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# **Essays in Financial Economics**

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December 2012

Licentiate Thesis



Dear Reader,

While this is just another step along the way of my academic career it is nevertheless an important milestone and it is time to thank the people who helped me come that far.

My deepest gratitude goes to my main supervisor Hossein Asgharian. Without his constant encouragement, motivation and help, I would not write these lines today. I could not have wished for a better supervisor to take care of me. Thank you, Hossein.

I would also like to thank Björn Hansson, my second supervisor, for his constant support and advice. It is always an experience to talk with Björn about any kind academic and non-academic subject. I also would like to take this opportunity to thank David Edgerton. Without his encouragement to apply for the programme, I would probably not be here today. I also want to thank the whole Department of Economics. While my academic working experience is not extensive I cannot imagine a more collegial and pleasant working environment.

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Living far away from home now for many years now, doesn't mean I have forgotten my roots. First and foremost I want to thank my parents. Without their constant love, support and ability to give me the freedom to live my life and pursue my dreams (that admittedly change often enough), I would not be where I am today. It is hard to express this gratitude in words.

Enjoy the reading

Emanuel Alfranseder  
November, 2012



# Introduction

The following thesis is divided into two chapters covering different subjects within financial economics. In the following those two chapters are described briefly. Chapter 1 is titled “Does the financial crisis affect distressed or constrained firms more heavily?” and chapter 2 is named “The Effect of Pessimism and Doubt on the Equity Premium”.

Chapter 1 investigates the impact of the financial crisis on the real economy. Departing from the financial crisis starting in 2007, we investigate to which extent the turmoil affected non-financial firms. Using an extended GARCH framework building upon Baur (2003), we sort firms according to financial constraints and financial distress. We measure the former by applying the Whited and Wu index (Whited and Wu, 2006) reflecting firms facing difficulties getting funding. We measure financial distress using Altman Z-scores (Altman, 1968) to obtain a measure of firms that are financially weak. According to basic economic theory, recessions provide an opportunity to drive weak and obsolete firms out of business. It would thus be a normal cathartic process, if financially distressed are negatively affected by the crisis. If, however, financially constrained firms are adversely affected by the financial crisis, economic growth is effectively lost.

Overall, we find evidence that the financial sector affects financially distressed firms more strongly during the financial crisis. We do, however, not find the same effect for financially constrained firms. The financial sector affects firms with comparatively high long-term debts more heavily during the crisis. We also show that the financial sector affects non-financial firms’ returns during the financial crisis, but has very limited impact on conditional volatility.

Chapter 2 is addressing the equity premium puzzle of Mehra and Prescott (1985) both theoretically and empirically. The main idea is building upon Abel (2002) and departs from the traditional rational expectations framework by

implementing pessimism and doubt into the theoretical model. Departing from the overlapping generations model (Samuelson 1958), we explain how both pessimism and doubt drive down the average price of the risky asset and thus help solve the equity premium puzzle.

In the empirical part of this chapter we use the theoretical framework to perform a cross-sectional study using the SHARE data. We find that pessimism moves the equity premium in the expected direction and more pessimistic countries tend to have a higher risk premium. The variable proxying for doubt shows that countries that are on average more doubtful, have a lower risk premium contradicting our theoretical predictions. Thus we can partly confirm the theoretical findings and provide evidence that pessimism increases the average equity premium.

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

Emanuel Alfranseder\*

## 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 affects financially distressed firms more heavily than non-distressed firms. Financial constraints do not play an equally crucial role during the crisis. Overall, the analysis shows that the financial sector affects the returns of non-financial firms during the crisis. We find little evidence that the turbulence in the financial sector expressed in terms of volatility fully encroaches upon non-financial firms.

