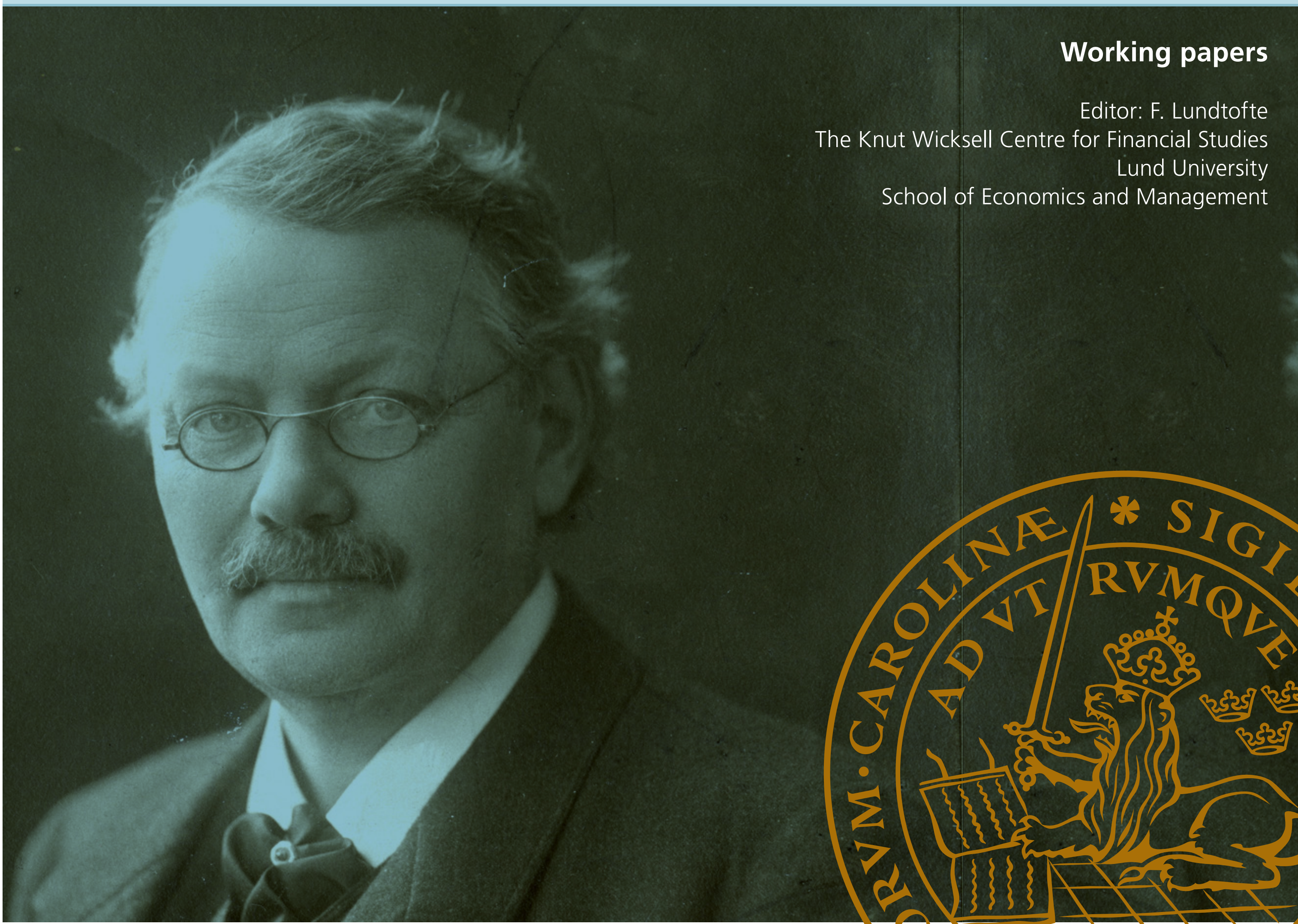
Does the financial crisis affect distressed or constrained firms more heavily?

EMANUEL ALFRANSEDER

KNUT WICKSELL WORKING PAPER 2015:4



Working papers

Editor: F. Lundtofte
The Knut Wicksell Centre for Financial Studies
Lund University
School of Economics and Management

Does the financial crisis affect distressed or constrained firms more heavily?

Emanuel Alfranseder*

Working paper version from April 2015

Abstract

We develop a framework to investigate the impact of the financial crisis starting in 2007 and employ an extended GARCH model to test for spillover and contagion effects originating from the financial sector. We find that the financial crisis affected financially distressed firms more heavily than undistressed firms and that financial constraints did not play an equally crucial role during the crisis. Overall, the analysis shows that the financial sector affected the returns of nonfinancial firms during the crisis. We find little evidence that the turbulence in the financial sector expressed in terms of volatility fully encroached upon nonfinancial firms.

JEL classification: G01

Keywords: GARCH; Spillover; Contagion; Financial Distress; Financial Constraints; Financial Crisis

* Department of Economics, Lund University, Box 7082 S-22007 Lund, Sweden
Emanuel.Alfranseder@nek.lu.se, +46-(0)46-222 8673

2 Does the financial crisis affect distressed or constrained firms more heavily?

We develop a framework to investigate the impact of the financial crisis starting in 2007 and employ an extended GARCH model to test for spillover and contagion effects originating from the financial sector. We find that the financial crisis affected financially distressed firms more heavily than undistressed firms and that financial constraints did not play an equally crucial role during the crisis. Overall, the analysis shows that the financial sector affected the returns of nonfinancial firms during the crisis. We find little evidence that the turbulence in the financial sector expressed in terms of volatility fully encroached upon nonfinancial firms.

1 Introduction

An increasing body of literature investigates the causes and consequences of the financial crisis triggered by the subprime-mortgage collapse starting around August 2007. A sharp recession followed in a majority of mature industrialized economies, the worst contraction since the Great Depression for many countries. While the deep recession in itself provides evidence that the financial crisis encroached upon the real economy, we do not have a clear understanding of how such spillovers happen and, in particular, who is affected. In the following work, we provide evidence mostly on the latter issue.

The question posed leads us to take a macroeconomic perspective of the financial crisis. Building on the Schumpeterian idea of creative destruction (Schumpeter, 1939) and basic microeconomic theory on competitive markets, recessions provide an opportunity to drive weak and obsolete firms out of business. Taking that line of argumentation, a recession should affect businesses already in distress prior to that recession. We identify financially weak businesses by measuring the firms' degree of financial distress of nonfinancial firms with Altman's Z-score (Altman, 1968). If the financial turmoil adversely affects financially distressed firms, as could certainly be expected, the subsequent cathartic process of the economy is conducive to future growth and development.

A different scenario unfolds when the crisis negatively affects principally healthy firms. Our measurement in that context will be financial constraint, and we draw on a whole body of existing literature on the topic (e.g., Whited and Wu, 2006; Lamont et al., 2001) to identify an appropriate measure of financial constraint. Financially constrained firms might need to reduce investment further (Duchin et al., 2010) when financing dries up. If such effects dominate, potential economic output is essentially lost without any future positive effects. Modigliani and Miller (1958) show in their seminal work that a firm can choose its financing channel arbitrarily, without any effects on profitability and investment. Their work provides a purely theoretical model that assumes that no market frictions prevent access to capital. However, both the theoretical and empirical literature identifies such frictions (e.g., Fazzari, et al., 1988) and shows that access to capital does influence investment decisions and the resultant level of investment. Whether financial constraints affect performance negatively, is, on the other hand, not a priori clear. The lower capacity to overinvest prior to the crisis can be positive for more constrained firms.

