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Keywords: financial crisis, systematic risk, credit supply, aggregate demand

JEL Classification : G01, G12, G32

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The 2007-2009 Financial Crisis: Changing Market Dynamics and the Impact of Credit Supply and Aggregate Demand Sensitivity*

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11 April 2012

Abstract

This paper highlights the impact of credit supply and aggregate demand sensitivity on 91 US industries' stock performance during the 2007-2009 financial crisis. We account explicitly for changes in the market model and investigate, next to stock returns, the changes in systematic risk and idiosyncratic return induced by the financial crisis. The results show that leverage has a significantly positive effect on systematic risk changes during the financial crisis. After accounting for the change in systematic risk, the crisis induced idiosyncratic return is significantly related to industry leverage and the industry's sensitivity to aggregate demand. A subsequent analysis shows that both leverage and demand sensitivity have economically large effects on industry performance during the crisis.

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1. Introduction

Most policy makers and economists agree that financial crises have adverse consequences for the real economy. This can be attributed to either lower demand for credit by over-leveraged households and firms and/or can be caused by a reduction in the supply of credit by financial institutions as they try to rearrange and reinforce their capital base. Kroszner et al. (2007) report that industries relying more on external finance suffer greater value added losses during a banking crisis, thereby providing evidence in line with the latter mechanism. Recent work by Tong and Wei (2011) and Calomiris et al. (2012) shows that both higher leverage and higher demand sensitivity result in a significantly worse stock market performance for non-US firms during the financial crisis.

Nevertheless, in interpreting correctly this empirical evidence a confounding effect may well be in play through changes on the firm's systematic risk induced by the financial crisis. Already during the 1970s authors show that a firm's systematic risk changes during the business cycle (Robichek and Cohn, 1974) and exhibits a positive relation to its leverage (Hamada, 1972). In particular, Merton (1974) shows that a stock market shock, whether due to a financial crisis or any other cause for a bear market, increases the debt/equity ratio and thereby the sensitivity to systematic risk. The extant literature on the 2007-2009 financial crisis does not account for a potential change in systematic risk induced by the overall increase in debt ratios. In addition, to date there is no evidence on US industries' relative stock market performance during the financial crisis.

This paper tests explicitly whether the impact of financial crises is felt through changing market dynamics and notably changes in systematic risk or through economic effects, as postulated by the "Reduction in credit supply" and the "Demand reduction" hypotheses, for a sample 91 US industries. Put in another way, it seeks to investigate if the latter economic effects can still be detected after accounting for changes in systematic risk caused by the financial crisis.

Both mechanisms have different implications for portfolio managers, investors and policy makers alike who are concerned with mitigating the impacts of financial crises. If systematic risk increases disproportionately for more levered industries or industries more

sensitive to demand shocks, asset managers may underestimate the inherent riskiness pre-crisis. These industries increase slower than the market during the upturn, but decrease even faster than what can be expected from pre-crisis betas during the crisis.

The first objective of the present study, therefore, is to examine the overall return performance and to analyze cross sectional differences in the relative performance for the entire spectrum of US industries (including both manufacturing and services, but excluding the financial sector) during the peak to trough crisis period (8 October 2007 – 3 March 2009). The results show that industries with a higher leverage ratio face a stronger stock price decrease compared to industries with more equity finance. In addition, industries more sensitive to demand shocks experience larger losses.

The second objective is to shed new light on the mechanism of these impacts through a careful investigation of changes in the market model dynamics associated with the financial crisis. In particular, we allow alpha and beta to change during the crisis. The evidence indicates that more levered industries experience a significantly larger increase in systematic risk during the crisis. However, even after accounting for the change in systematic risk we find that both leverage and demand sensitivity are statistically significant and economically important explanatory variables of the change in idiosyncratic return across industries. More levered industries and industries more sensitive to demand shocks have larger stock price decreases during the crisis.

The rest of the paper is organized as follows: Section 2 reviews the related literature and Section 3 presents the methodology and the data. Section 4 discusses the empirical findings. Section 5 presents several robustness checks and finally, Section 6 concludes.

2. Related literature

This study draws on the extant literature relating firm and/or industry performance to financial market stress. Starting from Rajan and Zingales (1998), who establish a positive relationship between industry growth and financial development, researchers investigate the mechanisms by which financial crises generate problems in the real sector. For example, Braun and Larrain (2005) and Kannan (2010) show that industries more dependent on external finance

suffer more during recessions. The observed effects become larger when financial frictions are more prevalent.

Kroszner et al (2007) highlight the role of the banking sector. They report that sectors highly dependent on external finance tend to experience a substantially greater contraction of value added during a banking crisis in deeper financial systems compared to countries with shallower financial systems.¹ In a recent study Laeven and Valencia (2011) show that value added growth is larger for firms highly dependent on external finance in countries where governments conducted large bank bailout packages, thereby providing additional evidence on the importance of the bank lending channel for real activity.

Instead of studying value added growth, researchers increasingly seek to use market determined performance measures such as equity returns. Thus, by investigating the Russian crisis of Fall 1998, Chava and Purnanandam (2011) separate the effect of demand for credit from the supply of credit and find that firms which rely primarily on banks for capital suffer larger valuation losses compared to firms with access to public debt markets. The authors examine the impact on stock returns by applying a standard event-study methodology to compute the market model adjusted returns for the event (crisis) window for all firms.

Consistent findings are also reported by Tong and Wei (2011) who examine the effects of the credit crunch during the financial crisis and report that in developing countries, on average, the decline in stock prices is more severe for firms intrinsically more dependent on external finance for working capital. In addition, Tong and Wei (2011) also find that both leverage and demand sensitivity decrease stock returns. Their findings are supported by Calomiris et al (2012) who find evidence in favor of three effects on firm returns: credit supply, global demand and selling pressure.