*JEL classification:* G01

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# 1 Introduction

An increasing body of literature is investigating the causes and consequences of the financial crisis triggered by the sub-prime mortgage collapse starting around August 2007. A sharp recession has followed in a majority of mature industrialized economies, for many countries the worst contraction since the Great Depression. 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 the degree of financial distress of non-financial firms applying Altman's Z-scores (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 affects in principle healthy firms negatively. Our measurement in that context will be financial constraint and we will draw on a whole body of existing literature on the topic (e.g., Whited and Wu, 2006; Lamont, Polk, and Saá-Requejo, 2001) to identify an appropriate measure of financial constraint. Financially constrained firms might need to reduce investment further (cf. Duchin, Ozbas, and Sensoy, 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 exist and prevent access to capital. However, both theoretical and empirical literature deals with the existence of such frictions (e.g., Fazzari, Hubbard, Petersen, Blinder, and Poterba, 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 very essential assumptions that have been partly taken for granted in a lot of pre-crisis 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 thesis does not hold and firms face differing financial constraints.

The proposed framework is suitable to investigate two main questions. First, does the financial crisis affect non-financial firms or is 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 policy-makers understand how to design potential counter-measures. 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 pre-classifying firms into different groups according to financial constraint and financial distress, construct portfolios, and perform 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 both the first and the second moment simultaneously. The model draws a careful distinction between spillover and contagion effects, the former describing a more permanent codependence and the latter singling out the 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 non-financial 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 financial constraints of individual firms. The work of Fazzari, Hubbard, and Petersen (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, Polk, and Saa-Requejo (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 index optimizing the present discounted value of future dividends (Tong and Wei, 2008) and incorporate 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 Whited-Wu (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 degree of financial constraints of a firm.

Hadlock and Pierce (2009) carefully read financial filings of a sample of U.S. firms to pre-classify firms in five categories of constraints. Essentially replicating the analysis of Lamont, Polk, and Saa-Requejo (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, labelled the SA index, which focuses solely on age and size. The WW index highly correlates with the SA index, and 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 financial distress of firms is not only of interest for academics but an essential part of a multi-billion dollar private industry. As a result, private sector firms have developed extensive methodology to assess financial distress. To survey 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 by using ratio analysis of accounting-based balance sheet data. Ohlson (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 (cf. Campbell, Hilscher, and Szilagyi, 2008).

## 2.3 Empirical Modelling

Different approaches exist to investigate contagion and spillover effects of various markets. Dungey, Fry, Gonzalez-Hermosillo, and Martin (2004) give a comprehensive overview of available approaches and this section refers to some of the literature outlined in their work. Researchers need to make a number of crucial choices when performing an analysis of spillover and contagion effects. The following chapter 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 the choice whether to investigate 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 non-crisis 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 upward biased. Consequently, if we test for a significant difference between crisis and non-crisis 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 non-crisis 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 a non-symmetric phenomenon.

As a result, Baur proposes a modelling approach that incorporates the shocks directly.

An essential consideration is whether to determine the crisis periods exogenously or 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 via 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 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, Karolyi, and Stulz (2003) propose such approaches with some differing 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 for modelling 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 of the conditional variance of the potentially infected country and tests for significance. This approach does not address the problem of endogeneity, that is to say it simply assumes that the included estimates of the conditional variance of the originating country are exogenous. This essay will partly adapt this concept and combine it with the approach in Baur (2003).

### 3 Data and empirical approaches

An essential part of the analysis consists of modelling financial constraint and financial distress. As described earlier, the literature suggests several indicators to measure financial constraints. We decide to employ the rather novel measure for financial constraint set forth in Whited and Wu (2006). By

developing a partial-equilibrium investment model, deriving an Euler equation, and finally estimating the model with GMM, they arrive at a financial constraint index that is denoted as follows:

$$-0,091CF_{it} - 0,062DIVPOS_{it} + 0,021TLTD_{it} - 0,044LNTA_{it} + 0,102ISG_{it} - 0,035SG_{it} \quad (1)$$