The following empirical work builds on two essential assumptions that have been partly taken for granted in much of the precrisis literature. First, we assume some form of efficient markets, in the sense that newly arriving information is immediately incorporated into stock market prices. Second, we assume that Modigliani and Miller's (1958) assumptions do not hold and firms face differing financial constraints.

The proposed framework is suitable to investigate two main questions. First, did the financial crisis affect nonfinancial firms or was the development, rather, a self-contained event? Second, are there any differences with respect to the financial distress and constraint of firms? The first question helps to evaluate the overall impact of the financial crisis on the real economy and helps policymakers understand how to design potential countermeasures. The second question helps to gain insight into which resources are affected and how the financial crisis spills over to the real economy. In addition, the analysis allows us to draw implications for portfolio choices in terms of risk during crisis periods.

We implement the analysis by preclassifying firms into different groups according to financial constraint and financial distress, constructing portfolios, and performing the spillover and contagion analysis. The main empirical model follows Baur (2003) in using an extended asymmetric GARCH model and investigates spillover and contagion effects originating from the financial sector. We model the first and second moments simultaneously. The model draws a careful distinction between spillover and contagion effects, the former describing a more permanent codependence and the latter singling out a change in correlation during a crisis period.

The contribution of the paper to the literature is twofold. First, we propose a novel framework to investigate the impact of the financial crisis. Second, drawing on the empirical analysis, we provide insight on the impact of the financial crisis starting in 2007. We find that the financial sector affects financially distressed firms more strongly during the financial crisis, while we do not find the same evidence for financially constrained firms. In addition, the financial sector affects firms with comparatively high long-term debts more heavily during the crisis. We provide evidence that the financial sector affects nonfinancial firms' returns during the financial crisis, but has very limited impact on conditional volatility.

2 Related literature

2.1 Financial constraints

An active body of literature covers the measurement of individual firms' financial constraints. The work of Fazzari et al. (1988) tackles the problem using investment-cash-flow sensitivities. They show that financial constraints do matter for investment decisions and further argue that they contribute to macro fluctuations of investment. Building on the work of Kaplan and Zingales (1997), Lamont et al. (2001) propose what is commonly referred to as the KZ index. They estimate ordered logit models to determine which balance sheet items optimally predict financial constraints. Although the KZ index has been a popular measure of financial constraint, recent literature casts certain doubts on the validity of the index. Whited and Wu (2006) and Hadlock and Pierce (2009) provide evidence of weaknesses of the KZ index and both propose alternative measures. Rajan and Zingales (1998) construct a simple ratio for the dependence on external finance on a sector level, which measures a different but related phenomenon. In their work, they take the ratio of capital expenditure minus cash flow to cash flow and compare the individual dependencies to the median sector level to determine demand for external financing.

Whited and Wu (2006) develop their WW index optimizing the present discounted value of future dividends (Tong and Wei, 2008) and incorporating inequality constraints with respect to dividend payouts and the stock of debt in every period. Parameterizing the model and estimating it with Generalized Methods of Moments (GMM), they identify the best fit for predicting financial constraints. A potential drawback of the WW index is that some variables used to determine financial constraints face endogeneity issues. In particular, the dividend dummy, cash flow, and debt levels are partly determined by the firm’s degree of financial constraints.

Hadlock and Pierce (2009) carefully read financial filings of a sample of U.S. firms to preclassify firms in five categories of constraints. Essentially replicating the analysis of Lamont et al. (2001), they find age, size, cash flow, and leverage to be the only significant predictors of financial distress. To avoid endogeneity issues, they propose an index, the SA index, which focuses solely on age and size. The WW index correlates closely with the SA index: Hadlock and Pierce (2009) report a simple correlation coefficient of 0.8 in their underlying sample.

For this paper, the WW index offers two advantages: First, the theoretical underpinning of the model is, in general, more solid, whereas the SA index is a product of mainly empirical analysis. Second, the WW index offers more time variability, with the SA index varying less over time. In addition, since we build portfolios prior to downturns, we can, with a long enough lag, reasonably assume that endogeneity is not a serious issue.

2.2 Financial distress

Predicting firms' financial distress is not only of interest for academics. It is an essential part of a multibillion dollar private industry. As a result, private sector firms have developed extensive methodology to assess financial distress. Surveying the literature on predicting financial distress more comprehensively is beyond the scope of this work and we provide only a short selection of relevant references.

Altman (1968) assesses a firm's probability of defaulting on its liabilities using ratio analysis of accounting-based balance-sheet data. Ohlsson (1980) proposes a similar indicator derived from a conditional logit model also employing accounting-based measures. We discuss a revision of Altman's approach in greater detail in section 3. In his seminal contribution, Merton (1974) proposes an alternative approach by describing a firm's equity as a call option on the value of its assets. Current equity prices help to determine the probability of default, incorporating market evaluations in the financial-distress assessment. Subsequent research attempts to improve on the accuracy of both accounting and market-based measures or partly combines them (Campbell, Hilscher, and Szilagyi, 2008).

2.3 Empirical modeling

Different approaches exist to investigate contagion and spillover effects of various markets. Dungey et al. (2004) give a comprehensive overview of available approaches and this section refers to some of the literature outlined in their work. Researchers make a number of crucial choices when performing an analysis of spillover and contagion effects. The following section provides a selection of prior research relevant for the empirical investigations in this essay and clarifies certain terminological issues that are not consistent across the literature.

Regardless of whether one is investigating the first or the second moment of market movements, precisely defining the terms spillover and contagion is crucial. Forbes and Rigobon (2002, p. 2223) define contagion as "a significant increase in cross-market linkages after a shock." This definition allows a distinction to be made between spillover and contagion effects. Common factors that are present in both noncrisis and crisis times cause interdependences of markets and lead to spillover effects. Simple correlation coefficients can express such spillovers. The isolated effect of the crisis, possibly originating in one market, leads to contagion that is potentially different from regular spillover. An intuitive way to express contagion is as an increase in correlation between markets. This notion of spillover and contagion serves as the definition applied in this paper.

Directly using correlation measurements can be problematic and Forbes and Rigobon (2002) show that estimates of market cross-correlations are biased in the case of heteroskedastic error terms. Typically, increasing volatility characterizes crisis periods and in that case cross-correlation estimates are upwardly biased. Consequently, if we test for a significant difference between crisis and noncrisis periods, we tend to falsely conclude that contagion occurs. In that context, Dungey and Zhumabekova (2001) demonstrate that the correlation coefficient is inappropriate if the crisis period is small in comparison to the noncrisis period. Although a model could adjust for the bias, Baur (2003, p. 410) argues that the correlation coefficient is not suitable for measuring contagion effects as it is a symmetric measure, whereas contagion originates in one market and is thus an asymmetrical phenomenon. Consequently, Baur proposes a modeling approach that incorporates the shocks directly.

An essential consideration is whether to determine the crisis periods exogenously or to implement the model in a way that determines them endogenously. In this paper, the crisis periods are explicitly determined a priori and established exogenously. Favero and Giavazzi (2002) apply a method allowing the determination of the crisis from the magnitude of shocks. They define a crisis period as a point in time where shocks exceed a certain size that depends on the size of the shocks relative to the conditional variance. They initially estimate a vector autoregression (VAR) model to obtain residuals and control for interdependences. This method is suitable for investigating contagion effects between markets in general, but will most certainly not allow us to obtain a connected crisis period, as not all shocks will be big enough to trigger a crisis determination during an uninterrupted period.