In a related study, Ivashina and Scharfstein (2010) document that new lending to US firms declined substantially during the 2007-2010 financial crisis across all types of loans. This is evidence in favor of a supply effect: banks with less access to deposit financing and more revolving line exposure reduce their lending more than other banks. Further evidence is provided by De Haas and Van Horen (2012) who show that banks that had to effectuate write

¹ Interestingly, in a robustness test the authors find no relation between stock returns and leverage during crises.

downs on their sub-prime assets and to refinance large amounts of long-term debt decreased their lending abroad.

Campello et al. (2010) survey CFOs in the U.S., Europe, and Asia to directly assess whether firms face credit constraints during the global credit crisis of 2007-2010. Comparing the traditional measures of financial constraints (firm size, ownership form, and credit ratings) with the direct survey responses they find that the direct survey-based measure of constraints has better explanatory power over the traditional measures. In fact, the impact of the financial crisis is severe for credit constrained firms, leading to deeper cuts in planned R&D spending, employment, and capital spending.

In summary, documenting the adverse effects of financial constraints on the real economy and understanding the key mechanisms through which financial crises affect the real economy (namely the supply of credit to the corporate sector or a decline in the overall demand for credit) are and will continue to be areas of continued academic interest.

However, the evidence may be confounded by the possible effect of financial crises on the firms' systematic risk instead. Hamada (1972) shows that a firm's systematic risk is positively correlated with its leverage, among other determinants. Starting from the standard CAPM, several other studies show that beta changes, e.g. due to economic fluctuations (Robichek and Cohn, 1974), accounting variables (Bowman, 1979; Hill and Stone, 1980) and news about future cash flows or the discount rate (Campbell and Vuolteenaho, 2004).

According to this view, a capital market shock, whether due to a financial crisis or to any other crisis, has an impact on stock values via changes on their sensitivity to systematic risk. For example, increasing debt ratios increase systematic risk, due to the lower market value of equity. Consequently, in a market downturn share prices decrease faster for relatively more levered industries.

In a related reasoning, the extensive contagion literature recognizes explicitly that the transmission channels act specifically through volatility and/or correlations changes linked to a financial shock. For example, a well-accepted definition employed in this literature is that "(Shift-) contagion occurs when the transmission channel intensifies or, more generally, changes after a shock in one market" (Pericoli and Sbracia, (2003)).

Evidence by Ang and Chen (2002) indeed shows that stock market co-movement is larger on the downside than on the upside. More recently, van Oordt and Zhou (2011) show that during crises a so called tail beta emerges. The authors show that during market stress tail beta and thereby systematic risk increases for a sample of US industry portfolios. For the recent financial crisis Grammatikos and Vermeulen (2012) find that European non-financials become more dependent on US market developments, compared to the pre-crisis period.

Given the evidence suggesting that the market model dynamics have changed during the financial crisis the objective of the present study, therefore, is to explicitly isolate the impact of the financial crisis on US industry performance, after accounting for possible changes in systematic risk.

3. Empirical Methodology and Data

3.1 Empirical Methodology

3.1.1 Estimating the market model

In order to study the impact of the crisis on systematic risk we build on the standard CAPM in which the coefficient on the excess market return, β_i , represents the systematic risk of industry i , i.e. beta quantifies the sensitivity of industry i to movements in the market index. Hence, we postulate the following model during tranquil times:

$$r_{i,t} = \alpha_i + \beta_i * (r_{S\&P1500,t} - r_t^f) + \varepsilon_{i,t}, \quad (1)$$

where $r_{i,t}$ represents the daily excess return of industry i , $r_{S\&P1500,t}$ the daily return on the S&P 1500 index and r_t^f the risk free rate. α_i is the idiosyncratic return of industry i .

During tranquil times we use the model in Equation (1) to capture the movements in industry i 's stock market returns. However, during the financial crisis we allow for a change in the market model. We follow a similar approach as Grammatikos and Vermeulen (2012) by calculating a “tranquil” beta and a “crisis” beta. We also allow alpha to change during the crisis.

Therefore, we introduce an indicator variable that is equal to zero in tranquil times ($I(c=0) = 0$) and equal to one during the crisis period ($I(c=1) = 1$). Equation (2) specifies this model:

$$r_{i,t} = \alpha_i + \alpha_i^c * I(c=1) + \beta_i * (r_{S\&P1500,t} - r_t^f) + \beta_i^c * I(c=1) * (r_{S\&P1500,t} - r_t^f) + \varepsilon_{i,t}, \quad (2)$$

where $I(c=1)$ is the indicator variable and α_i^c and β_i^c are the additional effects of the crisis on top of the original coefficients (referred to as “crisis” alphas and betas in the rest of the paper). Notice that the “crisis” alphas capture the overall economic impact of the crisis period on individual industries and their relative size should depend on the idiosyncratic factors of each industry. The magnitude of the “crisis” betas could also depend on idiosyncratic factors as per Hamada (1972) and others. The relative importance of these two channels is of particular interest in this study. We estimate the market model using the familiar Newey-West method.

3.1.2 Measuring the impact of the financial crisis

The next step in the analysis is to explain cross sectional differences in α_i^c and β_i^c with industry specific characteristics. We follow the approach of recent studies, such as Tong and Wei (2011) and Calomiris et al (2012), who explain stock market returns during a crisis period with various accounting variables.