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 the indicator proposed in Altman (1968) to determine financial distress. The measure derives from a multiple discriminant analysis (MDA) and allows for *a priori* grouping of firms into distressed and non-distressed ones. 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 the purpose of this paper. Altman (2000) re-examines Z-scores and shows that they still work well as a predictor for default. Altman's Z-score is denoted as the following:

$$Z = 0,012WC_{it} + 0,014RE_{it} + 0,033EBIT_{it} + 0,006MVTL_{it} + 0,999SA_{it} \quad (2)$$

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

The model for analyzing contagion and spillover effects follows Baur (2003). We model the first moment spillover and contagion effects as the following:

$$R_{N,t} = a_0 + a_1R_{N,t-1} + a_2R_{M-F,t} + b_1R_{F,t} + b_2R_{F,t}D_{Crisis} + u_{N,t} \quad (3)$$

Equation (3) highlights the main idea of the empirical model.  $R_{N,t}$  stands for the return of a portfolio comprising non-financial firms,  $a_0$  is the intercept,  $R_{F,t}$  represents the return of the financial sector,  $D_{Crisis}$  is a dummy variable for the crisis period, and  $u_{N,t}$  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  $R_{M-F,t}$  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:

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

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

$$\sigma_{N,t}^2 = c_0 + c_1\sigma_{N,t-1}^2 + c_2\epsilon_{N,t-1}^2 + c_3\epsilon_{N,t-1}^2 I_{N,t-1} + c_4R_{M-F,t-1}^2 + d_1R_{F,t-1}^2 + d_2R_{F,t-1}^2 D_{Crisis} \quad (5)$$

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  $\sigma_{N,t}^2$  denotes the conditional variance of a portfolio of non-financial firms,  $c_0$  the intercept of the conditional volatility, and  $\epsilon_{N,t-1}^2$  the squared error from equation (3).  $I_{N,t-1}$  is an indicator variable that is one if the shock is negative and zero otherwise and  $R_{F,t-1}^2$  the conditional volatility of the financial sector proxied by the squared returns.  $R_{M-F,t-1}^2$  denotes the lagged squared returns of the market index minus 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 is 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 the 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 Whited-Wu index to classify firms as distressed and constrained. 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 investigate specifically 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 an essential choice of 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 sub-prime mortgage collapse in the U.S. market. Reinhart and Rogoff (2008) date the beginning of the sub-prime 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 could not find 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 signalling 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 and contagion analysis.

Panel A of Figure 2 shows the evolution of average Altman's Z-scores at a 25 % cut-off level for distressed and non-distressed firms. Altman (1968) classifies firms with a Z-score of below 1.8 as distressed, whereas the area between 1.81 and 2.99 includes both distressed and non-distressed firms. Values above 3 predict no imminent financial distress. Deducing a clear-cut trend for the development since 1989 is not immediately apparent. The less distressed firms in the 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 and lowered 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 non-constrained 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 constraints.

[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 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 indices and portfolios. For the distressed portfolio, observed returns are considerably lower, confirming previous results reported e.g., in Dichev (1998) and Campbell, Hilscher, and Szilagyi (2008). The financially constrained portfolio, however, has substantially higher returns than the non-constrained portfolio.

[INSERT TABLE 1 HERE]

## 4.2 Spillover and contagion analysis

Taking the 25% least and the 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 Whited-Wu index. We apply the model described via 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 non-crisis period, mean spillover point estimates are positive and relatively close in size for both constrained and non-constrained portfolios. Mean contagion effects are not statistically significant for either the constrained or the non-constrained portfolio and the total effect (obtained by adding  $b_1$  and  $b_2$ ) during the financial crisis is very similar in size.