Other researchers investigate contagion by defining a certain threshold return as a crisis indicator and apply a probit/logit approach to identify contagion effects by the overlapping of returns exceeding the threshold return. Baur and Schulze (2005) and Bae et al. (2003) propose such approaches with some various features. This again has the advantage of determining the crisis periods endogenously after establishing certain criteria, but is not a good fit for the analyzed question. Edwards and Susmel (2000) investigate weekly interest rates in three South American countries, aiming to demonstrate volatility contagion. They apply a regime-switching SWARCH model that allows them to determine breakpoints endogenously. They can identify periods of contagion lasting between two and seven weeks.

Investigating volatility contagion in three financial crises, Jaque (2004) applies a T-GARCH approach to modeling time-varying sovereign bond spreads of individual countries. To test for contagion effects, he includes the estimated conditional variance of the originator in the equation for the conditional variance of the potentially infected country and tests for significance. This approach does not address the problem of endogeneity, it simply assumes that the included estimates of the originating country's conditional variance are exogenous. This essay will partly adapt this concept and combine it with Baur's (2003) approach.

3 Data and empirical approaches

An essential part of the analysis consists of modeling financial constraint and distress. As described earlier, the literature suggests several indicators to measure financial constraint. We employ the rather novel measure for financial constraint set forth in Whited and Wu (2006). By developing a partial-equilibrium investment model, deriving a Euler equation, and finally estimating the model with GMM, they arrive at a financial constraint index calculated as

$$-0.091CF_{it} - 0.062DIVPOS_{it} + 0.021TLTD_{it} - 0.044LNTA_{it} + 0.102ISG_{it} - 0.035SG_{it}. \quad (1)$$

Here CF_{it} is the ratio of cash flow to total assets, $DIVPOS_{it}$ represents an indicator that is one if a firm pays cash dividends and zero otherwise, $TLTD_{it}$ is the ratio of long-term debt to total assets, $LNTA_{it}$ is the natural log of total assets, ISG_{it} is the firm's three-digit-industry sales growth, and SG_{it} is the firm's sales growth.

We use Altman's (1968) Z-score to determine financial distress. The measure derives from a multiple-discriminant analysis (MDA) and allows for a priori grouping of firms as distressed and undistressed. A number of sophisticated, partly proprietary models to predict the risk of default exist. While they are certainly useful and probably more accurate to predict exact default probabilities, Z-scores give sufficient information for our purposes. Altman (2000) reexamines Z-scores and shows that they still work well as a predictor for default. Altman's Z-score is calculated as

$$Z = 0.012WC_{it} + 0.014RE_{it} + 0.033EBIT_{it} + 0.006MVTL_{it} + 0.999SA_{it}. \quad (2)$$

Here WC_{it} is the ratio of working capital to total assets, RE_{it} represents the ratio of retained earnings to total assets, $EBIT_{it}$ stands for the ratio of earnings before interest and taxes to total assets, $MVTL_{it}$ represents the ratio of the market value equity to the book value of total liabilities, and SA_{it} stands for the ratio of sales to total assets.

The model for analyzing contagion and spillover effects follows Baur (2003) and maintains the idea of distinguishing between noncrisis (spillover) and crisis (contagion). We model the first-moment spillover and contagion effects as

$$R_{\mathrm{N},t} = a_0 + a_1 R_{\mathrm{N},t-1} + a_2 R_{M-F,t} + b_1 R_{\mathrm{F},t} + b_2 R_{\mathrm{F},t} D_{\mathrm{Crisis}} + u_{\mathrm{N},t}. \quad (3)$$

Equation (3) highlights the main idea of the empirical model. $R_{\mathrm{N},t}$ stands for the return of a portfolio comprising nonfinancial firms, a_0 is the intercept, $R_{\mathrm{F},t}$ represents the return of the financial sector, D_{Crisis} is a dummy variable for the crisis period, and $u_{\mathrm{N},t}$ denotes the error term. Note that b_1 illustrates spillover effects, whereas b_2 shows contagion effects. As a suitable index excluding financial firms is not available, we construct the variable $R_{\mathrm{M-F},t}$ to remove the financial sector effect from the market index. We take the average of the financial sector weight at the beginning and the end of a year to approximate the weight of the whole year and subtract the weighted financial sector returns from the market returns.

We model the second moment according to the following basic scenario.

$$u_{\mathrm{N},t} = z_{\mathrm{N},t}\sigma_{\mathrm{N},t} \quad (4)$$

where $z_{N,t}$ is normally distributed with mean zero and variance one and $\sigma_{N,t}$ is the conditional volatility of $R_{N,t}$ calculated as

$$\sigma^2_{\mathrm{N},t} = c_0 + c_1\sigma^2_{\mathrm{N},t-1} + c_2\epsilon^2_{\mathrm{N},t-1} + c_3\epsilon^2_{\mathrm{N},t-1} I_{\mathrm{N},t-1} + c_4 R^2_{\mathrm{M-F},t-1} + d_1 R^2_{\mathrm{F},t-1} + d_2 R^2_{\mathrm{F},t-1} D_{\mathrm{Crisis}} \quad (5)$$

Equation (5) describes the model for investigating second-moment contagion. We essentially use an asymmetric GARCH model that includes financial-sector volatility as an additional explanatory variable. Here $\sigma^2_{\mathrm{N},t}$ denotes the conditional variance of a portfolio of nonfinancial firms, c_0 the intercept of the conditional volatility, and $\epsilon^2_{\mathrm{N},t-1}$ the squared error from equation (3). The indicator variable $I_{\mathrm{N},t-1}$ is one if the shock is negative and zero otherwise, and the conditional volatility of the financial sector is proxied by the squared returns, $R^2_{\mathrm{F},t-1}$. $R^2_{\mathrm{M-F},t-1}$ denotes the lagged squared returns of the market index less the financial index as defined previously. Analogously to the mean equation, d_1 represents the parameter for volatility spillover and d_2 is the parameter for potential contagion effects. Note that c_3 shows the leverage effect, which is not of prior interest, but including this effect has proved useful in explaining conditional volatility in general.

All balance-sheet and stock market data are from the Datastream Advance database. The initial sample consists of 708 firms. All firms in the current Standard & Poor's 500 stock index of July 2010, the composition of the index of August 2005, and Standard & Poor's 500 of September 1989, are included in the sample. We remove firms with no available balance-sheet data for the analyzed period and firms with Standard Industry Classification (SIC) codes between 6000 and 6999 (financial firms). The Standard & Poor's 500 EW Financials represents the financial sector in the analysis of spillover and contagion effects. We apply both Z-scores and the WW index to classify firms as distressed and constrained, respectively. For many of the firms, figures of balance-sheet data are not available during the entire period analyzed, thus the reported averages never comprise observations of the whole sample.

To specifically investigate the financial crisis, we need to determine the exact crisis period and the business year to use for grouping firms. The first signs of the financial crisis emerged in 2007 and, to avoid potential endogeneity problems, we take the balance-sheet data from 2006 for determining a firm's financial distress and constraint according to equations (1) and (2), respectively. The sample of daily stock market prices starts with January 2, 1990, and the last observation is from August 4, 2010.