First, in order to compare our results with the existing literature we start by estimating the cross-sectional determinants of industry sector returns:

$$r_i = \Gamma^r * X_i + \varepsilon_i^r, \quad (3)$$

where r_i is industry i 's excess return during 9 October 2007 – 3 March 2009, while X_i is a matrix containing control variables and a constant. We estimate Equation (3) with OLS.²

Next, we explain the crisis induced changes in alphas and betas, as calculated from Equation (2), using the same set of variables as in Equation (3):

² Unreported results show that the magnitude and significance of the estimated coefficients are very similar when using a quantile regression on the median or when using bootstrapped standard errors in the OLS estimation.

$$\beta_i^c = \Gamma^b * X_i + \varepsilon_{i,}^b, \quad (4)$$

$$\alpha_i^c = \Gamma^a * X_i + \varepsilon_{i,}^a, \quad (5)$$

3.1.3 Specifying control variables

This section explains in detail the control variables (X_i) that capture the cross-sectional changes in equity returns, crisis beta and crisis alpha in models (3), (4) and (5), respectively. First, we include the pre-crisis beta when explaining crisis returns, to grasp the expected stock return from historical relationships. Pre-crisis beta measures the sensitivity to the market and should explain a large portion of industry returns, unless systematic risk changes during the crisis. Note that we calculate all control variables in X_i using pre-crisis data to ensure that the regressors are predetermined.³

To capture possible effects of the financial crisis via an impact on industry demand ideally we should have a measure of profit or sales sensitivity to the business cycle for each industry. Unfortunately, these data are not available and cannot be reliably estimated due to the annual frequency of balance sheet data. As an, albeit imperfect, alternative we construct a measure of stock price sensitivity to demand shocks following Tong and Wei (2008). It is defined as the industry's return between 10 September 2001 and 28 September 2001. The September 11 terrorist attacks created much uncertainty about future economic growth among market participants. After the Fed intervened there were virtually no effects on the financial system. Hence, we may interpret the stock price movement during this short period as a pure demand effect.⁴

During a financial crisis banks decrease their lending to the private sector. This implies that firms/industries that rely intrinsically more on external sources of finance for investments and/or working capital should suffer more from credit rationing. We use several indicators to quantify different aspects of the need for outside financing.

First, the debt-to-assets ratio captures the leverage of the industry, which reflects the industry's sensitivity to the availability of credit. Also, investors may perceive leveraged

³ Rajan and Zingales (1998) highlight the endogeneity problem when using contemporaneous data.

⁴ See Tong and Wei (2008) for a more extensive discussion on and justification of the demand sensitivity indicator.

industries as more risky during a credit crunch, due to fears of refinancing problems (Sharpe, 1991; He and Xiong, 2012). In the estimations we test if debt maturity is important by distinguishing between short and long term debt.

Second, the dependence of industries on external finance for investment is captured with the well-known external finance indicator of Rajan and Zingales (1998):

Rajan-Zingales external finance indicator = (capital expenditures – cash flow – Δ inventories – Δ receivables + Δ payables) / capital expenditures

This indicator measures the percentage of capital expenditures financed externally. It captures the need for outside capital for investments. Hence, in a credit crunch we expect industries that rely heavily on this type of financing to suffer more compared to those which rely more on internal sources of funding. However, it is also possible that these industries delay their investments when facing weaker demand prospects. When external finance is only needed for investments and not for running expenses, the firm remains financially sound when delaying investments. The empirical analysis may reveal which effect dominates.⁵

Third, some industries rely more on trade credit than others. We define trade credit as

$$\text{trade credit} = (\text{accounts payables} - \text{accounts receivables}) / \text{total assets}$$

A higher use of trade credit implies that the industry owes more to its suppliers than it is owed by its customers. When cash is scarce, accounts receivables become more risky, which favors industries using much trade credit. Hence, we expect a positive effect of trade credit on an industry's return.

Following up on the related literature we include some additional control variables that capture firm/industry specific structural differences (cf. Tong and Wei, 2011; Calomiris et al., 2012). We use as momentum the return between February 2007 and October 2007, a period

⁵ Note that Rajan and Zingales (1998) only consider manufacturing industries, while this paper also include service industries. Capital investments are less important for service industries, which may affect the usefulness of the external finance indicator.

when the first signs of the sub-prime concerns arose, but with no signs of a global financial crisis or recession looming. The predicted sign is negative, because a high return during the early phase of the financial crisis may be a sign of investor mispricing. In fact, investors believing that the financial crisis would be constrained to the U.S. housing market had to revise their expectations during the next phase of the crisis (Dooley and Hutchison, 2009).

The interest coverage ratio measures the easiness to pay the interest on debt out of operating income (operating income before interest, taxes and dividends / interest expense). A higher ratio signals a better ability to service the interest payments, which has an expected positive effect on returns.

Next, we measure the tangibility of assets as the ratio of the value of property, plant and equipment divided by total assets. In general, it is easier to use tangible assets as collateral for bank loans. Therefore, we expect industries with relatively more tangible assets to perform better during the crisis.

Finally, to quantify the risk of bankruptcy, we calculate for each industry its Altman's (2012) revised Z-score, using the formula for private firms:

$$Z = 0.717(X1) + 0.847(X2) + 3.107(X3) + 0.420(X4) + 0.998(X5)$$

where X1 is working capital/total assets, X2 retained earnings/total assets, X3 earnings before interest and taxes/total assets, X4 book value equity/book value of total liabilities and X5 sales/total assets. The higher Z, the further away is a firm from bankruptcy. Hence, we expect a positive effect of Z on industry returns.

3.2 Data

The S&P 1500 contains all firms of the S&P 500 index (large-caps), S&P 400 index (mid-caps) and S&P 600 index (small-caps). We collect data at the sub-industry level from the Global Industry Classification System (GICS), which is the highest industry disaggregation possible in Compustat and Datastream, our main data sources. This amounts to 137 industries with full data availability. However, there is some attrition due to changing industry definitions and

missing data. In addition, we exclude financial industries (GIC sector 40) for two reasons: 1) The objective of the paper is to analyze the effects of the financial crisis on non-financial industries and 2) The balance sheet structure of financials is very different from non-financials, which severely biases a comprehensive analysis based on accounting ratios.⁶ This reduces the sample to 91 industries. Appendix A provides a detailed list of all industries in the sample as well as their crisis return, crisis alphas and crisis betas.