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

Volatility spillovers are only significant at a 5% level for the distressed portfolio, but comparatively small in size. Volatility contagion is not statistically significant for any of the portfolios. For the non-distressed and non-constrained 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 constraints. As previously argued, conflicting effects of financial constraints on performance or the difficulty of measuring and defining financial constraints could explain those results. We take the variables featuring most prominently in the Whited-Wu indicator (CF, DIVPOS, TLTD, LNTA) to construct portfolios sorting firms according to just one criterion. As size strongly dominates the Whited-Wu indicator, 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 will 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 also non-crisis spillovers are less pronounced. Spillover and contagion effects are smaller for firms paying no dividends as compared to dividend-paying firms. Both the theoretical arguments and empirical findings are coherent with this result. Arguing again with the fundamental results in Modigliani and Miller (1958), 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 during both the non-crisis 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 Whited-Wu index shows again the difficulty of making definite conclusions concerning constrained and non-constrained 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, Kogan, Lochstoer and Ozyildirim, 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 obvious. 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 in tendency statistically less 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. Pre-classifying firms according to financial constraints 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. Taking volatility as an indicator shows that financial market volatility remains 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 the financial sector volatility then returned to levels closer to pre-crisis 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 compared to 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 non-financial firms during the financial crisis is significantly positive for the portfolio of distressed firms. Thus, the worsening conditions to finance operations suggest additional re-evaluations of non-financial 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 is happening during the financial crisis and rids the economy of non-competitive businesses. Results show that the financial sector does not affect financially constrained firms more strongly than non-constrained 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 over-investment 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 non-financial 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.

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Figure 1: Determination of crisis period

The figure illustrates the determination of the 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.

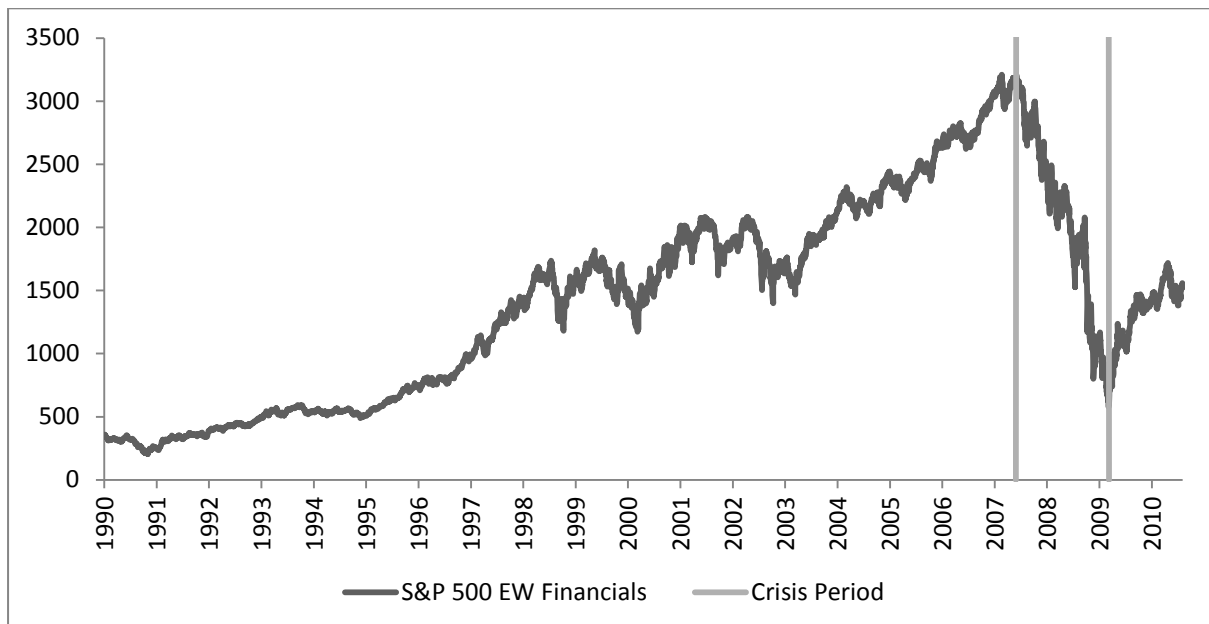
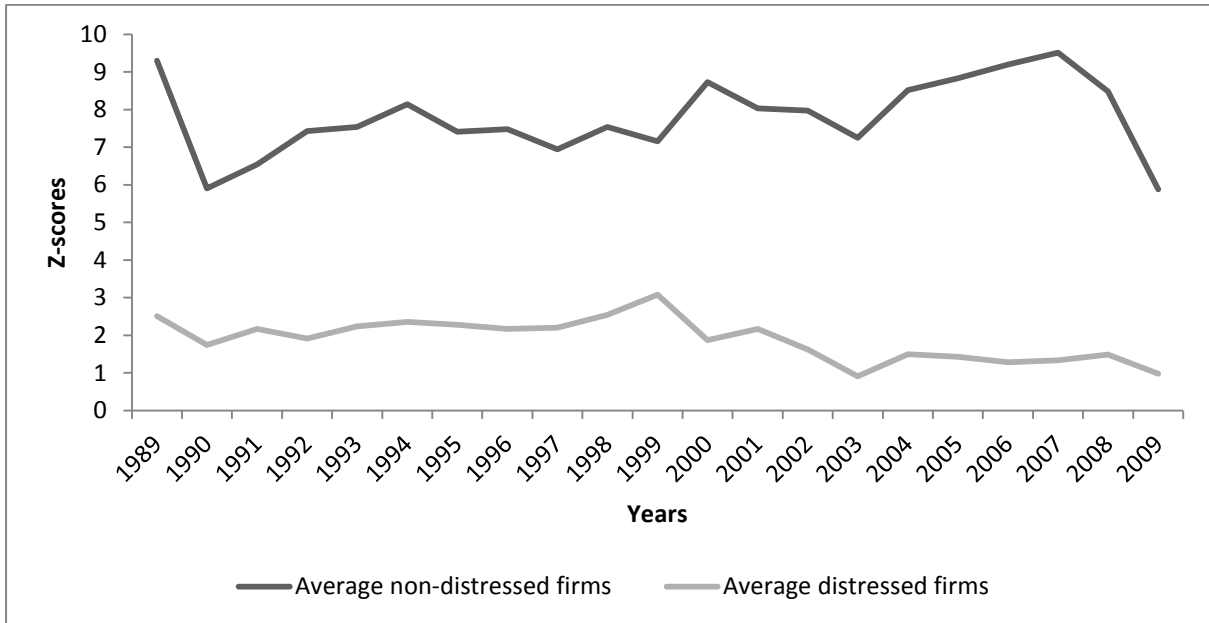


