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Financial versus Demand shocks in stock price returns of US non-financial firms in the crisis of 2007

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Abstract

In the aftermath of the recent bank-centered financial crisis it is still unclear how much of the decline in non-financial firms' stock prices was due to liquidity shortage, and how much of this decline was due to lower expected consumer demand. The stock returns are examined over nine periods between July 31, 2007 and March 31, 2010. The near-collapse of Bear Stearns and the failure of Lehman Brothers can be both characterised as liquidity shocks that had a greater impact on financially fragile non-financial firms. It was mostly improvement in demand expectations that positively affected the performance of US non-financial firms in the first months of recovery. In the later periods, however, neither amelioration in demand expectations nor improvement of financial conditions can explain the performance of US non-financial firms.

Keywords: Stock price returns, Financial constraints, Liquidity shortage, Shock on demand expectations.

JEL Classification Numbers: E44, G01, G12.

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Résumé

Suite à la récente crise financière qui a touché le secteur bancaire, on ne sait toujours pas dans quelle mesure la baisse des cours des actions des sociétés non financières s'explique par un manque de liquidité ou bien par une baisse de la demande anticipée des consommateurs. On détermine plusieurs périodes entre le 31 juillet 2007 et le 31 mars 2010 au cours desquelles on examine les rendements des actions des entreprises non financières aux États-Unis. Le quasi-effondrement de Bear Stearns et la faillite de Lehman Brothers peuvent être tous les deux caractérisés comme des chocs de liquidité qui ont eu un impact plus important sur les entreprises non financières étant financièrement fragiles. C'était surtout l'amélioration des anticipations de demande qui a eu un effet positif sur la performance des entreprises non financières aux États-Unis pendant les premiers mois de la reprise. Après ces premiers mois, cependant, ni l'amélioration des anticipations de demande ni l'amélioration des conditions financières ne peuvent pas expliquer la performance des ces entreprises.

1 Introduction

The financial crisis of 2007-2009 caused global recession that far exceeded the scope of the losses in subprime markets. The banking sector was affected first, when asset prices started to fall, leading to deterioration in financial institutions' balance sheets. Thus, lending standards and margins tightened, causing fire-sales and even more tightening in funding (Acharya *et al.*, 2009 ; Brunnermeier, 2009). In the same time interbank lending dried up due to the collapse in the banks' confidence in the soundness of other financial institutions (Von Hagen, 2009). Banks were forced to start hoarding funds even if the creditworthiness of borrowers did not change.

This produced a large financial shock on the firms during the crisis, especially on those who relied heavily on external financing (see Duchin, Ozbas and Sensoy, 2010 for details). Facing lower demand expectations due to the loss of consumer confidence and the higher costs of external financing, firms had to reduce their production ; they suffered decay in their revenues which was anticipated in their stock returns.

To address these issues, this paper studies the cross-sectional changes in stock prices of US non-financial over nine large and small periods between July 31, 2007 and March 31, 2010. The paper aims to evaluate the influence of the shock on demand expectations as well as the financial crunch on these firms. To identify a firm-level cross-section of sensitivities to financial contraction and to the shock on demand expectations, two main groups of measures are used :

1. The sensitivity to liquidity contraction is defined through the Altman's Z-score, Moody's RiskCalc and BondScore model components as well as through the financial constraint index of Whited and Wu (2006). This cross-section is identified separately for each US firm prior to the crisis, in 2006, in order to limit the endogeneity problems.

2. The sensitivity to demand shock is identified in two distinct ways :

- As an elasticity of firm sales growth to growth in per capita personal income in the state where the company was headquartered in the period between 1990 to 2006 ;
- From the response of firms to the terrorist attack of 9/11, which was presumably a demand shock : as firm-level cumulative abnormal returns in the aftermath of the attack and as a median per sector change in log stock returns in the similar period (following Tong and Wei, 2009a and 2009b).

This paper extends Tong and Wei (2009a and 2009b) analysis using different measures of financial constraint and demand sensitivity during different time periods. On one hand, the short periods for stock returns are introduced to account for particular negative events as well as recovery periods in stock markets. It is also convenient as demand sensitivity index proposed by Tong and Wei, 2009a and 2009b is calculated for the short period of time around 2 weeks in the aftermaths of the terrorist attack of 2001. On the other hand, the period of analysis is extended until 2010.

Instead of focusing on the Whited and Wu financial constraint indicator, other balance sheet indicators are taken into account to identify the firm financial constraint. Besides, as demand sensitivity index proposed by Tong and Wei (2009a and 2009b) has been criticised for its accuracy, alternative ways to compute the demand sensitivity are suggested. Robustness checks include clustering the error terms by sectors, outlier selection and comparing continuous versus discrete time stock market returns.

The results show that in almost every analysed period, both factors - sensitivity to the shock on demand expectations and sensitivity to financial shortage - have a significant impact on US firms. Demand sensitivity index of Tong and Wei has the greatest explicative power comparing to the alternative indexes. It is also found to be positively correlated with the elasticity of firm net sales to income, another proxy of sensitivity to shock on demand expectations, which confirms the correct intuition of the index.

Quantitatively Altman's Z-zone indicator is more important than the shock on demand expectations index (computed from the firm reaction to the terrorist attack of 2001) in explaining the stock price performance in almost all the studied periods. Firms which were more vulnerable to demand contraction and more financially fragile (with smaller Z-score or classified to a more distressed zone according to the score) prior to the crisis experienced a larger reduction in the values of their stocks during the crisis.

Both events - the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers - are characterised by liquidity contraction (financially fragile firms were affected the most) as well as overall negative tendency of the market and its high volatility. These results confirm those of Ivashina and Scharfstein (2008) who show that the new bank loans to large borrowers fell by 47% by the end of the fourth quarter of 2008, representing the willingness or ability to lend during the crisis.

Cornett *et al.* (2010) and Del Giovane *et al.* (2010) also verify the link between drying up of liquidity and decline in credit supply, and find out that financially fragile non-financial firms should have being affected the most. The negative effect of supply factors on the growth of lending to firms was strongest after the bankruptcy of Lehman Brothers and Bear Stearns according to Del Giovane *et al.* (2010) and to results of this paper.

In the first month and quarter of the recovery in stock returns it was improvement in demand expectations that had a larger impact on US non-financial firms. However, this short-term effect did not last for a long time. Consumer spending did not increase much in 2009-2010 and the aggregate demand remained week (Feldstein, 2009). It can be also the reason why more profitable firms before the crisis had more problems to recover after the crisis.

The rest of the paper is structured as follows. Section 2 reviews the theoretical background on stock returns' evaluation and presents the estimation methodology adopted in the paper. Section 3 introduces the data, describes different time windows for stock returns and the construction of explanatory variables. Empirical results for cross-section estimations of the determinants of the US non-financial firms stock returns in the large and small windows are presented in Section 4. Section 5 concludes.

2 Theoretical background and model specification

The profits of the firm have a direct positive impact on return on assets and return on shareholders' equity. These last two measures of the firm's level of profitability are equal to each other in case the firm does not possess any debt. However, return on equity increases with the firm's debt and becomes larger than the return on assets if the latter one exceeds the rate of interest on the debt repayments. On the other side, the net return to the shareholders comprises current dividends and capital appreciation that should be equal to the required by shareholders rate of return according to the following arbitrage condition :

$$\frac{[E_t(q_{i,t+1}) - q_{i,t}] + E_t(d_{i,t+1})}{q_{i,t}} = r_{i,t}.$$

Here $q_{i,t}$ represents the asset price of the firm i at the end of the period t ; $d_{i,t+1}$ - are the expected dividends of the firms paid at period *t+1* ; $r_{i,t}$ is the required rate of return by firm's shareholders.