As we define the crisis period exogenously, determining the exact crisis period is essential to the empirical approach. Our notion of crisis is mainly connected with a bear market and increased volatility in the financial sector. Determining the beginning of a crisis is usually easier as triggering events are often directly observable. The triggering event of the financial crisis was the subprime mortgage collapse in the U.S. market. Reinhart and Rogoff (2008) date the beginning of the subprime mortgage to summer 2007. To establish a tangible criterion, we take the peak of the Standard & Poor's 500 EW Financials, June 4, as the starting date of the crisis. Finding the exact end of a crisis is a more difficult task and the past financial crisis is no different in that respect. For our context, we found no suitable academic literature attempting to exactly define the end of the financial crisis. Thus, we apply again an objective criterion and use the low of the Standard & Poor's 500 EW Financials index observed on March 6, 2009. Figure 1 illustrates the choice of our crisis period and shows that the index was establishing an upward trend following the low, indicating increasing market confidence and signaling an end to the financial crisis.

[INSERT FIGURE 1 HERE]

4 Empirical results

4.1 Descriptive analysis

We initially present the results of grouping firms according to their degree of financial distress and constraints to foster some intuition for the spillover–contagion analysis.

Panel A of Figure 2 shows the evolution of the average Altman's Z-scores at a 25% cut-off level for distressed and undistressed firms. Altman (1968) classifies firms with a Z-score below 1.8 as distressed, whereas the area between 1.81 and 2.99 includes both distressed and undistressed firms. Values above 3 predict no imminent financial distress. A clear-cut trend for the development since 1989 is not immediately apparent. The less distressed firms in Standard & Poor's 500 stock index remain quite comfortably in the financially healthy area throughout the analyzed period. The scores of the more distressed half of the firms have deteriorated during the past decade and have so far not recovered back to levels seen in the 1990s. The abundance of available financing has possibly led to a higher gearing of firms, lowering their overall financial health.

[INSERT FIGURE 2 HERE]

Panel B of Figure 2 shows the average development of financial constraints at a 25% cut-off level for constrained and unconstrained firms. In tendency, all firms appear to face decreasing difficulties in securing financing during the entire period. However, the size factor (log of total assets, see Figure 3) strongly dominates the index and is increasing over the entire sample period, thus decreasing the absolute value of the index. Therefore, real asset growth over the sample period contributes to the perceived decrease in financial constraint.

[INSERT FIGURE 3 HERE]

These simple indicators at least partly reflect the general economic background of increasingly loose monetary policy and lower risk aversion. The simple correlation between the indicators in our base year 2006 is 0.30, showing that the two indicators are not completely unrelated, but they do measure different things. While both indicators are worth further investigation, the main aim is to provide a framework for the analysis focusing on contagion and spillover effects.

Table 1 provides additional summary statistics of both indicators and returns of the relevant indexes and portfolios. For the distressed portfolio, observed returns are considerably lower, confirming previous results reported, for example, in Dichev (1998) and Campbell et al. (2008). The financially constrained portfolio, however, has substantially higher returns than the unconstrained portfolio.

[INSERT TABLE 1 HERE]

4.2 Spillover and contagion analysis

Taking the 25% least and 25% most distressed firms, we form equally weighted portfolios, as the size effect should not dominate the analysis. We proceed accordingly with portfolios ranked by the WW index. We apply the model described in equations (3)–(5) using the obtained portfolios. The following analysis focuses on the contagion and spillover parameters but reports the estimates of all parameters for completeness.

Table 2 reports the core results of our analysis, which confirm some of the initial intuition when it comes to mean spillovers and contagion and show the limited scope of volatility transmission. For the noncrisis period, mean-spillover-point estimates are positive and relatively close in size for both constrained and unconstrained portfolios. Mean contagion effects are not statistically significant for the constrained or the unconstrained portfolio and the total effects (obtained by adding b_1 and b_2) during the financial crisis are very similar in size.

Mean spillover effects are significantly positive for both the distressed and the undistressed portfolio and larger for the former. A significantly positive mean contagion effect for the distressed portfolio, which is, in addition, relatively large in size, demonstrates that the crisis affects financially distressed firms more heavily. Conversely, contagion for the undistressed portfolio is even negative, albeit only statistically significant at the 5% level. The resultant total effect during the crisis is substantially larger for the distressed portfolio.

Volatility spillovers are only significant at the 5% level for the distressed portfolio, but comparatively small in size. Volatility contagion is not statistically significant for any of the portfolios. For the undistressed and unconstrained portfolios, financial-sector volatility does not play any significant role in either period. Thus, overall evidence of volatility contagion and spillover effects during the financial crisis is very limited.

[INSERT TABLE 2 HERE]

4.3 Further analysis and robustness checks

So far, the results are not very conclusive using our indicator for financial constraint. As previously argued, conflicting effects of financial constraint on performance or the difficulty of measuring and defining financial constraint could explain these results. We take the variables featured most prominently in the WW index (*CF*, *DIVPOS*, *TLTD*, *LNTA*) to construct portfolios sorting firms according to just one criterion. As size strongly dominates the WW index, we additionally build a portfolio using all variables of the original indicator except for the log of total assets (*LNTA*). The results are reported in Table 3, and we focus on analyzing mean spillover and contagion, as volatility effects again show little economic and statistical significance.

As expected, the financial crisis affects firms with higher cash flow ratios less and noncrisis spillovers are less pronounced. Spillover and contagion effects are smaller for firms paying no dividends as compared to dividend-yielding firms. Both theoretical arguments and most empirical findings agree with this result. Using Modigliani and Miller's (1958) fundamental results, the proportion of paid cash dividends should not matter for investor returns. Lettau and Wachter (2007) show that dividend yields are not a good predictor of excess returns.

The strongest results derive from sorting firms according to their long-term debt holdings. Firms with higher long-term debt are much more affected in both the noncrisis and the crisis period. This finding supports the notion that markets price the expected increase in financing costs. Size itself, which strongly dominates our measure of financial constraint, does show that firms with comparatively low assets are more affected during the crisis. The effects are, however, less economically significant compared to discriminating according to long-term debt levels. Leaving out the size effect of the original WW index shows again the difficulty of making definite conclusions concerning constrained and unconstrained firms.

[INSERT TABLE 3 HERE]

Although efficient markets should take care to incorporate any new information immediately, evidence of investor inattention suggests market participants might take longer to process freely available but complex information (e.g., Huberman and Regev, 2001; DellaVigna and Pollet, 2009; Gilbert et al., 2011). While including lags in the empirical model can solve this issue, determining how much time it would take and how many lags to include is not straightforward. Thus, we perform the same exercise as before, using weekly data to allow for slower information transmission. The results, reported in Table 4, are overall very similar, albeit generally less statistically significant, which is probably due to the smaller sample size. This exercise confirms that slow information processing does not drive our results.

[INSERT TABLE 4 HERE]

As an additional robustness test, we replace the volatility proxy by estimating a separate standard asymmetric GARCH(1,1) model for the return of the financial sector. The obtained results are numerically different but not statistically more significant and confirm the results for mean contagion and spillover effects. Similar to our basic scenario, we do not find convincing evidence for volatility spillover and contagion.

In a supplementary exercise, we perform regressions for all individual firms according to the model outlined in equations (3)–(5). We thus obtain close to 400 single estimation results for individual firms. Preclassifying firms according to financial constraint and distress could give further insight for our analysis. The obtained results do not in any way contradict our previous analysis, but they are hard to present in a comprehensive way, and making tangible inference on such analysis is difficult. Therefore, we refrain from presenting the results in the paper, but they are available upon request.