Figure 2: Time Series of Z-scores and the Whited-Wu index

The figures depict the development of average Z-scores and the average of the Whited-Wu index, respectively. The averages are calculated taking the 25% most and least constrained firms according to Z-scores and the Whited-Wu index, respectively.

Panel A: Time Series of Z-scores



Panel B: Time Series of the Whited-Wu index

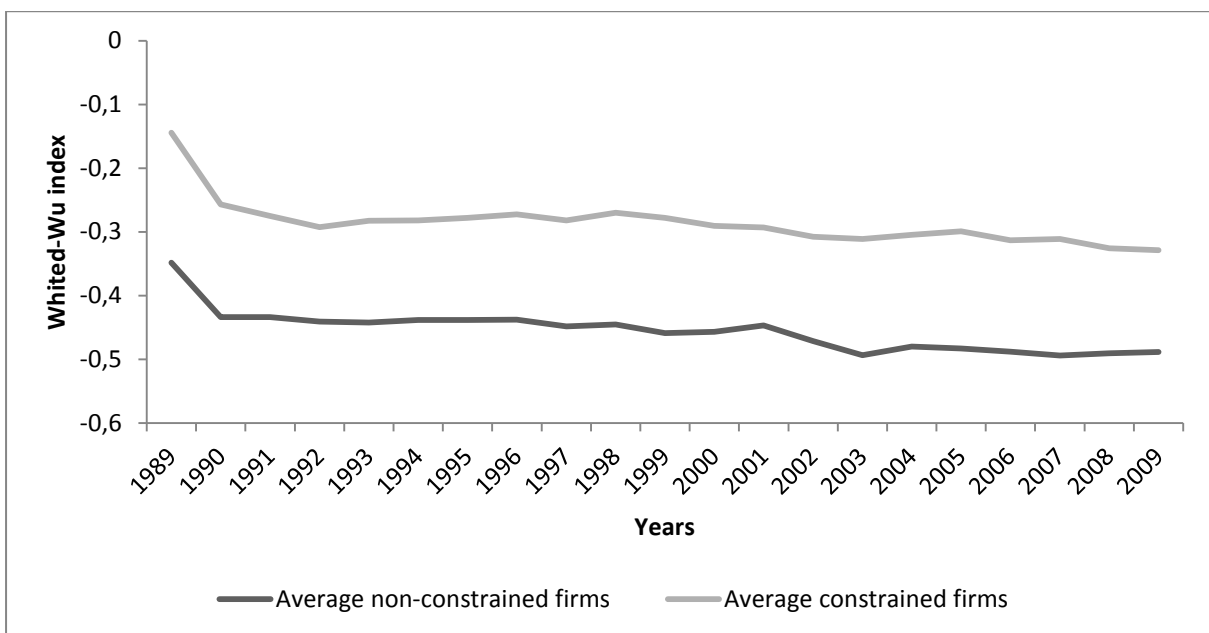
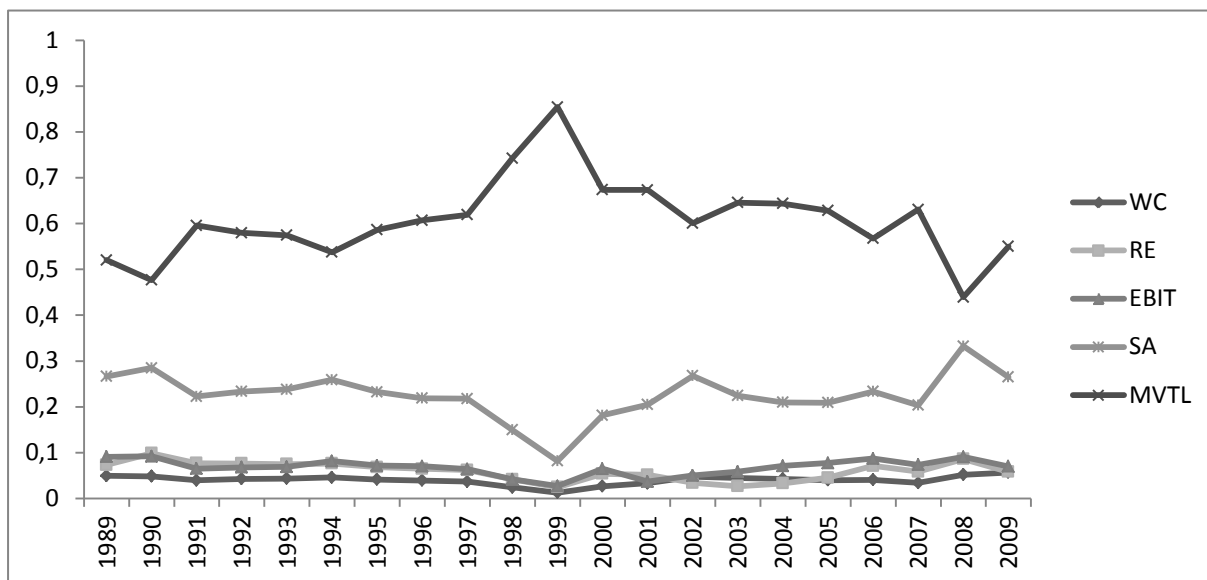




Figure 3: Decomposition of Z-scores and the Whited-Wu indicator

The figures show the average contribution in percentage to Z-scores and the Whited-Wu 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 Whited-Wu indicator