Solving this equation using forward iteration implies that fundamental value of an asset is the present discounted value of expected future earnings :

$$q_{i,t} = E_t \left[\sum_{j=1}^{k} (\frac{1}{1 + r_{i,j}})^j d_{i,t+j} \right].$$

In this paper the cross-sectional changes in stock returns are examined for US non-financial firms. One of the most prominent asset pricing single factor models is the Capital Asset Pricing Model (CAPM) developed by Sharpe (1964), Lintner (1965), and Mossin (1966). It requires the risk premium on any asset to be equal to the sum of the stock's expected return if the market's excess return is zero, the component of the return due to movements in market index and the firm specific component :

$$\Delta \ln(q_{i,t}) - r_f = \alpha_{i,t} + Beta_i \left[\Delta \ln(q_{M,t}) - r_f\right] + \epsilon_{i,t}, \tag{1}$$

where $\Delta \ln(q_{i,t})$ is the change in stock prices (measured through natural logarithms) over several large and small windows ; $\Delta \ln(q_{M,t})$ is the change in stock market returns measured through Standard and Poor's 500 (under the hypothesis that the stock market index $q_{M,t}$ represents a correct measure of the macroeconomic risk) ; r_f represents the risk-free rate of return ; $\epsilon_{i,t}$ are the firm specific error terms, non-correlated neither with systematic risk nor with the risk specific to another enterprise.

CAPM was augmented by additional factors. Rosenberg *et al.* (1985) and Chan *et al.* (1991) found the evidence of significance of the ratio of a firm's book value to market value for the cross-section of equity returns (in the United States and Japan, respectively). Fama and French (1993) introduced in their three-factor model both book-to-market values and firm size. Besides, a strong positive relationship was found between common stock returns and earning to price ratio of the NYSE firms in Basu (1983).

Another way of CAPM extension was the idea to introduce time-varying betas conditional on currently available information. Ferson and Harvey (1993) explained stock returns across world stock markets with conditional betas depending on local information variables (dividend yields, short-term interest rates, yield spread of low-risk bonds) and global risk premia depending on global variables. Jagannathan and Wang (1996) also used a conditional beta model and found out that the market risk premium on equities is a function of the corporate bond credit spread. In the present paper financial constraint as well as demand sensitivity characteristics are considered besides the rate of return on the stock market and the individual $Beta_i$ in the following cross-sectional regression :

$$\begin{aligned}\Delta \ln\left(q_{i,t}\right) &= \alpha_0 + \beta_1 Beta_{i,2001-2006} + \beta_2 BC_{i,2006} + \beta_3 SDS_{i,1990-2006} + \\ &+ \beta_4 \Delta \ln(q_{i,t-1}) + \beta_5 \frac{Book}{Market}_{i,2006} + \epsilon_s + \epsilon_{i,t}.\end{aligned}$$

$BC_{i,2006}$ are the balance sheet indicators that define the probability of firm's default : Altman's Z-score, inputs for Moody's RiskCalc and BondScore models.

$SDS_{i,1990-2006}$ are sensitivity to demand shock indexes that include several measures. First one is defined as elasticity of net sales growth to the growth in per capita personal income in the state where the company was headquartered during 1990-2006 period prior to financial crisis (another possibility is to measure sensitivity of firm net sales to GDP growth of the country). The second measure is cumulative abnormal stock price returns in the aftermath of the terrorist attack of 2001 and the third one is $\Delta \ln(q_{i,10sept'01-21sept'01})_s$ - a median per sector (191 sectors in total) of stock price reaction to the same event (following Tong and Wei, 2009a and 2009b).

Besides $Beta_i$ two other control variables are included in the model : $\Delta \ln(q_{i,t-1})$ is the autoregressive component for the period of the same length but prior to the examined window of stock returns ; $\frac{Book}{Market}_{i,2006}$ is book-to-market equity ratio of the firm (following Fama and French three-factor model) ; ϵ_s are the sectoral error terms (errors terms clustered by 191 sectors), $\epsilon_{i,t}$ are individual firm error terms.

3 Data and summary statistics

3.1 Data sources

The data set is composed of stock prices of 1058 US firms (traded at the New York Stock Exchange) collected from Datastream and firms' balance sheet information from Compustat during 2007-2009. The choice of the country of interest is justified by the fact that the financial crisis originated in the United States (see the data appendix for the sample selection). The sample used by Tong and Wei (2009b) is larger, it contains 2789 firms. The sample is different due to the merge of data sets from two sources (Datastream and Compustat), differences in the company names and in outlier selection procedures (see details in appendix).

3.2 Dependent variable : different time windows for stock returns

The key idea of this paper is to examine changes in firms' stock prices over nine periods : four large windows (where the first one is similar to the window studied in Tong and Wei (2009b) and, thus, will be further referred to as the TW period), two small windows following the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers and three small windows when the recovery in stock indexes has begun in the markets.

In the large windows the start date is set on July 31, 2007 following the collapse on June 20, 2007 of two highly levered Bear Stearns-managed hedge funds that invested in subprime asset-backed securities (see Acharya and Richardson, 2009 for details). This collapse was triggered by the prices in the housing market that have stopped appreciating since 2006. Mortgage refinancing was replaced by rising mortgage defaults in subprime sector which led to the fall in the prices of collateralized debt obligations, fire sales and even faster declining value of assets.

Bear Stearns hedge funds were shuttered the following month. The credit spreads on all kind of investment bonds started to rise, and in the beginning of August, 2007 financial crisis started to be discussed worldwide and completed by the run on BNP Paribas structured investment vehicles on August 09, 2007.

The end of each period is determined through graphical analysis (figure 1) and identified as a date of the trough in stock prices including the largest market failures as during the near-collapse of Bear Stearns (week of March 10, 2008) and the bankruptcy of Lehman Brothers (September 15, 2008).

Bear Stearns was the fifth-largest investment bank in the U.S. with the most leverage and highly exposed to the subprime mortgage market (Acharya and Richardson, 2009). The fall of Bear Stearns is also called a "rescue" or a "near-collapse" as the bank was finally purchased by JPMorgan Chase with government guarantee of $29 billion of subprime securities. The government has considered a bank to be "too big to fail" and to carry a large systemic risk. Thus, even though the near-collapse of Bear Stearns has had a negative impact on the market, it was considerably less than in the case of Lehman Brothers bankruptcy. The mean stock price decline is 8.5 times smaller than that in the case of Lehman Brothers (-0.07 relative to -0.59, table 1). Besides, high values of standard deviations imply some evidence of excessive cross-sectional volatility in the stock returns.

- INSERT TABLE 1 HERE -

Lehman Brothers also contained a large systemic risk. The fact that Lehman Brothers did not receive liquidity from the Treasury[1] (at least immediately) could mean that other investment banks were at risk as well. The "tail" risk has realized, most of financial institutions were heavily exposed to it and without Treasury's support the whole financial system of the U.S. was in danger. More than 90% of US non-financial firms have experienced a fall in their stock prices in the period between July 31, 2007 and October 27, 2008.

- INSERT FIGURE 1 HERE -

Figure 1 plots the S&P 500 composite index displayed on a logarithmic scale, the slope of the curve measuring the monthly rate of growth during the period from January 1, 2007 to October 1, 2010. The index points out several periods when stock market lost much of its value : on March 17, 2008, on October 27, 2008, on December 01, 2008, and reached its lowest point on March 09, 2009. The start dates in small windows are taken month or month and a half before the trough dates.

After March 09, 2009 a slow recovery begins, expansionist and non-conventional monetary policies having their effect on the stock market. There is a mean increase in stock returns of

[1]Later the Treasury drastically expanded it role as a lender of last resort (LOLR)

0.34 during the first month (RW1), 0.44 during the first quarter of recovery (RW2) and 0.09 during the first quarter of 2010 (RW3). In the beginning of 2010 firm stock returns stabilise and almost do not rise which is the consequence of the sluggish economic growth.

Large windows

- **TW window** [$\Delta \ln(q_{i,TW})$] July 31, 2007 until March 17, 2008 - after the fall of Bear Stearns - duration of 7,5 months (TW window is of similar length to the one examined by Tong and Wei (2009b)).

- **LW1** [$\Delta \ln(q_{i,t1})$] July 31, 2007 until October 27, 2008 - after the fall of Lehman Brothers - duration of 15 months.

- **LW2** [$\Delta \ln(q_{i,t2})$] July 31, 2007 until December 01, 2008 - end of the "crisis" year - duration of 17 months.

- **LW3** [$\Delta \ln(q_{i,t3})$] July 31, 2007 until March 09, 2009 - the largest drop in stock price returns during 2007-2010 - duration of 19 months.