Daily prices for the S&P 1500 index and its sub-industry indexes are from Datastream with a timespan from 30 April 2003 until 3 March 2009. This period contains the relatively tranquil period after the crash of the Dot-com bubble and the financial crisis. As discussed in the previous section, we consider the S&P 1500 peak to trough period as the financial crisis (8 October 2007 – 3 March 2009). Therefore, 30 April 2003 – 7 October 2007 is the pre-crisis period. The return on the S&P 1500 index during the crisis period is -81%.⁷

We match the above data with annual balance sheet information from the COMPUSTAT Industry database to construct several of the aforementioned control variables. In particular, we use data from end-2003 until end-2006 to ensure that all right hand side variables are predetermined and avoid short term distortions.⁸ The exception is Altman's Z-score where we use only 2006 data to more accurately reflect the distance to default at the start of the crisis.

Table 1 provides summary statistics of all cross-sectional variables used in the study. The relative log-return performance during the crisis varies widely across industries, ranging from -258% for photographic products to -9.5% for brewers.

Insert Table 1 about here

To visualize the impact of the crisis on the market model Figures 1 and 2 show a histogram on crisis alphas and betas, respectively. The figures show that the crisis had a large impact on both variables, given their great dispersion. Crisis beta ranges from -0.44 to 0.43,

⁶ For an extensive analysis on bank risk during the financial crisis we refer to Altunbas et al. (2011).

⁷ Note that we use log-differences to calculate returns.

⁸ Robustness tests in Section 5 show that using solely end-2006 or end-2008 data does not alter the main results.

while crisis alpha ranges from -0.38 to 0.16. These ranges are economically large and potentially related to industry characteristics.

Insert Figures 1 and 2 about here

The other control variables confirm that there is quite some heterogeneity among US industries in the S&P 1500. As an example, the debt ratio ranges from 0.05 to 0.57 and trade credit from -0.34 to 0.30. The variation in the Rajan-Zingales external finance indicator is also larger than commonly reported in empirical studies. This is mainly because the sample includes many service industries, which have lower capital expenditures relative to manufacturing industries.

Insert Table 2 about here

Table 2 presents the correlation matrix of the independent variables. Most correlations are below 0.5, which is important to avoid multicollinearity problems in estimations. However, there are some correlated variables. The correlation between the debt ratio and the short and long term debt ratios is quite high, because both are subcomponents of the former. The total debt / long term debt correlation is especially high, suggesting most industry debt is long term.

4. Empirical Findings

4.1 The overall impact of the financial crisis on stock returns

Table 3 presents results of various specifications of model (3) where the dependent variable is the total industry return during the crisis.

Insert Table 3 about here

Column (1) presents the coefficients of the benchmark specification. Pre crisis beta*S&P 1500 return, which is the return we expect based on historical relationships, is statistically significant and economically relevant. In fact, the crisis coefficient is one when past betas perfectly predict the return. The coefficient around 0.7 is therefore encouraging. Also, its magnitude is higher than the coefficients around 0.3 reported by Tong and Wei (2011). However, a coefficient not equal to one suggests that the pre-crisis betas cannot explain all the cross-sectional variation during the crisis.

The coefficient on demand sensitivity is large and statistically significant. This is in line with an (expected) demand contraction being one reason for the deteriorating stock performance. The magnitude of the coefficient is quite stable across the different specifications. Its size of 1.6 implies that industries which lost 10%, say, in the weeks after 9/11, lose 16% during the financial crisis.

Consistent with Tong and Wei (2011) and Calomiris et al. (2012) indebtedness turns out to be significant and with the expected sign. This implies that leveraged firms suffered greater stock price declines during the crisis, probably due to the difficulty of rolling over debt in an environment of tight credit supply. This finding is also consistent with a general debt aversion and an increased perceived riskiness of debt by investors.

The Rajan-Zingales external finance indicator is only marginally significant, which suggests that investors do not treat industries relying more on external sources of finance differently. During the crisis firms may delay investments because of low demand and investors revise beliefs about future growth.

We do not find evidence that industries providing trade credit suffered more, in contrast to Tong and Wei (2011), even though the sign is in the expected direction.⁹ While these industries are more prone to the risk of not being paid by customers, a possible explanation for this finding is the relatively strong cash position of US firms at the advent of the crisis (Bates et al., 2009). This finding is supported by unreported results, where the cash ratio is insignificant when added to the regression.

⁹ Tong and Wei (2011) use the cash conversion cycle to capture cash needs for working capital. The cash conversion cycle is appropriate for manufacturing industries, but less suitable for service industries, which dominate our sample.

In columns (2)-(6) we add additional control variables. In column (2) we add momentum. While we expect industries that performed better during the six months prior to the crisis to perform worse during the crisis, the results do not confirm this expectation. Instead, the sign on momentum is even positive albeit insignificant.

Column (3) shows that the interest coverage ratio is insignificant. Industries which are better able to service their interest payments do not outperform other industries. This is quite surprising because we expect industries more able to service their debt obligations to perform better during a credit crunch.

In column (4) we investigate if industries with more tangible assets – property, plant and equipment – perform better. The sign on this variable is positive, but insignificant, which therefore suggests an unimportant role for the (in)tangibility of assets. Column (5) adds Altman's Z-score to the model. The higher Altman's Z, the further an industry is away from default. The coefficient is insignificant, but the sign is in the predicted direction.

Finally, we test if the maturity of debt matters for the result by splitting the debt ratio into a short- and long-term debt ratio (column (6)). Both ratios have a negative sign of the same order of magnitude. However, only the long-term debt ratio is statistically significant due to its smaller standard error. In sum, investors' focus on the overall debt ratio seems to be driven by the industry's long term debt, which is in general the main source of debt financing.