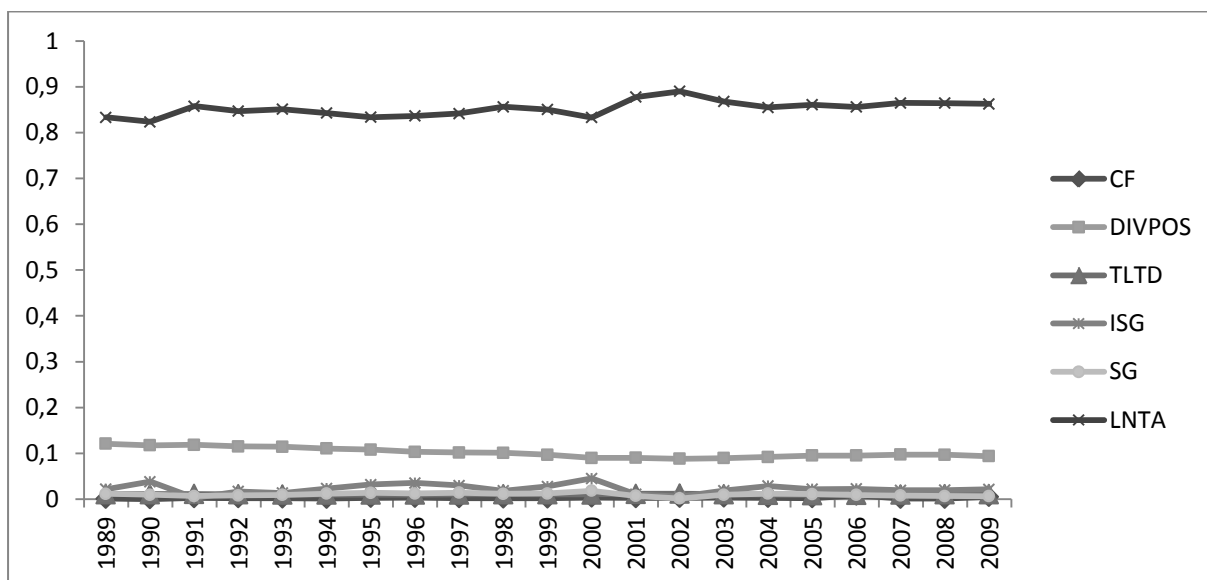


Table 1: Summary Statistics

The table depicts summary statistics of the indicators for both financial distress and constraint and the stock price data. Indicators and portfolios are based on accounting data of 2006. 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 and the Whited-Wu index taking the 25% most and least distressed/constrained firms.

*Panel A: Summary statistics indicators*

	Z-scores		Whited-Wu index	
	Distressed	Non-Distressed	Constrained	Non-Constrained
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: Summary statistics stock returns*

	S&P 500 EW Financials	S&P 500 Composite	Constrained Portfolio	Non- Constrained Portfolio	Distressed Portfolio	Non- Distressed Portfolio
Sample Mean (yearly)	0.108	0.071	0.252	0.108	0,131	0,231
Sample Stdev. (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

The table reports results estimating the respective models described in equations (3)-(5). Portfolios are formed using daily stock price data and equally weighting the 25% least and most constrained/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	Non-Constrained	Distressed	Non-Distressed
$a_0$	0.0005**	0.0002**	0.0002**	0.0005**
Autoregr. ( $a_1$ )	0.0937**	0.0464**	0.0817**	0.0439**
Mean 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*
$c_0$	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**
Volatility 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 0.01 and 0.05 levels, respectively.

Table 3: Forming portfolios according to selected criteria

The table reports results using daily data and estimating the respective models described in equations (3)-(5). 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 Whited-Wu index without the size effect (LNTA). Portfolios are formed by equally weighting firms below the lower quartile and above the upper quartile, respectively. The standard errors are computed using heteroskedasticity consistent standard errors according to Bollerslev and Wooldridge (1992).