Small windows

- **SW1** [$\Delta \ln(q_{i,t4})$] February 17, 2008 until March 17, 2008 - 1 month gap (Bear Stearns fall).

- **SW2** [$\Delta \ln(q_{i,t5})$] September 11, 2008 until October 27, 2008 - 1,5 month gap (Lehman Brothers collapse).

Recovery in stock prices windows

- **RW1** [$\Delta \ln(q_{i,t6})$] March 09, 2009 until April 09, 2009 - 1 month gap (first month of recovery).

- **RW2** [$\Delta \ln(q_{i,t7})$] March 09, 2009 until June 30, 2009 - 3 months gap (first quarter of recovery).

- **RW3** [$\Delta \ln(q_{i,t8})$] January 01, 2010 until March 31, 2010 - 3 months gap (first quarter of 2010).

3.3 Balance sheet characteristics

The question of the impact of various frictions in financial markets on financial constraint of the firms is well investigated in the corporate finance and investment literature (Chatelain, 2002). To assess the role of financial constraints in firms' activities, some indexes were proposed : investment cash-flow sensitivities (Fazzari *et al.*, 1988), Kaplan and Zingales (1997) and Rajan and Zingales (1998) indexes of constraints, Whited and Wu index of constraints (2006). Chatelain (2000) shows that such measures of financial constraints may be misspecified, however, he mostly agrees on the choice of the financial constraint determinants by Whited (1992).

Altman's Z-score (referred to as Z in tables, Altman, 1968) is a well-known weighted indicator of corporate financial fragility that classifies companies from financially distressed to financially stable ones using five financial ratios (see details in appendix). Besides, an additional Altman's Z-zone (referred to as ZZ in tables) indicator is constructed which it takes values 1, 2 or 3 depending on the "zone of discrimination" :

- if $Z - score > 2.99$ – "Safe" Zone and Altman's Z-zone is 3 ;
- if $1.80 < Z - score < 2.99$ – "Grey" Zone and Altman's Z-zone is 2 ;
- if $Z - score < 1.80$ –"Distress" Zone and Altman's Z-zone is 1.

More than 60% of the firms are found to be "safe" according to the Z-score computed for 2006, around 20% are classified as being in "grey" zone, and around 15% are distressed.

More recent Moody's KMV RiskCalc V3.1 (Dwyer *et al.*, 2004) is the Moody's rating agency model for predicting probability of the bank default. It comprises financial statement variables and equity market information on the bank's prospects and business risk.

Financial ratios are classified in one of the next groups : capital structure, profitability, asset concentration, liquidity and asset quality. The weight of each variable is then calculated using non-parametric techniques and the estimated default frequency is computed for each bank.

As expected default frequency measures as well as the formula for computing them are not available in public access, the input variables of Moody's model are plugged directly in the regressions (taking into account multicollinearity issues with indicators from other models). Some exact ratios that are proposed by Moody's model were not available on Datastream, thus, proxies for these variables and ratios have been used.

Variables from this model that are expected to increase the firm default risk are those that have a negative impact on the firm's performance and enlarge the firm's loses during the crisis.

BondScore Credit Model is another model that calculates credit risks for all U.S. non-financial corporations with total assets in excess of $250 millions and publicly traded equity. BondScore Model inputs are described in table 2.

-INSERT TABLE 2 HERE -

Whited and Wu index identifies financial constraint for each firm individually depending on several balance sheet characteristics (see appendix for details).

Altman's Z-score includes similar indicators as those used in Moody's RiskCalc model that is confirmed by the correlation coefficients (0.3 between Z-score and retained earnings to current liabilities ratio ; -0.41 between Z-score and ratio of current liabilities to sales, table 3). In general, Z-score is higher when long-term debt and current liabilities of the firm are lower.

Higher share of retained earnings, return on assets and liquidity are associated with smaller loses of non-financial firms during the crisis. Higher leverage indicates a greater decline in stock prices of the firms. These conclusions are in line with assumptions from probability of default models.

-INSERT TABLE 3 HERE -

In most of the windows correlation between firm stock returns and Z-zone index is larger than that between stock returns and Z-score indicator (0.24 and 0.15 respectively in LW3 period, table 4). In its absolute value it is similar to the correlation between firms' stock returns and sensitivity to demand shock measured through the reaction of firm stock prices to the terrorist attack of 2001 (it reaches 0.28 in RW1 period).

-INSERT TABLE 4 HERE -

Everything else being equal, more financially fragile non-financial firms are expected to exhibit greater loses during the crisis. Thus, periods in which such firms are significantly affected can be characterised by scarcity of the sources of external financing. By construction, all the variables are taken at the end of 2006, which helps to avoid the endogeneity problem.

3.4 Sensitivity to the shock on demand expectations

Several indexes are constructed to measure firms' sensitivities to the shock on demand expectations (table 5).

-INSERT TABLE 5 HERE -

First measure is the elasticity of firm sales growth to growth in per capita personal income in the state where the company was headquartered in the period between 1990 and 2006. The idea beyond the index is to estimate the impact of an increase in per capita income on net sales of the firm during 16 years prior to crisis (see appendix for details). As per capita income directly affects the demand, this coefficient can be interpreted as a sensitivity of the firm to changes in demand expectations. As an alternative, the sensitivity of net sales to changes in GDP is estimated during the same period.

The second family of measures is based on the idea of Tong and Wei (2009a and 2009b) to interpret the terrorist attack of 09/11 as an event that produced a short-lived shock on demand expectations in the market. As the Report for Congress (Makinen, 2002) emphasizes, first it was expected that demand would be seriously affected. The GDP of the US contracted in the third quarter of 2001, but then the positive growth resumed in the 4th quarter. That suggests that any effects from the 9/11 on aggregate demand expectations were short-lived. Thus, the terrorist attack is referred to as a large negative shock on demand expectations rather than an effective shock on the real output actually taking place the next year.

The shock of the 9/11 terrorist attack did not spread in financial markets and did not cause the shortage of liquidity : the Federal Reserve took appropriate actions to avert financial panic. Financial assistance and supplementary access to the loans were provided for the businesses. Tong and Wei (2009b) test that hypothesis and find out that the stock market reaction in the aftermath of the attack was not due to the worsened conditions on the financial markets, and thus, it could be interpreted as a fall in demand expectations.

Two measures of the stock price reaction in the aftermath of the terrorist attack are used in the regressions : the cumulative abnormal returns and the change in stock prices in the short period after the attack.

The cumulative abnormal returns are mostly used in the event study methodology to assess the response of some firm/institution to the negative event. The event date in this study is the first trading date after the terrorist attack of 09/11 : September, 17th of 2001. The stock exchanges in the U.S. have been closed on September, 11 of 2001 (the day of the attack) and they have remained closed for another three days. The event window includes 5 trading days before and following the attack, thus, a total of 11 days. The estimation window is from 500 trading days to 15 days prior to the event date, which corresponds the year of 2000 and the first half of 2001 (see appendix for details).

As an alternative measure, the difference in log stock prices is calculated between September 10, 2001 and September 21, 2001. The median per sector is then taken as a sector-level index of sensitivity to the shock on demand expectations. Originally in the paper of Tong and Wei (2009b) the index is calculated for the period of 18 days, in this article the window is reduced to 11 days (see data appendix for details) as the lowest point in stock markets was reached on September 21, 2001 (figure is available on demand).

Financial shortage may cause demand contraction and vice versa (Bashar, 2011). During liquidity crises banks try to restrict their lending to very short maturities and to increase the interest rates for term loans. Facing worsening financial conditions, firms cut their costs which in a large part include salaries of their workers. Consequently, demand should be deteriorated in the nearest future. However, demand declines in a proportion larger than the fall in the salaries of workers. The reason is that future expectations change rapidly, and the anticipations of future productivity and profits of the enterprises fall significantly.

In the present paper such an interdependence is avoided by construction : the indexes of financial constraint and sensitivity to shock on demand expectations are calculated prior to 2007.

The elasticities of firm sales to personal income and real GDP of the U.S. are positively correlated with cumulative abnormal returns and stock returns in the aftermath of the terrorist attack of 2001 (0.34 and 0.17 respectively, column 2, table 6). That at some point proves the accuracy of intuition behind Tong and Wei idea of using the terrorist attack of 2001 as a presumable shock on demand expectations.