4.2 The impact of the financial crisis on industry alphas and betas

The evidence indicates that the market dynamics may be subject to change because of or during the event under analysis and hence need to be taken into account in the analysis. Moreover, it is important to identify what factors explain these changing market dynamics. The existence of any such factors could then be employed to account for these changes in practical settings, for example, in asset management policies.

Table 4 presents the results of the estimation when using specifications (1) and (6) from Table 3 to explain the crisis betas (columns (1) and (2)) and crisis alphas (columns (3) and (4)).

Insert Table 4 about here

Column (1) shows that only the debt ratio significantly explains crisis beta (β_i^C). Demand sensitivity, the Rajan-Zingales external finance indicator and trade credit turn out to be insignificant. According to the Merton (1974) model the market value of equity relative to debt decreases when stock prices decrease, which increases systematic risk. The significantly positive sign on the debt ratio confirms the positive relationship between leverage and systematic risk.

Hence, if asset managers base their investment decisions solely on tranquil market betas, they fail to recognize the increased sensitivity of more levered industries to the market index during a bear market. Such a strategy will lead to undesirable outcomes. There is an underperformance relative to industry risk during the upturn and even larger than expected losses during the downturn. Therefore, it is important to take the leverage ratio into account in portfolio decisions.

The results in column (2) show that the long term debt ratio has a statistically significant effect on systematic risk, while the short term debt ratio is insignificant. This finding suggests that the increase in systematic risk is driven by the industry's debt level in general and not necessarily investor concerns regarding rollover risk.

Next, columns (3) and (4) show the regression results of Equation (5), where crisis alpha (α_i^C) is the dependent variable. First, the results show that demand sensitivity has strong explanatory power. The coefficient is significantly positive and its magnitude is economically large. The coefficient of around 0.4 implies that industries which may have lost 10%, after the 9/11 demand shock lose an additional 4% during the financial crisis.

In addition, the debt ratio is significantly negative, which implies that more levered industries bear a lower idiosyncratic return. Note that this negative effect is on top of the increase in systematic risk induced by the crisis.

The Rajan-Zingales external finance indicator is significantly positive. This is perhaps a surprising finding, because it suggests that industries relying more on outside sources of funds to finance investments performed better during the financial crisis. However, this can be explained by firms delaying investments. When firms do not use external financing for current expenses they are less likely to run into financial problem. The coefficient on trade credit is

never significant across the different estimations, indicating that industries relying on trade credit did not suffer more during the crisis.

Finally, column (4) shows that the sign of both short- and long-term debt is negative, while only long-term debt has a significantly negative effect. The magnitude of both coefficients is in line with the coefficient on the overall debt ratio.

In sum, during the crisis systematic risk changes are associated with the debt ratio, potentially driven by the Merton (1974) effect. In addition, both the “Reduction in credit supply” and the “Demand reduction” hypotheses are valid for the change in idiosyncratic return during the crisis.

4.3 Economic importance of credit supply and demand effects

The previous results show the importance of demand sensitivity and leverage for total industry returns, changes in systematic risk and idiosyncratic returns during the financial crisis. In addition, the Rajan-Zingales indicator also provides some evidence on the importance of external sources of finance used for investment purposes. In this section we ask the question: What are the effects on industry return, crisis beta and crisis alpha if an industry moves from the 25th percent quantile to the 75th percent quantile in the demand sensitivity, leverage and external finance distribution.

Table 5 shows the values of the 25th and 75th quantile of these three variables and the difference between them. For ease of exposition it also presents the coefficients on the respective variables from Tables 3 and 4, where we use the specification in column (1) of Table 3 for return and columns (1) and (3) of Table 4 for crisis beta and crisis alpha, respectively.

Insert Table 5 about here

The results show that especially demand sensitivity and leverage have a strong impact on industry returns. So, if an industry becomes less sensitive to demand shocks and moves from the 25th to the 75th quantile regarding demand sensitivity, its return would be around 15 percent better during the crisis. The effect is even stronger for leverage. When an industry

moves from a low debt ratio to a higher debt ratio, its return is about 30 percent lower. The effect of the Rajan-Zingales measure is smaller, with an impact below 6 percent.

Regarding systematic risk, only an increase in the leverage ratio has an economically important impact on beta. In fact, beta increases by 0.10 with a change from the 25th to 75th quantile. The economic impact of the variables on the idiosyncratic return is large, -12% for demand sensitivity, -19% for the debt ratio and +7% for the Rajan-Zingales external finance indicator. This shows that both credit supply and demand effects are important determinants of relative industry returns during the financial crisis.

5. Robustness

We now proceed with presenting the results for several robustness tests. First, we analyze the sensitivity of using 2003-2006 balance sheet data, compared to the use of 2006 or 2008 balance sheet data. Second, we assess whether pre-crisis alphas and betas have predictive power on the change in alphas and betas during the crisis.

5.1 Predeterminedness of the independent variables

In the previous estimations we use 2003-2006 balance sheet averages to calculate the debt ratio, external finance and trade credit. This avoids endogeneity problems and distortions due to short term fluctuations. We now assess the sensitivity of the results by estimating the benchmark model for return, crisis beta and crisis alpha using 2006 (columns (1)-(3)) and 2008 balance sheet data (columns (4)-(6)) in Table 6.

Insert Table 6 about here

The results in Table 6 remain qualitatively and quantitatively similar to the benchmark results for demand sensitivity and debt ratio. The coefficient on the Rajan-Zingales external finance indicator is less stable across regressions. These results are comforting, but to avoid

endogeneity problems and distortions due to short term fluctuations we prefer using 2003-2006 in the main specifications.

