31***	-46.89***
	[3.15]	[3.57]	[3.12]	[3.54]
Observations	2408	2325	2408	2325
R-squared	0.15	0.16	0.15	0.16

Note: The exposures to exchange rates and commodity prices are constructed following a two-step procedure. In Step 1, for each firm, we regress its weekly stock returns on the S&P 500 market return, percentage changes in the euro-dollar exchange rate and the yen-dollar exchange rate, and percentage changes in three commodity groups' spot price indexes (energy, agriculture, and metal) during 2004 to 2006. We collect the five estimated coefficients on the exchange rates and the commodity prices for each firm. In step 2, we multiple these coefficients individually with the realized percentage changes for these exchange rates and commodity price indexes over July 31, 2007-March 31, 2008. These are firm-level *ex post* exposures to major currencies and commodity prices used in Columns 1 and 2. In Columns 3 and 4, we use an alternative definition of exposures in which all statistically insignificant coefficients in Step 1 are assigned a zero value.

Figure 1: The Log of Stock Index during Subprime Crisis

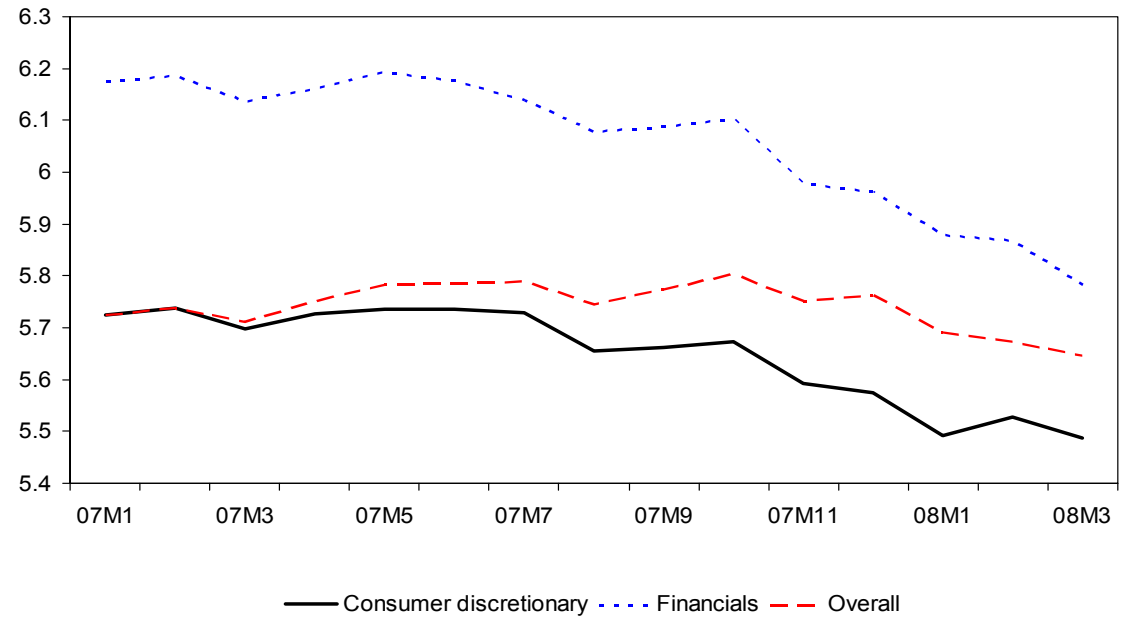
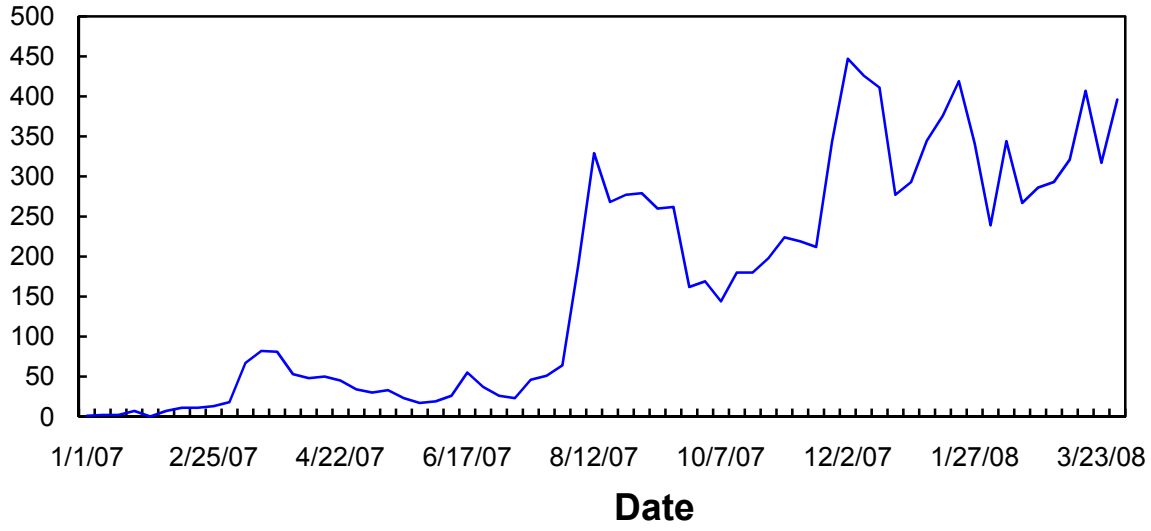
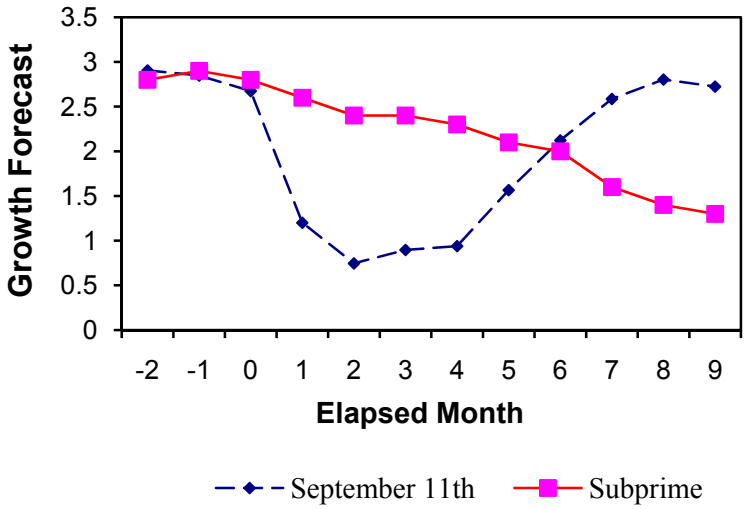