Besides, indexes of demand sensitivity are positively correlated with beta. This relationship is logical as firms that are more sensitive to changes in demand are expected to be more correlated with the rest of the market.

-INSERT TABLE 6 HERE -

4 Cross-section estimations of the non-financial stock returns determinants

4.0.1 Stock returns in the TW window and other large windows (over 15 to 19 months of the financial crisis)

TW window

The results for TW window (columns 3 and 4, table 7) are presented together with the original results from the Tong and Wei paper of 2009 (columns 5 and 6, table 7).

Regressions are conducted using stepwise backward selection method. This method begins with initial model and then compares the explanatory power of smaller models by removing nonsignificant variables. The significance level for removal is 0.05. All explanatory variables are standardised which makes the size of parameters comparable within each column.

- INSERT TABLE 7 HERE -

The results for that window are close to those of Tong and Wei. However, in the sample from this article White and Wu financial constraint index is not performing well. Firms with higher returns on assets P_1 prior to crisis performed better (by 6.7%, column 3, table 7) than the rest of the market, while firms with higher stock volatility Vol experienced a larger decline (by 6%, column 3, table 7) during TW period.

If firm net sales have been more sensitive to changes in personal income before 2007, the firm lost 5.2% (column 3, table 7) more in its stock value during the TW period of the crisis. At the same time, if firm stock prices have been more sensitive to the drop in demand expectations in 2001, the firm lost additional 5.1% (column 3, table 7) in its stock prices during the analysed period.

Other large windows

The results for other large windows are presented in table 8.

- INSERT TABLE 8 HERE -

Firms that according to their Z-score calculated for 2006 have been considered to be "safer" than the others (and accordingly have had a higher Z-score) performed better during the crisis than those that have been categorised as belonging to "grey" or "distress" zone and have had a lower Z-score (for more details, see section 3.4). An improvement in firm's Z-score in a way that the firm is transferred from the more distressed zone to the safer zone in the large period LW1 from July 31, 2007 until October 27, 2008 (column 3, table 8) is associated with an improvement in its stock returns by 10.9%.

Higher liquidity (Liq in table 8) and EBITDA margin (EM) prior to crisis are associated with a better performance of the firm during the crisis, while higher volatility (Vol) of firm's stocks before the crisis led to a larger decline in stock prices during the crisis.

These results confirm the negative impact of financial constraints on the firm performance, especially during the crisis. As a consequence, such financially constrained firms cut more investment, technology, marketing, and employment relative to financially unconstrained firms during the crisis (Campello *et al.*, 2009 ; Musso and Schiavo, 2008).

Beta shows an important negative influence on the stock market returns in three large periods (columns 4, 6 and 8, table 8) : in the large window LW1 from July 31, 2007 until October 27, 2008 its explicative power is two times larger than that of Z-zone indicator or demand sensitivity indexes. Stock prices of correlated with the market firms fell more during the crisis.

As CAPM model predicts the larger is the fall of the stock market index, the larger should be the parameter of the beta in the cross-sectional regressions (see equation 1). It turns out to be the case ; the largest fall of the stock market returns on figure 1 corresponds to the largest values of the parameters for three long periods (columns 4, 6, 8, table 8), (figure 1).

Among demand sensitivity indexes only reaction to the terrorist attack of 2001 ($\Delta \ln(q_{i,'01})_s$ in table 8) is significant and robust in all the periods. In the window LW1 an increase in ex ante sensitivity to shock on demand expectations by one standard deviation is associated with an extra drop in stock price by 10.8% (6% when control variables are included).

R-squared is in between 18% and 43.5% which is considered to be a good fit of the model when explaining stock returns.

4.1 Stock returns over 1 to 1.5 months following the Bear Stearns near-collapse and the failure of Lehman Brothers

Now regressions are run on stock returns in small windows around two particular events : the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers.

- INSERT TABLE 9 HERE -

Firms from "safe" zone experienced a smaller decline in stock prices during these periods. Besides, volatility indicator (Vol in table 9) has an important negative impact on the U.S. firm stock prices. Beta ($Beta$ in table 9) is quantitatively very important in Lehman Brothers period (SW2) which may be explained by spillover effects of Lehman collapse on the financial markets that confirms "too big to fail" argument. The overall market performance was hit by Lehman Brothers bankruptcy causing larger loses for more correlated with the market companies.

Musso and Schiavo (2008) found that financial constraints might be positively related to productivity growth in the short-term during the crisis due to cuts in costs. However, even if this effect exists, it is not presented in firm's stock returns.

Thus, both events - the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers - are characterised by liquidity contraction (financially fragile firms were affected the most) as well as overall negative tendency of the market and its high volatility. These results confirm arguments of Ivashina and Scharfstein (2008) who show that the new bank loans to large borrowers fell by 47% by the end of the fourth quarter of 2008, representing the willingness or ability to lend during the crisis.

Cornett *et al.* (2010) and Del Giovane *et al.* (2010) confirm the link between drying up of liquidity and decline in credit supply, which also suggests that financially fragile non-financial firms should have being affected the most. The effect of supply factors on the growth of lending to firms is the strongest after the bankruptcy of Lehman Brothers as it is also found by Del Giovane *et al.* (2010) and after the Bear Stearns near-collapse.

4.2 Stock returns over 1 to 3 months during the recovery period following March, 2009

In this section three small periods during which the stock market indexes restarted to rise are analysed. Table 10 presents the results for regressions with and without controls for these three windows.

- INSERT TABLE 10 HERE -

In the first RW1 (first month of recovery) and second period RW2 (first quarter of recovery) more sensitive to the shock on demand expectations firms (higher $\Delta \ln(q_{i,'01})_s$) had a better performance than the rest of the market. Its quantitative importance is partly offset by beta but index remains significant after inclusion of control variables. An increase in the sensitivity of the firms to the shock on demand expectations by one standard deviation prior to crisis led to the additional recovery of 2.3% (column 4, table 10) in the stock prices of these firms in the RW1 period. That allows to make a conclusion that in the first quarter of recovery there was an improvement in demand expectations in the market that positively affected the performance of U.S. non-financial firms.

However, this short-term effect did not last for a long time. Consumer spending did not increase much in 2009-2010 and the aggregate demand remained week (Feldstein, 2009). It can be also the reason why more profitable firms before the crisis had more problems to recover after the crisis.

Beta (*Beta* in table 10) coefficients change their signs to the positive ones in all three recovery periods. Due to the overall positive tendency of the market, firms with higher beta (whose stock prices are more correlated with the market) experienced a larger increase in their stock returns.

Firms with higher profits before the crisis did not grow as well as the rest of the market in RW1 period, as well as in RW3 period (from January 01, 2010 until March 31, 2010). In the RW3 period another demand sensitivity index - cumulative abnormal return at the period of the terrorist attack of 2001 - becomes significant, predicting lower rates of growth in stock prices of firms which have had higher abnormal returns in 2001. It could be related to a slow recovery of demand and production that did not increase as it was expected after all the stimulus measures undertaken in 2008-2009 and to the sluggish economy growth in general.

Firms with higher returns on assets (P_1) exhibit smaller growth in their stock prices during RW3 period which can be related to the size of the firms - bigger firms recover slower than the rest of the market (it can be also the consequence of the sluggish economic growth).

First robustness check consists of removing the 5^{th} and 95^{th} percentiles of the distribution of dependent variable in order to avoid excessive size of the outliers. Besides, the discrete growth rates are calculated. Both alternative regressions confirm the main results.

5 Conclusion

This paper focuses on the framework that assesses the relative importance of financial and demand shocks proposed by Tong and Wei (2009a and 2009b). The performance of US non-financial enterprises is analysed through changes in their stock price returns during the recent financial crisis. In this article stock price returns are examined in eight different periods and that of Tong and Wei (2009b).

The performance of Whited and Wu financial constraint index is poor, while other financial distress indicators (Altman's Z-score, liquidity ratio from Moody's RiskCalc model, volatility index from BondScore model) have better explicative power.

Quantitatively Altman's Z-zone indicator is more important than the shock on demand expectations index (computed from the firm reaction to the terrorist attack of 2001) in explaining the stock price performance in almost all the studied periods. Firms which were more vulnerable to demand contraction and more financially fragile (with smaller Z-score) prior to the crisis experienced a larger reduction in the values of their stocks during the crisis.