5.2 Predictive power of pre-crisis alphas and betas

In this robustness exercise we investigate if pre-crisis alphas and betas have predictive power on the changes in alphas and betas during the crisis. Table 7 shows that a high pre-crisis alpha increases systematic risk during the crisis, while a high beta before the crisis results in a lower beta during the crisis. The latter effect can be viewed as a mean reversion effect, while the former indicates that outperforming industries before the crisis have build up systematic risk, which materialized during the crisis.

Insert Table 7 about here

The build up of systematic risk before the crisis can be related to "fake alpha" or "hidden beta" as argued by Altunbas et al. (2012). They distinguish between good and bad management, where the former generates a true alpha for investors. While their results provide evidence for the emergence of hidden systematic risk for banks, the results in Table 8 suggest that this finding can be generalized to the non-financial sector as well.

Column (2) shows that pre-crisis alphas and betas are not related to the change in alpha during the crisis. Most importantly, adding pre-crisis alphas and betas to the model does not alter the conclusions obtained from Table 4.

6. Concluding remarks

This paper analyses the relative stock market performance of 91 US industries during the 2007-2009 financial crisis. The empirical methodology explicitly accounts for changes in the market model when explaining the changes in systematic risk and idiosyncratic return. The results show that leverage significantly increases the systematic risk of industries during the crisis. After accounting for the change in systematic risk, both leverage and demand sensitivity are important determinants of industries' change in idiosyncratic return during the crisis.

Our results indicate that market participants need to account for changes in the market model induced by financial crises in their portfolio decisions. In fact, it is important to acknowledge the underlying increase in systematic risk for levered industries during crisis periods. Not accounting for the change in systematic risk results in an underperformance relative to the actual inherent riskiness during bull markets and larger than expected losses during a bear market due to the increase in systematic risk.

More generally, the examination of market reactions to various events or event periods, including financial crises, has been a favorite academic tool in the financial literature. Firmly based on the market efficiency hypothesis this approach has been widely used to assess the market's consensus view on the impact of the event under analysis. The evidence produced in this study indicates that the market dynamics may be subject to change because of or during the event under analysis and hence need to be taken into account. In this sense the simple application of the market model in these studies may be insufficient for accurately measuring the market's reaction. Models that specifically allow for changing dynamics, for example, changing volatilities, correlations and/or including jumps in the return generating process, may be fruitful areas of future research.

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Table 1: Summary statistics on the cross sectional variables

Variable	Obs	Mean	Std. Dev.	Min	Max
crisis return	91	-0.99	0.49	-2.57	-0.10
crisis beta	91	-0.03	0.20	-0.44	0.43
crisis alpha	91	-0.04	0.10	-0.38	0.16
demand sensitivity	91	-0.09	0.07	-0.32	0.10
debt ratio	91	0.24	0.11	0.05	0.57
Rajan-Zingales external finance indicator	91	-1.23	2.97	-10.23	19.67
trade credit	91	-0.05	0.09	-0.34	0.31
momentum	91	0.05	0.17	-0.60	0.55
interest coverage ratio	91	25.12	77.82	1.91	738.85
plant, property and equipment / total assets	91	0.30	0.19	0.01	0.84
Altman's Z-score	91	2.12	0.87	0.67	5.05
short term debt ratio	91	0.04	0.04	0.00	0.20
long term debt ratio	91	0.21	0.09	0.05	0.45

Table 2: Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) crisis return	1												
(2) crisis beta	0.50	1											
(3) crisis alpha	0.90	-0.45	1										
(4) demand sensitivity	0.41	-0.01	0.32	1									
(5) debt ratio	-0.30	0.31	-0.33	-0.04	1								
(6) Rajan-Zingales external finance indicator	-0.05	0.04	0.16	-0.05	0.34	1							
(7) trade credit	0.27	-0.08	0.24	0.13	-0.29	-0.04	1						
(8) momentum	0.07	0.05	-0.04	-0.06	-0.17	-0.28	0.01	1					
(9) interest coverage ratio	0.08	-0.26	0.06	-0.31	-0.32	-0.10	0.01	0.09	1				
(10) plant, property and equipment / total assets	0.05	0.18	0.07	-0.08	0.26	0.23	0.30	0.09	-0.18	1			
(11) Altman's Z-score	0.22	-0.16	0.22	0.04	-0.46	0.01	0.18	-0.04	0.26	-0.13	1		
(12) short term debt ratio	-0.21	0.18	-0.22	0.03	0.60	0.17	-0.52	-0.09	-0.16	-0.20	-0.23	1	
(13) long term debt ratio	-0.28	0.30	-0.31	-0.06	0.95	0.33	-0.15	-0.16	-0.31	0.38	-0.46	0.32	1

Table 3: The overall impact of the financial crisis on stock returns

	(1)	(2)	(3)	(4)	(5)	(6)
pre-crisis beta * crisis market return	0.728*** (0.242)	0.769*** (0.244)	0.702*** (0.242)	0.730*** (0.241)	0.723*** (0.244)	0.731*** (0.244)
demand sensitivity	1.659** (0.648)	1.664** (0.647)	1.978*** (0.684)	1.756*** (0.650)	1.656** (0.651)	1.670** (0.655)
debt ratio	-1.724*** (0.469)	-1.710*** (0.467)	-1.494*** (0.494)	-1.916*** (0.490)	-1.598*** (0.528)	
Rajan-Zingales external finance indicator	0.029* (0.016)	0.034** (0.017)	0.028* (0.016)	0.026 (0.017)	0.027 (0.017)	0.029* (0.017)
trade credit	0.473 (0.493)	0.464 (0.492)	0.520 (0.492)	0.189 (0.539)	0.465 (0.496)	0.426 (0.562)
momentum		0.321 (0.268)				
interest coverage ratio			0.001 (0.001)			
plant, property and equipment / total assets				0.324 (0.254)		
Altman's Z-score					0.030 (0.057)	
short term debt ratio						-1.983 (1.538)
long term debt ratio						-1.679*** (0.537)
Observations	91	91	91	91	91	91
R-squared	0.346	0.357	0.361	0.358	0.348	0.346