We previously explained the difficulty of determining the exact end of the financial crisis. Financial market volatility remained at higher levels beyond the low of the Standard & Poor's 500 EW Financials. To check if the results are robust to the choice of the crisis period, we extend the crisis period until September 30, 2009. Examining volatility patterns shows that financial-sector volatility then returned to levels closer to precrisis periods. The results, which are not tabulated due to space constraints and are also available on request, are very similar and in tendency more statistically significant for the first moment. The greater significance is partly due to the fact that a longer crisis period increases statistical significance, everything else being equal. The second-moment results are very similar to those using our base crisis period and confirm that evidence of volatility spillover and contagion effects is minimal.

5 Conclusions

The analysis finds only partial evidence concerning our hypothesis of contagion resulting from the financial sector. Contagion for the returns of nonfinancial firms during the financial crisis is significantly positive for the portfolio of distressed firms. Thus, the worsening conditions to finance operations suggest additional reevaluations of nonfinancial assets expressed via mean contagion effects. The results are less convincing when analyzing volatility spillover and contagion effects. The turbulence of the financial sector did not increase volatility, as evidence of volatility spillover and contagion effects originating from the financial sector is very limited.

With regard to our second question, we find conclusive evidence that financial distress plays an important role in the analyzed framework. Considering our initiating macroeconomic perspective, this finding suggests that a partially beneficial, cathartic process occurred during the financial crisis to rid the economy of noncompetitive businesses. Results show that the financial sector did not affect financially constrained firms more strongly than unconstrained firms. We explain the empirical findings with our initial theoretical considerations that a lack of available financing can reduce profitable investment on the one hand, but the lack of prior overinvestment can have a positive effect on the other hand. Looking more closely into financial-constraint-related indicators, we find that long-term debt levels play an important role. The financial crisis affects firms with higher long-term debt levels substantially more than firms with low long-term debt levels. For investors, our findings confirm the additional exposure to the financial sector of more distressed and indebted firms during the financial crisis.

Overall, the effect of the financial crisis becomes clearly visible, but the evidence that it fully encroaches upon nonfinancial firms is not convincing. We apply the proposed framework to comparatively large Standard & Poor’s 500 firms, which are naturally more capable of insulating themselves from a financial meltdown. Further research could extend the analysis to a broader sample including smaller firms.

References

Altman, E. I., 1968. Financial Ratios, Discriminant Analysis and the Prediction of Corporate Bankruptcy, *Journal of Finance* 23, 589–609.

Altman, E. I., 2000. Predicting Financial Distress of Companies: Revisiting the Z-Score and Zeta Models, New York University Working paper.

Bae, K.-H., G. A. Karolyi and R. M. Stulz, 2003. A New Approach to Measuring Financial Contagion, *Review of Financial Studies* 16, 717–63.

Baur, D. G., 2003. Testing for Contagion – Mean and Volatility Contagion, *Journal of Multinational Financial Management* 13, 405–22.

Baur, D. G. and N. Schulze, 2005. Coexceedances in Financial Markets – A Quantile Regression Analysis of Contagion, *Emerging Markets Review* 6, 21–43.

Bollerslev, T. and J. M. Wooldridge, 1992. Quasi-maximum Likelihood Estimation and Inference in Dynamic Models with Time Varying Covariances, *Econometric Reviews* 11, 143–72.

Campbell, J. Y., J. Hilscher and J. Szilagyi, 2008. In Search of Distress Risk, *Journal of Finance* 63, 2899–939.

DellaVigna, S. and J. Pollet, 2009. Investor Inattention and Friday Earnings Announcements, *Journal of Finance* 64, 709–49.

Dichev, I. D., 1998. Is the Risk of Bankruptcy a Systematic Risk? *Journal of Finance* 53, 1131–47.

Duchin, R., O. Ozbas and B. A. Sensoy, 2010. Costly External Finance, Corporate Investment, and the Subprime Mortgage Credit Crisis, *Journal of Financial Economics* 97, 418–35.

Dungey, M., Fry, R., Gonzalez-Hermosillo, B. and V. Martin, 2004. Empirical Modelling of Contagion: A Review of Methodologies, *Econometric Society* 2004 Australasian Meetings, 243.

Dungey, M. and D. Zhumabekova, 2001. Testing for Contagion Using Correlations: Some Words of Caution, Federal Reserve Bank of San Francisco Pacific Basin Working Paper Series 01-09.

Edwards, S. and R. Susmel, 2000. Interest Rate Volatility and Contagion in Emerging Markets: Evidence from the 1990s, National Bureau of Economic Research Working Papers 7813.

Favero, C. A. and F. Giavazzi, 2002. Is the International Propagation of Financial Shocks Nonlinear? Evidence from the ERM, *Journal of International Economics* 57, 231–46.

Fazzari, S. M., Hubbard, R. G, Petersen, B. C, Blinder A. S. and J. M. Poterba, 1988. Financing constraints and corporate investment, *Brookings Papers on Economic Activity* 1, 141–206.

Forbes, K. J. and R. Rigobon, 2002. No Contagion, Only Interdependence: Measuring Stock Market Comovements, *Journal of Finance* 57, 2223–61.

Gilbert, T., S. Kogan, L. A. Lochstoer and A. Ozyildirim, 2011. Investor Inattention and the Market Impact of Summary Statistics, Working Paper.

Hadlock, C. J. and J. R. Pierce, 2009. Does the KZ Index Provide a Useful Measure of Financial Constraints? *Review of Financial Studies* 23, 1909–40.

Huberman, G. and T. Regev, 2001. Contagious Speculation and a Cure for Cancer: A Nonevent that Made Stock Prices Soar, *Journal of Finance* 56, 387–96.

Jaque, F., 2004. Emerging Market Economies: The Aftermath of Volatility Contagion in a Selection of Three Financial Crises, Central Bank of Chile Working Papers 305.

Kaplan, S. N. and L. Zingales, 1997. Do Financing Constraints Explain Why Investment Is Correlated with Cash Flow? *Quarterly Journal of Economics* 112, 169–215.

Lamont, O., Polk, C. and J. Saá-Requejo, 2001. Financial Constraints and Stock Returns, *Review of Financial Studies* 14, 529–54.

Lettau, M. and J. A. Wachter, 2007. Why Is Long-Horizon Equity Less Risky? A Duration-Based Explanation of the Value Premium, *Journal of Finance* 62, 55–92.

Merton, R. C., 1974. On the Pricing of Corporate Debt: The Risk Structure of Interest Rates, *Journal of Finance* 29, 449–70.

Modigliani, F. and M. H. Miller, 1958. The Cost of Capital, Corporation Finance and the Theory of Investment, *The American Economic Review* 48, 261–97.

Ohlsson, J. A., 1980. Financial Ratios and the Probabilistic Prediction of Bankruptcy, *Journal of Accounting Research* 18, 109–31.

Rajan, R. G. and L. Zingales, 1998. Financial Dependence and Growth, *American Economic Review* 88, 559–86.

Reinhart, C. M. and K. S. Rogoff, 2008. Is the 2007 U.S. Subprime Crisis so Different? An International Historical Comparison, *American Economic Review* 98, 339–44.

Schumpeter, J., 1939. *Business Cycles*. New York: McGraw-Hill.