More correlated with the market firms suffer from a larger decline in their stock prices during the recession period but also gain their value faster in the recovery periods. Firms that were not growing fast in terms of stock prices before the crisis lost more during the recession period but they also gained more in their value during the recovery periods.

Both events - the near-collapse of Bear Stearns and the bankruptcy of Lehman Brothers - are characterised by liquidity contraction (financially fragile firms were affected the most) as well as overall negative tendency of the market and its high volatility. The negative effect of supply factors on the lending to non-financial firms growth was strongest after the Bear Stearns and Lehman Brothers near-collapse according to results of this paper.

In the first month and quarter of the recovery of the stock returns it was improvement in the demand expectations that had a larger impact on US non-financial firms. However, this short-term effect did not last for a long time. Consumer spending did not increase much in 2009-2010, the aggregate demand remained week.

These findings can be potentially important for policy implications. Most of the negative events include both shocks on demand expectations and financial contraction. However, one of these two shocks may have a heavier negative effect on the market, affecting in a larger way more sensible to that shock firms. Understanding the transmission channels and correctly anticipating which shock will prevail in the market is essential to design appropriate macroeconomic policies.

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Appendices

A Sample selection

The data set consists of firms' stock returns and betas from Datastream [2] and balance sheet information of the firms from Compustat [3]. To select the sample, firms are classified by their SIC - Standard Industrial Classification codes. Financial firms (SIC codes between 6000 and 6999) and regulated utilities (SIC codes between 4900 and 4999) are excluded from the sample. The next step consists of deleting any firm observation with missing data or zero stock prices or total assets. The firms that were created after 2001 are eliminated, which is required by construction one type of sensitivity indexes to the shock on demand expectations.

Besides, there were several sectors which were directly affected by the 09/11 terrorist attack : airlines, defence and insurance. At the time of the 9/11, airlines industry was already in troubles due to recession and the terrorist attack severely compounded the industry's financial problem. Even the quickly organised aid package did not save some firms from collapsing. The loss of life and property gave rise to the largest claim in history, estimated for up to 40 billion US dollars - a huge burden for the insurance sector. Hence, firms that belong to these sectors are eliminated from the sample as the fall in their stock prices reflects the direct financial loses of these companies rather than their reaction to the drop in demand expectations. After the firms' preliminary selection the sample consists of 1612 US firms.

Other financial ratios (from Moody's RiskCalc U.S. firms model and BondScore model) are also cleaned by deleting extreme observations or winsorizing them at 1-2% level. Most of financial ratios are also standardised.

[2] Datastream - on-line historical database service provided by Thomson Financial that encompasses a broad range of financial entities and instruments with global geographical coverage.

[3] Compustat - Standard & Poor's database of financial, statistical and market information on active and inactive companies throughout the world.

B Construction of the variables

B.1 The balance sheet characteristics associated with firm financial constraint

- Altman's Z-score

  Altman's Bankruptcy model suggests an index based on the five main financial ratios where weight of each variables defined using discriminant analysis :

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5$$

  where X_1 is the ratio of difference between current assets and current liabilities to total assets ; X_2 is the ratio of retained earnings to total assets ; X_3 is the ratio of earnings before interest and taxes (EBIT) to total assets ; X_4 is the ratio of market value of equity to total liabilities ; X_5 is the ratio of sales to total assets.

- BondScore model indicators

  Liquidity ratio is a Quick Ratio taken directly from Datastream and is defined as follows : $\frac{CurrentAssets - Inventory}{CurrentLiabilities}$.

  Volatility of cash flow is calculated as a standard deviation of $\frac{EBITDA}{Assets}$ over 1996-2006.

- Whited and Wu financial constraint index identifies firm's financial constraint denoted $FC_{i,2006}$ as the shadow value of external financing that is predicted by six variables :

$$\begin{aligned} FC_{i,2006} \quad = \quad & -0.091 \cdot \frac{CF_{i,2006}}{A_{i,2006}} - 0.062 \cdot Div_{i,2006} + 0.021 \cdot \frac{LTDebt_{i,2006}}{A_{i,2006}} \\ & -0.044 \cdot \ln(A_{i,2006}) + 0.102 \cdot IG_{s,2006} - 0.035 \cdot FG_{i,2006}, \end{aligned}$$

  where $FC_{i,2006}$ financial constraint index of Whited and Wu (2007) computed for each US firm ; $\frac{CF_{i,2006}}{A_{i,2006}}$ ratio of cash flow to total assets of the firm ; $Div_{i,2006}$ dividend dummy that is the indicator which takes the value of 1 if the firm pays cash dividends, 0 otherwise ; $\frac{LTDebt_{i,2006}}{A_{i,2006}}$ ratio of long-term debt to total assets of the firm ; $\ln(A_{i,2006})$ natural logarithm of total assets of the firm ; $IG_{s,2006}$ one year three-digit sector sales growth ; $FG_{i,2006}$ one year firm sales growth.

B.2 Sensitivity indexes to demand shock

Defining sensitivity indexes through elasticity :

- Elasticity of firm net sales growth to growth in per capita personal income in the state where the company is headquartered in the period between 1990 and 2006 :

$$\Delta NS_{i,1990-2006} = \alpha_i + \beta_i \Delta \ln(PCI_{ST,1990-2006}) + \epsilon_{i,1990-2006}$$

  where $\beta_i = \epsilon_{PCI} = \epsilon_{\frac{\Delta NS_{i,1990-2006}}{\Delta PCI_{St,1990-2006}}}$ is the slope or sensitivity of change in net sales to the change in per capita income (PCI) of the state.

- Elasticity of firm net sales growth to U.S. real GDP during 1990-2006 :

$$\Delta NS_{i,1990-2006} = \alpha_i + \beta_i \Delta \ln(GDP_{US,1990-2006}) + \epsilon_{i,1990-2006}$$

  where $\beta_i = \epsilon_{GDP} = \epsilon_{\frac{\Delta NS_{i,1990-2006}}{\Delta RGDP_{US,1990-2006}}}$ is the slope or sensitivity of change in net sales to GDP growth.

Defining sensitivity through the reaction to the terrorist attack of 09/11 :

- Cumulative abnormal returns in the event window of 5 trading days before and after the attack (a total of 11 days). For each firm stock price the daily abnormal return is calculated as a difference between the actual returns and the expected returns estimated from the single-factor market model :

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \epsilon_{i,t}$$

  where market index $R_{m,t}$ is S&P 500 stock market index. Cumulative abnormal returns

$CAR_{i,Sept04'01-Sept21,'01}$ ($CAR_{i,'01}$ in the tables) for each firm are then calculated as the sum of daily abnormal returns in the event window.

– THE DIFFERENCE IN LOG STOCK PRICES between September 10, 2001 and September 21, 2001 (following Tong and Wei, 2009a and 2009b). First the percentage change in stock prices (that is the difference in log stock prices) is calculated for the period from September 10, 2001 to September 21, 2001. Then the firms are organised in sectors and the mean of log stock price changes for each three-digit sector is taken as the sector-level sensitivity to the shock on demand expectations $\Delta \ln(q_{i,10sept'01-21sept'01})_s$ ($\Delta \ln(q_{i,'01})_s$ in the tables).

B.3 Control variables

– AUTOREGRESSIVE COMPONENT captures persistance of firm's stock returns. It is computed as a difference in stock prices in the period of the same length but prior to the examined window of stock returns.

The value at the end of the period is always deducted from the value at the beginning of the period, the interpretation of the variable is the next one : the higher is the value of the autoregressive component, the larger was the fall in stock returns of the firm during the analysed past period (in case of falling stock prices) or the smaller was the stock price growth (in case of increasing stock prices). In a similar way autoregressive variable is calculated separately for every period.

– BETA is the quantitative measure of the volatility of a given stock relative to the overall market. The beta factor in Datastream is calculated over a 5-year period using monthly observations on logarithmic scale.

– BOOK-TO-MARKET RATIO is the book value of the firm (accounting value) divided by the market value (market capitalisation) of the firm.