Figure 2: News Count of "Subprime" and "Crisis"



This graph reports a weekly count of news articles containing the words "subprime" and "crisis" in all US newspapers, excluding republished news, recurring pricing and market data. A week is defined as from Sunday to Saturday. The count was 64 for the week of July 29th, 189 for the week of August 5th, and 329 for the week of August 12, 2007, respectively. Source: Factiva.

Figure 3: Consensus Forecast of US Real GDP Growth



The two lines trace forecast of annual GDP growth for the calendar year of 2002 and 2008, respectively

Figure 4: Consumer Confidence around Sept 11th and Subprime Crisis

Source: University of Michigan Consumer Expectation Survey

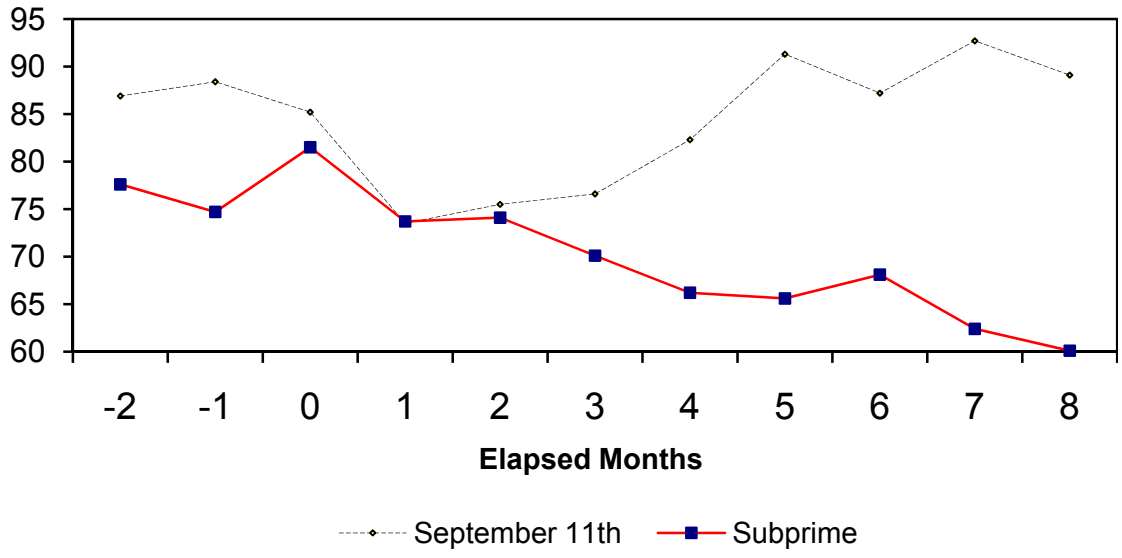


Figure 5: TED (Euro-dollar bond over Treasury Bond) spread around September 11th and Subprime Crisis