Tong, H. and S.-J. Wei, 2008. Real Effects of the Subprime Mortgage Crisis: Is It a Demand or a Finance Shock? IMF Working Paper 08/186.

Whited, T. M. and G. Wu, 2006. Financial Constraints Risk, *Review of Financial Studies* 19, 531–55.

Figure 1

Determination of crisis period

The peak of the Standard & Poor's 500 EW Financials occurring on June 4, 2007, marks the beginning and the low observed on March 6, 2009 is the end of the crisis period.

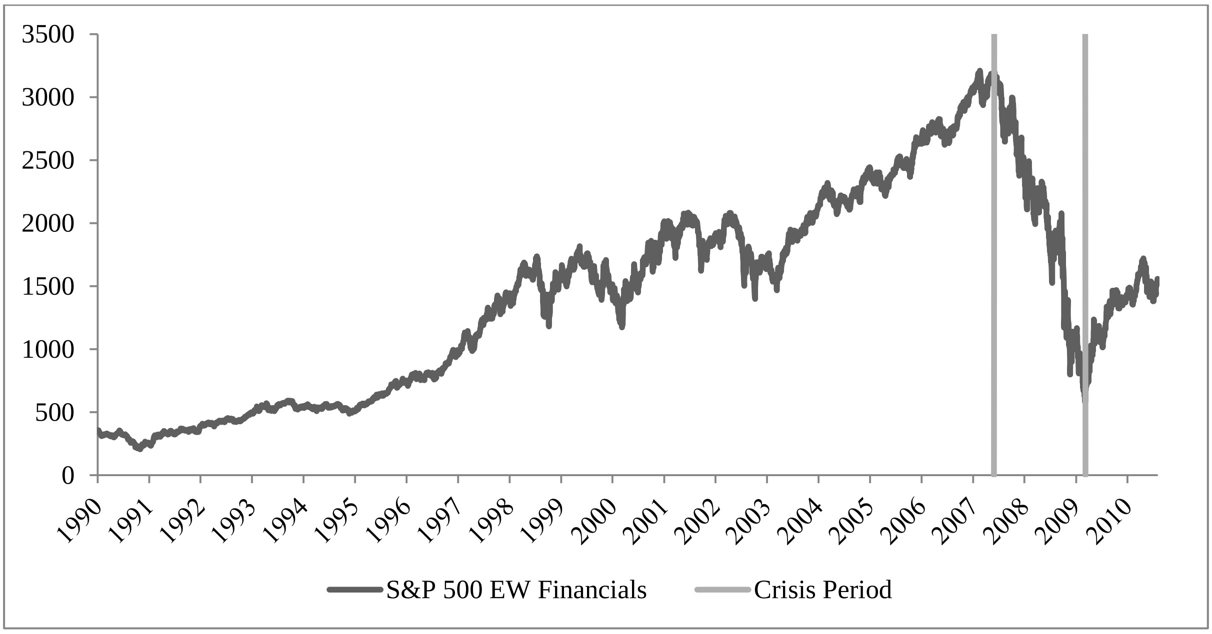
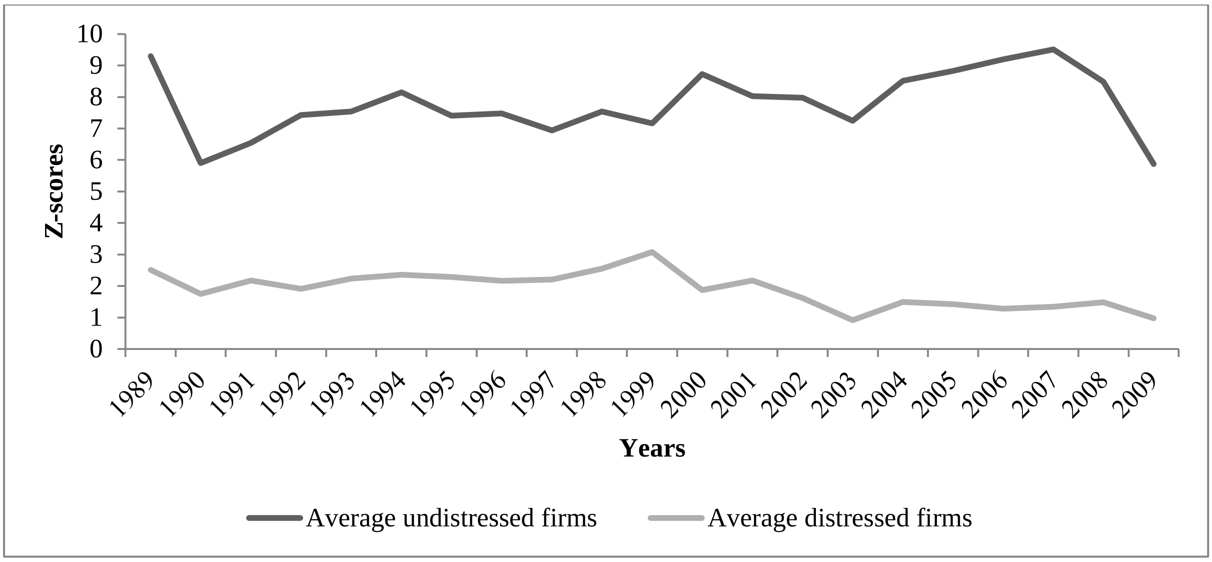


Figure 2

Time Series of Z-scores and the WW index

The averages are calculated taking the 25% most and least distressed and constrained firms according to Z-scores and the WW index, respectively.