TABLE 1: The summary statistics of changes in stock returns for U.S. non-financial firms

Period	Variable	Name	Obs	Mean	SD	Min	Max
	TW window						
TW	Change in stock prices (July 31, 2007 – March 17, 2008)	$\Delta \ln(q_{i,TW})$	1025	-0.26	0.34	-1.60	0.53
	Autoregressive component TW (December 15, 2006 – July 31, 2007), standardised	$\Delta \ln(q_{i,TW-1})$	1025	0	1	-2.96	3.56
	Large windows						
LW1	Change in stock prices (July 31, 2007 – October 27, 2008)	$\Delta \ln(q_{i,t1})$	1022	-0.8	0.6	-3.46	0.35
	Autoregressive component 1 (April 28, 2006 – July 31, 2007), standardised	$\Delta \ln(q_{i,t1-1})$	1022	0	1	-2.6	3.87
LW2	Change in stock prices (July 31, 2007 – December 01, 2008)	$\Delta \ln(q_{i,t1})$	1022	-0.94	0.7	-3.61	0.39
	Autoregressive component 2 (March 28, 2006 – July 31, 2007), standardised	$\Delta \ln(q_{i,t2-1})$	1022	0	1	-2.6	3.87
LW3	Change in stock prices (July 31, 2007 – March 09, 2009)	$\Delta \ln(q_{i,t3})$	1020	-1.19	0.85	-4.6	0.22
	Autoregressive component 3 (December 31, 2005 – July 31,2007), standardised	$\Delta \ln(q_{i,t3-1})$	1020	0	1	-2.84	3.5
	Small windows						
SW1	Change in stock prices (February 17, 2008 – March 17, 2008) – The **Bear Stearns** near-collapse	$\Delta \ln(q_{i,t4})$	1031	-0.07	0.11	-0.43	0.23
	Autoregressive component 4 (January 17, 2008 – February 17,2008), standardised	$\Delta \ln(q_{i,t4-1})$	1030	0	1	-4.41	3.61
SW2	Change in stock prices (September 11, 2008 – October 27, 2008) – The **Lehman Brothers** failure	$\Delta \ln(q_{i,t5})$	1019	-0.59	0.32	-1.79	0.043

Continued on next page

Table 1 – *Continued from previous page*

Period	Variable	Name	Obs	Mean	SD	Min	Max
	Autoregressive component 5 (July 26, 2008 – September 11, 2008), standardised	$\Delta \ln(q_{i,t5-1})$	1019	0	1	-2.49	3.80
	Recovery in stock prices						
RW1	Change in stock prices (March 09, 2009 – April 09, 2009) - the first month of positive growth	$\Delta \ln(q_{i,t6})$	1011	0.34	0.22	-0.29	1.18
	Autoregressive component 6 (February 09, 2009 – March 09, 2009), standardised	$\Delta \ln(q_{i,t6-1})$	1011	0	1	-2.33	3.57
RW2	Change in stock prices (March 09, 2009 – June 30, 2009)- the first quarter of positive growth	$\Delta \ln(q_{i,t7})$	1023	0.44	0.84	-9.48	7.6
	Autoregressive component 7 (November 10, 2008 – March 09, 2009), standardised	$\Delta \ln(q_{i,t7-1})$	1023	0	1	-3.53	3.66
RW3	Change in stock prices (January 01, 2010 – March 31, 2010)	$\Delta \ln(q_{i,t8})$	1025	0.09	0.2	-1.77	1.69
	Autoregressive component 8 (October 01, 2009 – January 01, 2010), standardised	$\Delta \ln(q_{i,t8-1})$	1025	0	1	-3.39	2.78

Table 2: Summary of balance sheet characteristics used to identify the financial constraints for U.S. non-financial firms

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
Altman's Z-score						
$\frac{CurrentAssets_{2006} - CurrentLiabilities_{2006}}{TotalAssets_{2006}}$	X_1	1025	0.28	0.21	-0.09	0.8
$\frac{RetainedEarnings_{2006}}{TotalAssets_{2006}}$	X_2	1025	0.11	0.7	-2.99	0.93
$\frac{EBIT_{2006}}{TotalAssets_{2006}}$	X_3	1025	0.09	0.09	-0.17	0.30
$\frac{MarketValueofEquity_{2006}}{TotalLiabilities_{2006}}$	X_4	1025	0	0.98	-1.93	1.90
$\frac{Sales_{2006}}{TotalAssets_{2006}}$	X_5	1025	1.15	0.83	0	7
Z-score	Z	1025	1.19	1.43	-2.10	5.4
Z-zone	ZZ	1025	2.56	0.7	1	3
Z-zone, standardised	ZZ	1025	0	1	-2.21	0.62
Moody's RiskCalc U.S.						
$\frac{LongTermDebt_{2006}}{LTD+NetWorth_{2006}}$, standardised	L_1	1025	0	1	-1.23	3.80
$\frac{RetainedEarnings_{2006}}{CurrentLiabilities_{2006}}$, winsorized at 1%level, standardised	L_2	1025	0	1	-3.47	1.69
$RetOnAssets_{2006}$, winsorized at 1%level, standardised	P_1	1025	0	1	-3.28	2.58
$\Delta RetOnAssets_{'04-'06}$, winsorized at 1%level, standardised	P_2	1025	0	1	-2.71	3.66
$\frac{CashFlow_{2006}}{InterestExpense_{2006}}$, winsorized at 3%level, standardised	DC	1025	0	1	-0.64	3.47
$\frac{CashMarketSec_{2006}}{TotalAssets_{2006}}$, winsorized at 1%level, standardised	Liq	1025	0	1	-0.94	3.00
$\frac{Inventories_{2006}}{Sales_{2006}}$, winsorized at 1%level, standardised	A_1	1025	0	1	-1.22	3.5
$\Delta \frac{AccountRec}{Sales}_{'04-'06}$, winsorized at 1%level, standardised	A_2	1025	0	1	-2.85	3.5
$\frac{CurrentLiabilities_{2006}}{Sales_{2006}}$, winsorized at 1%level, standardised	A_3	1025	0	1	-1.36	3.6
$SalesGrowth_{2006}$, winsorized at 1%level, standardised	G	1025	0	1	-2.6	3.52
$Size_{2006}$, winsorized at 1%level, standardised	S	1025	0	1	-2.45	2.23
BondScore U.S.						
$\frac{EBITDA_{2006}}{Sales_{2006}}$, winsorized at 2%level, standardised	EM	1025	0	1	-3.45	2.62

Continued on next page

Table 2 – *Continued from previous page*

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
$\frac{Sales_{2006}}{TotalAssets_{2006}}$, winsorized at 1%level, standardised	AT	1025	0	1	-1.36	3.54
$\frac{Debt_{2006}}{MarketCap+BookValueDebt_{2006}}$, winsorized at 1%level, standardised	L	1025	0	1	-1.09	2.88
$QuickRatio_{2006}$, winsorized at 1%level, standardised	QR	1025	0	1	-0.93	3.63
$Volatility_{2006}$, standardised	Vol	1025	0	1	-1.98	3.37
White and Wu index						
WW_{2006}, winsorized at 1%level, standardised	WW	1025	0	1	-2.33	2.5

TABLE 3: Correlation among explanatory balance sheet and control variables[a] for US non-financial firms