Note: This table presents the results of the estimation of Equation (3) using OLS. The dependent variable is industry *i*'s return during the period 9 October 2007 to 3 March 2009. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 4: The impact of the financial crisis on industry betas and alphas

	(1) crisis beta	(2) crisis beta	(3) crisis alpha	(4) crisis alpha
demand sensitivity	0.003 (0.284)	0.004 (0.289)	0.399*** (0.116)	0.400*** (0.118)
debt ratio	0.636*** (0.212)		-0.345*** (0.087)	
Rajan-Zingales external finance indicator	-0.005 (0.008)	-0.005 (0.008)	0.010*** (0.003)	0.010*** (0.003)
trade credit	0.044 (0.237)	0.039 (0.269)	0.090 (0.097)	0.088 (0.110)
short term debt ratio		0.608 (0.740)		-0.355 (0.303)
long term debt ratio		0.642** (0.250)		-0.344*** (0.103)
Observations	91	91	91	91
R-squared	0.102	0.102	0.303	0.303

Note: This table presents the results of the estimation of Equations (4) and (5) using OLS. The dependent variable is either industry i 's crisis beta (β_i^c) or crisis alpha (α_i^c) during the period 9 October 2007 to 3 March 2009. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 5: Economic magnitude

	Q25	Q75	Q75-Q25	coefficients table 3 (1)	crisis return	coefficients table 4 (1)	crisis beta	coefficients table 4 (3)	crisis alpha
demand sensitivity	-0.038	-0.131	-0.093	1.659	-15.43%	0.003	0.000	0.399	-12.38%
debt ratio	0.149	0.321	0.172	-1.724	-29.65%	0.636	0.109	-0.345	-19.05%
Rajan-Zingales external finance indicator	-2.208	-0.259	1.949	0.029	5.65%	-0.005	-0.010	0.010	7.18%

Note: This table shows the economic impact when an industry moves from the 25th quantile to 75th quantile of the distribution of a particular variable. The coefficient columns present the coefficient on the respective variable for the benchmark specifications on return (Table 3, column (1)), crisis beta (Table 4, column (1)) and crisis alpha (Table 4, column (3)). The columns return, crisis beta and crisis alpha show the change in the respective dependent variable induced by the move from the 25th to 75th quantile. For comparability with the crisis return, the return of crisis alpha is multiplied by the number of trading days during the crisis. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 6: Predeterminedness of accounting variables

	(1) crisis return	(2) crisis beta	(3) crisis alpha	(4) crisis return	(5) crisis beta	(6) crisis alpha
pre-crisis beta * crisis market return	0.566** (0.228)			0.552** (0.216)		
demand sensitivity	1.917*** (0.627)	-0.107 (0.273)	0.399*** (0.118)	2.276*** (0.566)	-0.155 (0.259)	0.472*** (0.103)
debt ratio (2006)	-1.455*** (0.430)	0.502** (0.202)	-0.239*** (0.087)			
Rajan-Zingales external finance indicator (2006)	-0.003 (0.018)	0.009 (0.009)	-0.003 (0.004)			
trade credit (2006)	0.562 (0.469)	-0.027 (0.224)	0.126 (0.097)			
debt ratio (2008)				-1.903*** (0.329)	0.560*** (0.164)	-0.363*** (0.066)
Rajan-Zingales external finance indicator (2008)				-0.002* (0.001)	0.001 (0.001)	-0.001*** (0.000)
trade credit (2008)				-0.092 (0.243)	0.010 (0.121)	-0.034 (0.048)
Observations	93	93	93	94	94	94
R-squared	0.323	0.094	0.228	0.415	0.128	0.376

Note: This table estimates the benchmark estimations from Tables 3 and 4 using either 2006 or 2008 balance sheet data to calculate the independent variables. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 7: Predictive power of pre-crisis alphas and betas

	(1) crisis beta	(2) crisis alpha
pre-crisis alpha	1.470** (0.559)	0.133 (0.248)
pre-crisis beta	-0.328*** (0.097)	-0.038 (0.043)
demand sensitivity	-0.416 (0.295)	0.350*** (0.131)
debt ratio	0.420* (0.213)	-0.372*** (0.095)
Rajan-Zingales external finance indicator	0.006 (0.008)	0.011*** (0.003)
trade credit	-0.132 (0.225)	0.071 (0.100)
Observations	91	91
R-squared	0.244	0.311

Note: This table estimates Equations (4) and (5) for crisis beta and crisis alpha with additional control variables. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively. Pre-crisis alpha and beta are α_i and β_i from Equation (2).