Panel A: Time Series of Z-scores



Panel B: Time Series of the WW index

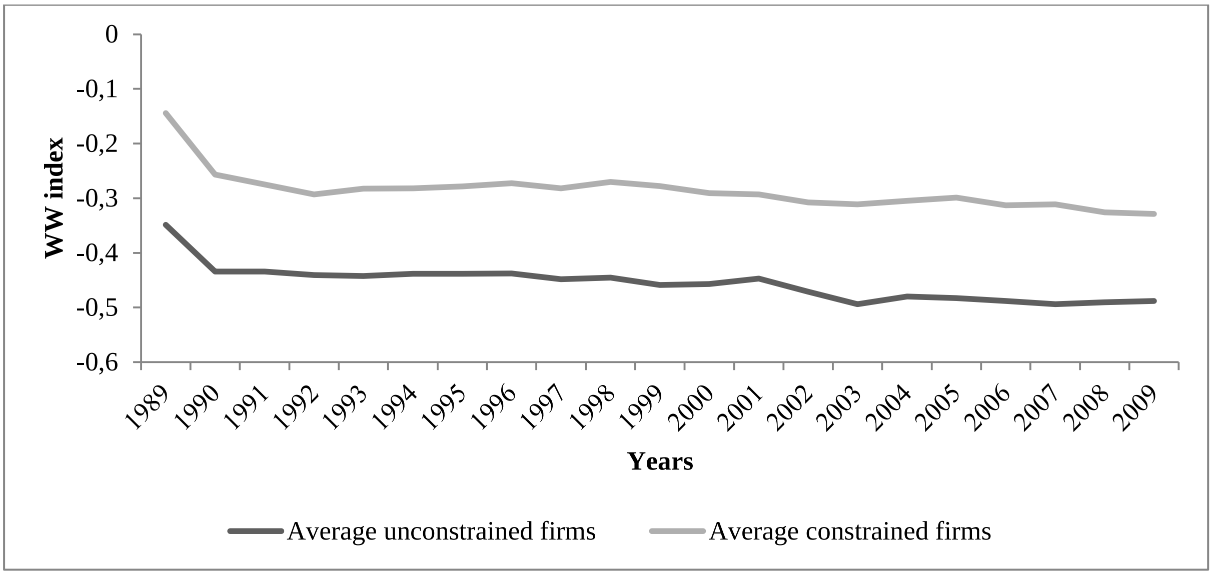
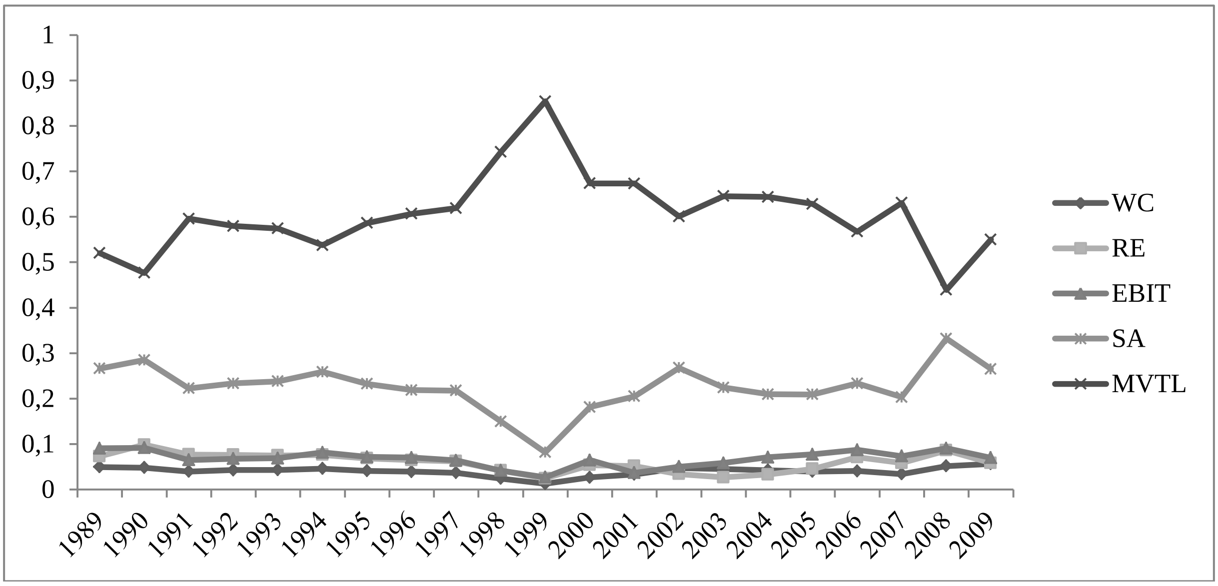


Figure 3

Decomposition of Z-scores and the WW index

The average contribution in percentage to Z-scores and the WW index. The averages are calculated for the whole sample according to equations (1) and (2), respectively.

Panel A: Decomposition of Z-scores



Panel B: Decomposition of the WW index

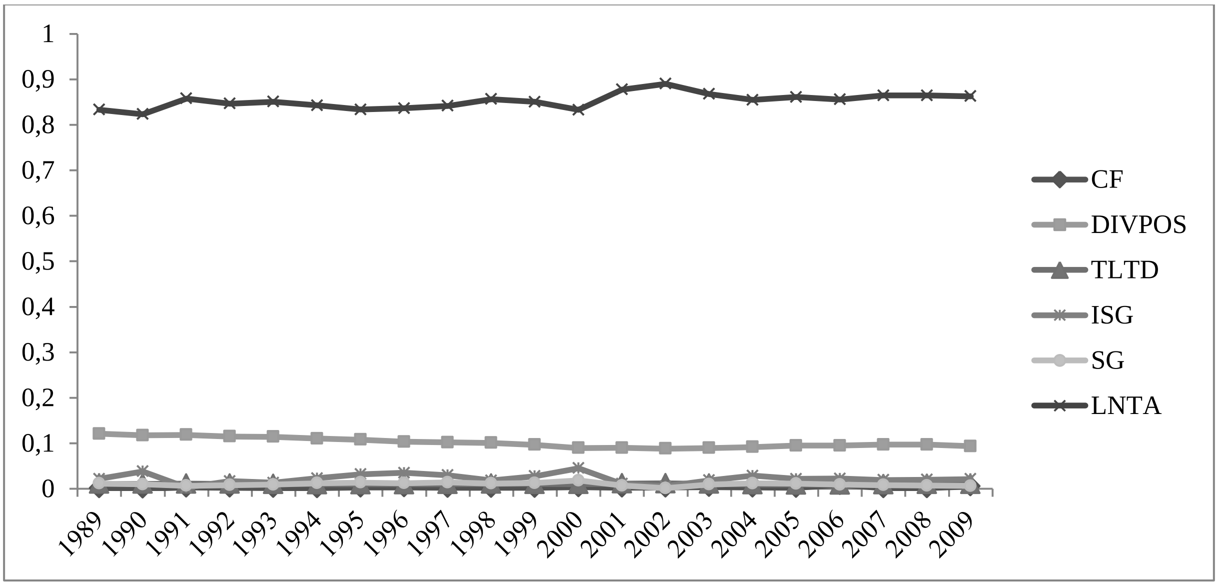


Table 1

Summary Statistics

Summary statistics of the indicators for both financial distress and constraint and the corresponding stock-price data. Indicators and portfolios are based on 2006 accounting data. Panel A is calculated using portfolios obtained by equally weighting the 25% least and most distressed firms, respectively. The portfolios in Panel B are analogously constructed according to Altman's Z-scores (WW index) taking the 25% most and least distressed (constrained) firms.

Panel A: Indicators

	Z-scores		WW index	
	Distressed	Undistressed	Constrained	Unconstrained
Sample mean	1.337	9.549	−0.311	−0.494
Sample SD	0.847	4.617	0.035	0.027
Median	1.411	7.638	−0.318	−0.488
Maximum	2.263	29.405	−0.202	−0.459
Minimum	−4.619	5.810	−0.360	−0.602
Skewness	−4.094	2.208	0.767	−1.585
Kurtosis	26.177	5.762	0.265	2.859
Sample size	95	95	99	99

Panel B: Stock returns

	S&P 500 EW Financials	S&P 500 Composite	Constrained Portfolio	Unconstrained Portfolio	Distressed Portfolio	Undistressed Portfolio
Sample mean (yearly)	0.108	0.071	0.252	0.108	0.131	0.231
Sample st dev. (yearly)	0.282	0.183	0.231	0.163	0.189	0.013
Median	0.000	0.000	0.001	0.000	0.001	0.001
Maximum	0.171	0.116	0.123	0.117	0.130	0.110
Minimum	−0.168	−0.090	−0.104	−0.095	−0.109	−0.098
Skewness	0.287	−0.005	−0.034	−0.017	−0.177	0.045
Kurtosis	15.804	9.436	5.496	12.175	12.193	5.599
Sample	5,372	5,372	5,372	5,372	5,372	5,372
Correlation	0.850		0.816		0.875	
Correlation with S&P 500 EW Financials			0.708	0.807	0.794	0.747

Table 2

Spillover and contagion with the base model

Estimation of the models described in equations (3)–(5). Portfolios are formed using daily stock-price data and equally weighting the 25% least and most constrained or distressed firms according to equations (1) and (2), respectively. Standard errors are computed using heteroskedasticity-consistent standard errors according to Bollerslev and Wooldridge (1992).