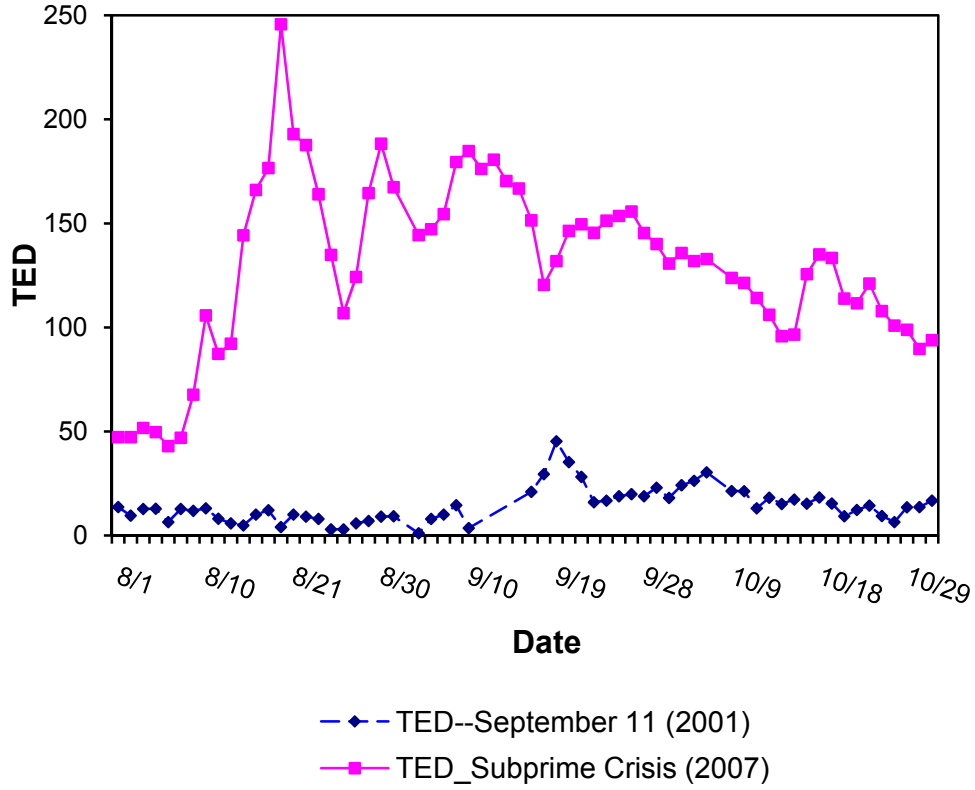


Figure 6: Cumulative Stock Returns Since August 2007

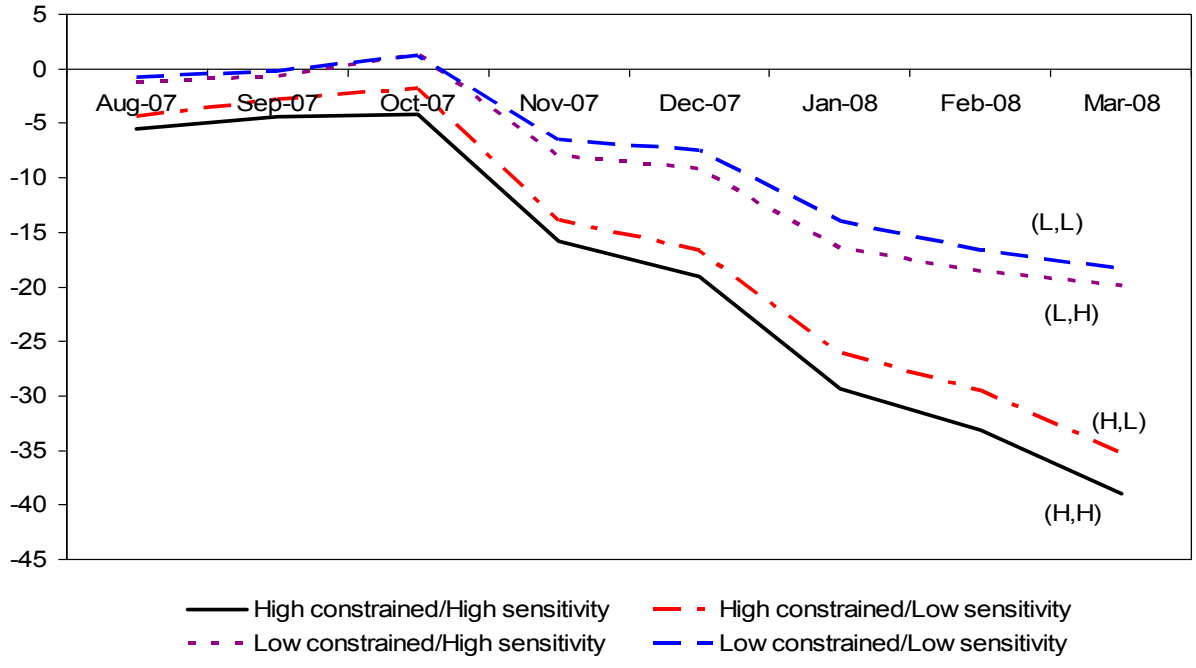


Figure 7: Key Regression Coefficients from Successively Expanding Samples