Figure 1: Histogram of crisis alpha

Figure 2: Histogram of crisis beta

Appendix A: Industry characteristics

Index Name	GIC industry code	crisis return		
		(log returns)	crisis beta	crisis alpha
Advertising	25401010	-106.2%	0.135***	-0.043
Aerospace and Defence	20101010	-90.2%	-0.094**	-0.097*
Agricultural Products	30202010	-39.6%	0.189*	0.095
Air Freight and Couriers	20301010	-79.0%	-0.025	-0.004
Airlines	20302010	-108.7%	-0.305***	-0.009
Aluminium	15104010	-208.7%	0.256**	-0.170
Apparel and Accessories	25203010	-120.4%	-0.040	-0.084
Apparel Retail	25504010	-79.5%	-0.132**	0.044
Application Software	45103010	-85.7%	-0.262***	-0.005
Automobile Manufacturers	25102010	-214.9%	0.204	-0.206
Auto Parts and Equipment	25101010	-147.8%	-0.020	-0.121
Broadcasting	25401020	-187.5%	0.372***	-0.162
Biotechnology	35201010	-24.2%	-0.387***	0.129
Brewers	30201010	-9.5%	-0.093	0.100
Building Products	20102010	-117.2%	-0.085	-0.061
Casinos and Gaming	25301010	-176.9%	0.377***	-0.235*
Commercial Printing	20201010	-192.8%	0.293***	-0.274**
Commodity Chemicals	15101010	-218.6%	0.296**	-0.262
Communication Equipment	45201020	-85.4%	-0.392***	0.000
Companies Storage and Peripherals	45202020	-90.6%	-0.437***	-0.019
Computer Hardware	45202010	-67.6%	-0.170***	0.002
Computer and Electrical Retail	25504020	-85.7%	-0.206**	0.012
Construction and Farming Machine	20106010	-128.3%	-0.074	-0.102
Construction Materials	15102010	-98.0%	-0.154*	-0.052
Construction and Engineering	20103010	-84.7%	0.122	0.069
Department Stores	25503010	-120.2%	-0.020	-0.076
Distillers and Vintners	30201020	-53.3%	0.009	-0.004
Diversified Chemicals	15101020	-134.0%	0.035	-0.092
Drug Retail	30101010	-53.7%	-0.104	0.003
Diversified Metals and Mining	15104020	-134.0%	0.064	-0.111
Electronic Equipment and Instruments	45203010	-100.4%	-0.382***	-0.054
Electrical Companies and Equipment	20104010	-92.2%	-0.069	-0.016
Environmental and Facilities Services	20201050	-52.3%	-0.059	0.021
Food Distributors	30101020	-60.4%	-0.090	0.014
Food Retail	30101030	-69.2%	-0.215***	-0.046
Footwear	25203020	-74.8%	0.108	-0.015
Forest Products	15105010	-142.1%	-0.006	-0.098
Gas Utilities	55102010	-57.4%	0.094	0.057
General Merchandising Stores	25503020	-75.9%	-0.162**	0.028
Gold	15104030	-22.1%	-0.080	0.117
Health Care Distributors	35102010	-61.2%	-0.151**	-0.003
Health Care Equipment	35101010	-58.6%	-0.117**	-0.015
Health Care Facilities	35102020	-95.8%	0.174**	-0.065
Health Care Supplies	35101020	-57.7%	-0.201***	-0.029
Home Furnishings	25201020	-125.3%	-0.086	-0.070

Home Improve Retail	25504030	-67.8%	-0.115*	0.083
Homebuilding	25201030	-91.5%	-0.206	0.158
Household Appliances	25201040	-125.1%	-0.146*	-0.116
Household Products	30301010	-47.4%	0.001	0.003
Housewares and Specialties	25201050	-161.5%	0.139**	-0.206**
Hotels	25301020	-135.0%	0.185***	-0.111
Human Resource and Employment Services	20201040	-98.7%	-0.341***	-0.017
Industrial Conglomerates	20105010	-155.8%	0.088	-0.185**
Industrial Gases	15101040	-61.0%	-0.007	0.068
Industrial Machinery	20106020	-91.9%	-0.111***	-0.026
Integrated Oil and Gas	10102010	-48.2%	0.103	0.088
Integrated Telecommunications Services	50101020	-66.9%	0.035	0.011
Internet Retail	25502020	-65.5%	-0.328***	0.052
Internet Software and Services	45101010	-87.0%	-0.440***	-0.046
Information Technology Consulting and Other Services	45102010	-75.4%	-0.311***	0.015
Leisure Products	25202010	-85.3%	-0.129**	-0.005
Managed Health Care	35102030	-110.2%	0.123	-0.130
Marine	20303010	-101.3%	-0.207**	-0.065
Metal and Glass Containers	15103010	-88.1%	-0.065	-0.047
Motorcycle Manufacturers	25102020	-182.8%	0.387***	-0.140
Movies and Entertainment	25401030	-107.0%	0.162***	-0.007
Multi Utilities	55103010	-54.3%	-0.154***	0.008
Office Electronics	45204010	-134.5%	-0.083	-0.127
Office Services and Supplies	20201060	-113.4%	0.067	-0.075
Oil and Gas Drilling	10101010	-96.5%	0.290***	0.015
Oil and Gas Refining and Marketing	10102030	-134.7%	0.433***	-0.117
Oil and Gas Equipment and Services	10101020	-110.4%	0.285***	-0.047
Oil and Gas Exploration and Producers	10102020	-65.4%	0.357***	0.078
Packaged Foods	30202030	-42.6%	-0.041	0.015
Paper Packaging	15103020	-94.6%	-0.145**	-0.026
Paper Products	15105020	-184.6%	0.029	-0.193*
Personal Products	30302010	-79.8%	0.056	-0.070
Pharmaceutical	35202010	-50.7%	-0.099**	0.052
Photographic Products	25202020	-257.0%	0.086	-0.377**
Publishing and Printing	25401040	-138.3%	0.403***	-0.077
Railroads	20304010	-64.5%	-0.182***	0.021
Restaurants	25301040	-42.8%	-0.209***	0.031
Soft Drinks	30201030	-49.0%	0.010	-0.011
Specialty Chemicals	15101050	-64.7%	-0.153***	0.043
Specialty Stores	25504040	-93.1%	-0.013	0.021
Steel	15104050	-126.9%	-0.030	-0.020
Systems Software	45103020	-62.7%	-0.097**	0.070
Tires and Rubber	25101020	-207.9%	0.216	-0.231
Tobacco	30203010	-34.7%	-0.088	-0.010
Trading Companies and Distributors	20107010	-73.4%	-0.332***	-0.001
Trucking	20304020	-83.1%	-0.333***	0.027

*, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.