Model	Var	Z	ZZ	L_1	L_2	P_1	P_2	DC	Liq	A_1	A_2	A_3	G	S	EM	AT	L	QR	Vol	WW	AR_{TW}	B	$\frac{B}{M}$
Altman's Z-score	Z	1.00																					
Altman's Z-zone	ZZ	0.61	1.00																				
Moody's	L_1	**-0.47**	**-0.54**	1.00																			
RiskCalc	L_2	0.29	0.25	-0.13	1.00																		
	P_1	0.40	0.29	-0.19	0.11	1.00																	
	P_2	-0.01	0.03	-0.02	-0.08	0.35	1.00																
	DC	-0.20	-0.36	0.44	-0.05	-0.06	0.04	1.00															
	Liq	0.47	0.27	-0.32	-0.05	0.24	0.03	-0.19	1.00														
	A_1	0.00	0.12	-0.11	0.03	-0.10	-0.04	-0.14	0.00	1.00													
	A_2	-0.11	-0.04	0.05	-0.08	-0.09	-0.03	-0.11	-0.04	0.00	1.00												
	A_3	-0.18	-0.14	0.07	-0.21	-0.09	-0.04	0.16	0.14	0.05	0.20	1.00											
	G	0.10	0.05	-0.04	-0.03	0.13	0.05	-0.03	0.11	-0.03	-0.32	0.04	1.00										
	S	-0.18	-0.16	0.29	0.06	-0.05	0.00	**0.62**	-0.08	-0.10	-0.06	0.25	0.04	1.00									
Bond	EM	0.25	0.10	0.00	0.28	0.20	0.02	0.14	0.15	-0.17	-0.01	0.30	0.17	0.16	1.00								
Score	AT	0.03	0.26	-0.10	-0.12	0.16	0.04	-0.14	-0.11	-0.08	-0.05	-0.43	-0.05	-0.16	**-0.56**	1.00							
	L	**-0.50**	**-0.51**	**0.96**	-0.15	-0.20	-0.05	0.41	-0.36	-0.09	0.05	0.15	-0.04	0.29	-0.02	-0.07	1.00						
	QR	0.53	0.16	-0.28	0.16	0.16	0.03	-0.24	**0.69**	0.00	-0.05	-0.15	0.11	-0.24	0.25	-0.26	-0.33	1.00					
	Vol	0.12	0.03	-0.11	-0.41	0.12	0.09	-0.23	0.36	0.02	0.06	0.05	0.18	-0.38	-0.10	0.12	-0.13	0.25	1.00				
Whited and Wu	WW	0.15	0.11	-0.24	-0.15	0.00	0.02	**-0.58**	0.16	0.11	0.07	-0.16	0.04	**-0.93**	-0.16	0.09	-0.25	0.28	0.52	1.00			
Control	AR_{TW}[b]	0.00	0.03	0.00	0.07	-0.04	-0.09	0.00	-0.13	0.03	0.00	-0.06	-0.09	0.03	0.05	-0.01	0.01	-0.08	-0.11	-0.07	1.00		
var-s	BB is beta	-0.16	-0.14	0.07	-0.09	-0.04	0.03	0.06	-0.05	0.04	0.00	0.07	0.13	0.16	-0.12	-0.08	0.07	-0.09	0.12	-0.10	-0.08	1.00	
	$\frac{B}{M}$[c]	-0.14	-0.09	-0.09	0.03	-0.25	-0.05	-0.11	-0.08	0.13	0.03	-0.11	0.00	-0.20	-0.11	0.06	-0.08	0.00	0.07	0.19	0.13	0.00	1.00

[a]All financial ratios are calculated for 2006. The growth rates are calculated for the period between 2004 and 2006.
[b]AR_{TW} is the autoregressive component from TW period $\Delta \ln(q_{i,TW-1})$
[c]$\frac{B}{M}$ is book-to-market ratio

TABLE 4: Simple correlation with dependent variables over nine periods [a] for US non-financial firms

Group of Var	Var	Large windows				Small windows		Recovery in stock prices windows		
		TW window	LW1	LW2	LW3	SW1	SW2	RW1	RW2	RW3
Altman's Z-score	Z	0.07	0.14	0.15	0.15	0.12	0.15	-0.03	-0.05	-0.08
Altman's Z-zone	ZZ	0.08	0.20	0.21	0.24	0.13	0.17	-0.06	-0.07	-0.16
Moody's RiskCalc	L_1	-0.05	-0.13	-0.12	-0.15	-0.14	-0.09	-0.10	0.06	0.04
	L_2	0.12	0.17	0.18	0.17	0.13	0.14	-0.07	-0.15	-0.12
	P_1	0.15	0.13	0.12	0.20	0.06	0.06	-0.14	-0.08	-0.11
	P_2	0.07	0.04	0.05	0.07	0.11	-0.04	-0.03	-0.01	0.04
	DC	0.02	-0.05	-0.02	-0.02	-0.04	-0.04	0.00	-0.01	-0.04
	Liq	0.05	0.09	0.10	0.15	0.02	0.07	-0.09	-0.11	-0.12
	A_1	-0.06	0.00	-0.01	0.00	0.05	0.00	0.06	-0.02	0.15
	A_2	0.03	-0.01	-0.02	0.00	-0.05	-0.05	0.00	0.06	0.03
	A_3	0.05	-0.02	0.00	0.00	-0.02	-0.08	-0.04	0.00	-0.04
	G	0.02	-0.02	0.00	0.00	-0.03	-0.09	-0.08	-0.09	-0.03
	S	0.06	0.00	0.05	0.08	-0.01	-0.09	0.02	-0.08	-0.08
Bond Score	EM	0.08	0.13	0.13	0.17	0.00	0.08	-0.10	-0.07	-0.22
	AT	-0.04	-0.02	0.01	0.03	0.02	0.05	0.03	0.03	0.06
	L	-0.06	-0.15	-0.13	-0.16	-0.10	-0.10	0.07	0.08	0.04
	QR	0.05	0.12	0.10	0.11	0.10	0.11	-0.14	-0.01	-0.17
	Vol	-0.22	-0.25	-0.28	-0.21	-0.15	-0.16	0.09	0.11	0.03
Whited and Wu	WW	-0.08	-0.03	-0.07	-0.07	-0.03	0.03	-0.07	0.09	0.08
Demand Sensitivity indexes	ϵ_{PCI}	-0.21	-0.15	-0.16	-0.12	-0.11	-0.08	0.11	0.04	-0.08
	ϵ_{GDP}	-0.15	-0.12	-0.14	-0.09	-0.06	-0.06	0.08	0.03	-0.02
	$CAR_{i,'01}$	-0.17	-0.06	-0.04	-0.02	-0.02	-0.04	0.04	0.01	-0.09
	$\Delta\ln(q_{i,'01})_s$	-0.22	-0.24	-0.22	-0.23	-0.07	-0.19	0.28	0.16	0.01
Control variables	$\Delta\ln(q_{i,t-1})$	-0.16	-0.13	-0.19	-0.11	-0.09	-0.24	0.56	0.90	0.18
	$Beta$	-0.15	-0.38	-0.40	-0.51	0.02	-0.56	0.59	0.45	0.17
	$\frac{Book}{Market}$	-0.16	-0.16	-0.19	-0.18	-0.08	-0.04	0.07	0.06	-0.06

[a] All financial ratios are calculated for 2006. The growth rates are calculated for the period between 2004 and 2006.

TABLE 5: Summary of the indexes of sensitivity to demand shock

Variable	Name	Obs	Mean	Std. Dev.	Min	Max
Elasticity of firm sales growth to growth in state per capita income during 1990-2006, winsorized at 1% and standardised	ϵ_{PCI}	1025	0	1	-2.21	3.38
Elasticity of firm sales growth to growth in US real GDP in 1990-2006, winsorized at 1% and standardised	ϵ_{GDP}	1025	0	1	-1.86	3.37
Cumulative abnormal stock price returns in the event window of 5 trading days before and after the terrorist attack of 09/11, winsorized at 2% and standardised	$CAR_{i,'01}$	1205	0	1	-1.20	3.48
Mean of change in log stock prices between September 10, 2001-September 21, 2001, computed by sector, winsorized at 1% and standardised	$\Delta\ln(q_{i,'01})_s$	1025	0	1	-3.81	3.58

TABLE 6: Correlation between the sensitivity indexes to demand shock and control variables for U.S. non-financial firms

Variable	ϵ_{PCI}	ϵ_{GDP}	CAR	$\Delta\ln(q_{i,'01})_s$	$\Delta\ln(q_{i,TW-1})$	$Beta$	$\frac{Book}{Market}$
ϵ_{PCI}	1.00						
ϵ_{GDP}	0.62	1.00					
CAR	0.34	0.35	1.00				
$\Delta\ln(q_{i,'01})_s$	0.17	0.15	0.02	1.00			
$\Delta\ln(q_{i,TW-1})$	0.03	0.11	0.12	0.05	1.00		
$Beta$	0.10	0.06	0.00	0.20	-0.05	1.00	
$\frac{Book}{Market}$	-0.02	-0.03	-0.07	-0.01	0.08	0.00	1.00