		Constrained	Unconstrained	Distressed	Undistressed
Mean	a_0	0.0005**	0.0002**	0.0002**	0.0005**
	Autoregr. (a_1)	0.0937**	0.0464**	0.0817**	0.0439**
	Market (a_2)	1.0131**	0.7364**	0.6881**	0.9546**
	Spillover (b_1)	0.1223**	0.1360**	0.1692**	0.1320**
	Contagion (b_2)	−0.0154	−0.0117	0.0418**	−0.0187*
Volatility	c_0	0.0000**	0.0000	0.0000**	0.0000**
	GARCH (c_1)	0.9396**	0.9363**	0.9161**	0.9416**
	ARCH (c_2)	0.0357**	0.0534**	0.0427**	0.0364**
	Leverage (c_3)	0.0228	0.0012	0.0262*	0.0292**
	Market (c_4)	0.0040**	0.0006*	0.0027**	0.0006
	Spillover (d_1)	0.0000	−0.0001	0.0009*	0.0001
	Contagion (d_2)	−0.0003	0.0002	−0.0005	0.0000

** and * indicate statistical significance at the 1% and 5% levels, respectively.

Table 3

Forming portfolios according to selected criteria

Estimation of the models described in equations (3)–(5) using daily data. The first four indicators correspond to sorting firms according to *CF*, *DIVPOS*, *TLTD*, *LNTA* in equation (1) and the last two columns apply portfolios sorted according to the WW index without the size effect (*LNTA*). Portfolios are formed by equally weighting firms in the lower and the upper quartiles, respectively. The standard errors are computed using heteroskedasticity-consistent standard errors according to Bollerslev and Wooldridge (1992).

		Cash Flow				Long-term debt		Assets		WW without size	
		High	Low	Dividend	No Dividend	High	Low	High	Low	Constrained	Unconstrained
	a_0	0.0005**	0.0004**	0.0003**	0.0005**	0.0002**	0.0005**	0.0002**	0.0005**	0.0005**	0.0002**
	Autoregr. (a_1)	0.0788**	0.0813**	0.0709**	0.0970**	0.0826**	0.0521**	0.0386**	0.0827**	0.0903**	0.0646**
Mean	Market (a_2)	0.9593**	0.8226**	0.7187**	1.0635**	0.6121**	1.0792**	0.7645**	0.8960**	0.9891**	0.7171**
	Spillover (b_1)	0.1368**	0.1757**	0.1650**	0.1259**	0.2177**	0.1073**	0.1309**	0.1485**	0.1177**	0.1754**
	Contagion (b_2)	0.0009	0.0208*	0.0321**	−0.0321**	0.0253*	−0.0373**	−0.0131*	0.0152	0.0137	0.0380**
	c_0	0.0000**	0.0000**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000**	0.0000**	0.0000**
	GARCH (c_1)	0.9362**	0.9024**	0.9301**	0.9488**	0.9318**	0.9510**	0.9546**	0.9294**	0.9340**	0.9358**
	ARCH (c_2)	0.0152*	0.0347**	0.0497**	0.0274**	0.0253**	0.0325**	0.0297**	0.0241**	0.0296**	0.0170*
Volatility	Leverage (c_3)	0.0431**	0.0260*	0.0135	0.0289**	0.0272**	0.0274**	0.0121	0.0359**	0.0302**	0.0195
	Market (c_4)	0.0027**	0.0026**	0.0006	0.0035*	0.0026**	0.0006	0.0007**	0.0050**	0.0032**	0.0011*
	Spillover (d_1)	0.0007*	0.0013**	0.0002	0.0001	0.0009*	0.0000	−0.0001	0.0004	0.0002	0.0018**
	Contagion (d_2)	−0.0008*	−0.0011**	0.0000	−0.0003	−0.0007	0.0001	0.0001	−0.0006	−0.0001	−0.0012**

** and * indicate statistical significance at the 1% and 5% levels, respectively.

Table 4

Forming portfolios according to selected criteria, weekly returns

Estimation of the models described in equations (3)–(5) using weekly data. Portfolios in the first four rows are formed using weekly stock-price data and equally weighting the 25% least and most constrained or distressed firms according to equations (1) and (2), respectively. The following portfolios correspond to sorting firms according to *CF*, *DIVPOS*, *TLTD*, *LNTA* in equation (1) and the last two rows apply portfolios sorted according to the WW index without the size effect (*LNTA*). The standard errors are computed using heteroskedasticity-consistent standard errors according to Bollerslev and Wooldridge (1992).

	Mean		Volatility	
	Spillover (b_1)	Contagion (b_2)	Spillover (d_1)	Contagion (d_2)
Constrained	0.1272**	−0.0151	−0.0025**	0.0007
Unconstrained	0.1492**	0.0049	−0.0005	0.0009
Distressed	0.1912**	0.0680*	−0.0011	0.0021*
Undistressed	0.1532**	0.0004	−0.0026**	0.0030
Cash flow – high	0.1698**	−0.0207	−0.0015**	0.0010
Cash flow – low	0.2196**	0.0285	0.0056*	−0.0019
Dividend	0.1988**	0.0364	−0.0003	0.0009
No dividend	0.1217**	−0.0361	−0.0026**	0.0005
Long-term debt – high	0.2365**	0.0619*	0.0011	0.0001
Long-term debt – low	0.1037**	−0.0482	−0.0025**	0.0018
Assets – high	0.1407**	0.0001	−0.0006**	0.0005
Assets – low	0.1779**	0.0070	−0.0024**	0.0020
WW without size – constrained	0.1339**	0.0052	−0.0021**	0.0014
WW without size – unconstrained	0.1942**	0.0826*	0.0016*	0.0000

** and * indicate statistical significance at the 1% and 5% levels, respectively.

Does the financial crisis affect distressed or constrained firms more heavily?

EMANUEL ALFRANSEDER

We develop a framework to investigate the impact of the financial crisis starting in 2007 and employ an extended GARCH model to test for spillover and contagion effects originating from the financial sector. We find that the financial crisis affected financially distressed firms more heavily than undistressed firms and that financial constraints did not play an equally crucial role during the crisis. Overall, the analysis shows that the financial sector affected the returns of nonfinancial firms during the crisis. We find little evidence that the turbulence in the financial sector expressed in terms of volatility fully encroached upon nonfinancial firms.

JEL classification: G01
Keywords: GARCH; Spillover; Contagion; Financial Distress; Financial Constraints; Financial Crisis

THE KNUT WICKSELL CENTRE FOR FINANCIAL STUDIES

The Knut Wicksell Centre for Financial Studies conducts cutting-edge research in financial economics and related academic disciplines. Established in 2011, the Centre is a collaboration between Lund University School of Economics and Management and the Research Institute of Industrial Economics (IFN) in Stockholm. The Centre supports research projects, arranges seminars, and organizes conferences. A key goal of the Centre is to foster interaction between academics, practitioners and students to better understand current topics related to financial markets.

LUND UNIVERSITY
School of Economics and Management

LUND UNIVERSITY
SCHOOL OF ECONOMICS AND MANAGEMENT
Working paper 2015:4
The Knut Wicksell Centre for Financial Studies
Printed by Media-Tryck, Lund, Sweden 2015