TABLE 7: Change in Stock Prices during the Subprime Crisis, US non-financial firms, cross-sectional OLS estimation for TW large window

Type	Name	**TW** window	**TW** window	Tong and Wei (2009b)	Tong and Wei (2009b)
		July 31, 2007 - Mar 17, 2008	July 31, 2007 - Mar 17, 2008	July 31, 2007 - Mar 31, 2008	July 31, 2007 - Mar 31, 2008
Balance sheet char-s					
MOODY'S	P_1	0.067***	0.055***		
RISKCALC		(3.08)	(2.75)		
BONDSCORE	Vol	-0.06***	-0.053***		
		(-3.97)	(-3.46)		
WHITED	WW			-0.117***	-0.123***
AND WU				(-14.23)	(-5.32)
Demand	ϵ_{PCI}	-0.052**	-0.060***		
Sensitivity		(-2.89)	(-3.57)		
	$\Delta\ln(q_{i,'01})_s$	-0.051**	-0.044**	-0.037***	-0.034***
		(-4.162)	(-3.29)	(-2.79)	(-3.87)
Control	$\Delta\ln(q_{i,t-1})$		-0.062***		0.002***
variables			(-3.80)		(6.67)
	$Beta$		-0.029*		0.030**
			(-2.38)		(2.43)
	$\frac{Book}{Market}$		-0.041*		-0.064***
			(-2.54)		(-10.11)
	Constant	-0.290***	-0.272***	-0.523***	-0.519***
		(-17.02)	(-2.38)	(-21.11)	(-16.75)
	R^2	0.111	0.165	0.07	0.14
	Obs	1024	1023	2761	2410

Notes : t-statistics in parentheses ; ***, ** and * denote p-value less than 0.1%, 1% and 5% respectively

TABLE 8: Change in Stock Prices during the Subprime Crisis, US non-financial firms, cross-sectional OLS estimation for large windows

Type of var	Name	**LW1** July 31, 2007 - Oct 27, 2008	**LW1** July 31, 2007 - Oct 27, 2008	**LW2** July 31, 2007 - Dec 01, 2008	**LW2** July 31, 2007 - Dec 01, 2008	**LW3** July 31, 2007 - Mar 09, 2009	**LW3** July 31, 2007 - Mar 09, 2009
Balance sheet char-s							
ALTMAN'S	ZZ	0.109***	0.086***	0.139***	0.084***	0.182***	0.131***
Z-ZONE		(4.17)	(3.37)	(4.70)	(3.34)	(4.85)	(4.38)
MOODY'S	P_1					0.105*	
RISKCALC						(2.00)	
	Liq	0.109***	0.060*	0.124***	0.073*	0.145***	0.089*
		(3.87)	(2.39)	(3.79)	(2.58)	(3.61)	(2.56)
BONDSCORE	EM	0.065*		0.083*		0.136**	0.102**
		(2.21)		(2.42)		(3.14)	(2.81)
	Vol	-0.159***	-0.141***	-0.212***	-0.190***	-0.197***	-0.169***
		(-5.70)	(-5.58)	(-6.54)	(-6.67)	(-4.94)	(-4.90)
Demand	ϵ_{PCI}	-0.057*					
Sensitivity		(-1.99)					
	$\Delta \ln(q_{i,'01})_s$	-0.108***	-0.060**	-0.134***	-0.057**	-0.165***	-0.068*
		(-4.86)	(-2.93)	(-5.06)	(-2.66)	(-5.17)	(-2.42)
Control	$\Delta \ln(q_{i,t-1})$		-0.090***		-0.133***		-0.186***
variables			(-4.06)		(-5.29)		(-6.25)
	$Beta$		-0.200***		-0.284***		-0.379***
			(-10.08)		(-12.60)		(-13.96)
	$\frac{Book}{Market}$		-0.050*		-0.067**		-0.078*
			(-2.38)		(-2.83)		(-2.57)
	Constant	-1.121***	-1.062***	-1.437***	-1.234***	-1.878***	-1.673***
		(-11.88)	(-11.58)	(-12.31)	(-12.06)	(-13.05)	(-13.43)
	R^2	0.183	0.320	0.193	0.398	0.204	0.435
	Obs	1023	1022	1024	1024	1022	1021

Notes : t-statistics in parentheses ; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

TABLE 9: Change in Stock Prices during the Subprime Crisis, US non-financial firms, cross-sectional OLS estimation for small windows following the Bear Stearns near-collapse and the bankruptcy of Lehman Brothers

Type of variable	Name	**SW1** Bear Stearns (Feb 17, 2008 - Mar 17, 2008)	**SW1** Bear Stearns(Feb 17, 2008 - Mar 17, 2008)	**SW2** Lehman Brothers (Sept 11, 2008 - Oct 27, 2008)	**SW2** Lehman Brothers (Sept 11, 2008 - Oct 27, 2008)
Balance sheet char-s					
ALTMAN'S	ZZ	0.015**	0.015**	0.048***	0.025*
Z-ZONE		(3.14)	(3.10)	(3.37)	(2.19)
MOODY'S	Liq			0.058***	
RISKCALC				(3.80)	
BONDSCORE	Vol	-0.016***	-0.015***	-0.065***	-0.026*
		(-4.19)	(-3.12)	(-3.23)	(-2.21)
Demand	$\Delta \ln(q_{i,'01})_s$			-0.055***	
Sensitivity				(-4.30)	
Control	$\Delta \ln(q_{i,t-1})$		-0.011*		-0.041**
variables			(-2.06)		(-3.24)
	$Beta$				-0.178***
					(-18.04)
	Constant	-0.074***	-0.075***	-0.575***	-0.560***
		(-16.84)	(-16.78)	(-44.81)	(-54.19)
	R^2	0.035	0.049	0.108	0.434
	Obs	1031	1030	1019	1019

Notes : t-statistics in parentheses ; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

TABLE 10: Change in Stock Prices during the Subprime Crisis, US non-financial firms, cross-sectional OLS estimation for small recovery in stock prices windows

Type of var	Name	**RW1** First month of recovery (Mar 09, 2009 - Apr 09, 2009)	**RW1** First month of recovery (Mar 09, 2009 - Apr 09, 2009)	**RW2** First quarter of recovery Mar 09, 2009 - June 30, 2009	**RW2** First quarter of recovery Mar 09, 2009 - June 30, 2009	**RW3** First quarter of 2010 Jan 01, 2010 - Mar 31, 2010	**RW3** First quarter of 2010 Jan 01, 2010 - Mar 31, 2010
Balance sheet char-s							
ALTMAN'S	ZZ					-0.019**	
Z-ZONE						(-2.68)	
MOODY'S	P_1			-0.073*			-0.020*
RISKCALC				(-1.98)			(-2.01)
	A_1					0.019**	0.019**
						(2.97)	(2.97)
	Liq	-0.038***		-0.099***			
		(-3.62)		(-3.45)			
BONDSCORE	EM	-0.052***	-0.031***			-0.040***	-0.026**
		(-4.31)	(-3.45)			(-4.87)	(-3.08)
	Vol			0.084**			
				(2.88)			
Demand	CAR					-0.014*	-0.019**
Sensitivity						(-2.07)	(-3.00)
indexes	$\Delta \ln(q_{i,'01})_s$	0.065***	0.023***	0.084***	0.056***		
		(7.097)	(3.21)	(3.54)	(3.81)		
Control	$\Delta \ln(q_{i,t-1})$		0.058***				0.037***
variables			(6.72)				(4.50)
	$Beta$		0.111***		0.188***		0.024***
			(13.30)		(8.17)		(3.88)
	$\frac{Book}{Market}$				0.034***		-0.028***
					(3.46)		(-3.89)
	Constant	0.347***	0.345***	0.477***	0.435***	0.104***	0.108***
		(36.35)	(47.84)	(17.48)	(35.29)	(16.01)	(14.55)
	R^2	0.131	0.513	0.071	0.182	0.071	0.143
	Obs	1011	1011	1023	1021	1025	1024

Notes : t-statistics in parentheses ; ***, ** and* denote p-value less than 0.1%, 1% and 5% respectively

FIGURE 1: S&P 500 composite index displayed on a logarithmic scale from January 1, 2007 to October 1, 2010