		Cash Flow - high	Cash Flow - low	Dividend	No Dividend	Long-term debt - high	Long-term debt - low	Assets - high	Assets - low	WW without size - Constrained	WW without size - non- constrained
Mean	$a_0$	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**
	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**
Volatility	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*
	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 0.01 and 0.05 levels, respectively.

Table 4: Forming portfolios according to selected criteria, weekly returns

The table reports results using weekly data and estimating the respective models described in equations (3)-(5). Portfolios in the first four rows are formed using weekly stock price data and equally weighting the 25% least and most constrained/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 Whited-Wu 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 <sub>1</sub> )	Contagion (b <sub>2</sub> )	Spillover (d <sub>1</sub> )	Contagion (d <sub>2</sub> )
Constrained	0.1272**	-0.0151	-0.0025**	0.0007
Non-Constrained	0.1492**	0.0049	-0.0005	0.0009
Distressed	0.1912**	0.0680*	-0.0011	0.0021*
Non-Distressed	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 - non-constrained	0.1942**	0.0826*	0.0016*	0.0000

\*\* and \* indicate statistical significance at the 0.01 and 0.05 levels, respectively.

# The Effect of Pessimism and Doubt on the Equity Premium\*

Emanuel Alfranseder<sup>†</sup>  
Xiang Zhang<sup>‡</sup>

## Abstract

This paper introduces a model aiming to explain the equity premium puzzle. Consumers exhibit both pessimism and doubt. Consumers are pessimistic if their beliefs about the dividend are a translation of the objective dividend by an independent and identically distributed normal random variable with negative mean. Consumers exhibit doubt if their beliefs are a translation of the objective dividend by an independent and identically distributed normal random variable with mean zero. A cross-sectional empirical study using the SHARE database explores the differences between various European countries in terms of pessimism and doubt and tests the theoretical model empirically.

*JEL Classification:* G14; G12; D81

*Keywords:* Behavioral Finance; Equity Premium; Doubt; Pessimism

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# 1 Introduction

The hypothesis that consumers have rational expectations about the relevant economic variables is an assumption made in the majority of asset pricing models. According to this hypothesis, the subjective probability of the outcomes should tend to the objective probability distribution of the outcomes. This assumption is attractive because consumers can forecast the economic variables of interest.

As mentioned by Abel (2002), rational expectations are also attractive because they avoid the multiple modeling choices that arise once the premise of rational expectations is removed. Nevertheless, the assumption of rational expectations does not necessarily hold. Abel (2002) uses the Lucas fruit tree model with a representative agent (Lucas, 1978) to explore how two particular departures from rationality, pessimism and doubt about the process of dividends, affect the means of asset returns. Abel (2002) characterizes pessimism by the first degree of stochastic dominance and doubt by the second degree of stochastic dominance. A major finding is that pessimism and doubt can help resolve some asset pricing puzzles. In particular, pessimism and doubt lead to an increase of the average equity premium, and thus can help resolve the equity premium puzzle of Mehra and Prescott (1985).

In Abel's work, pessimism and doubt are taken as given, without modeling the source of the departures from the complete rationality of expectations. Numerous contributions point out the lack of an explanation of these departures of rationality as a weaknesses of Abel's work. From a theoretical point of view, Jouini and Napp (2008) show that Abel's result on the impact of doubt on the equity premium is not correct in general. From a practical standpoint, an evaluation of the empirical plausibility of pessimism and doubt (in the sense of Abel) is performed by Giordani and Soderlind (2006). Using data on US consumption and income, they find that individual forecasters are in fact pessimistic, but show overconfidence rather than doubt.

Therefore, Abel's doubt might not be a promising explanation of the equity premium puzzle. However, the implications for Abel's model depend on how the empirically heterogeneous beliefs are mapped into the beliefs of a representative agent. Jouini and Napp (2006) study, in a more general equilibrium setting, how more general notions of pessimism and doubt at the aggregate level result from pessimism and doubt at the individual level. They also find that pessimism and doubt have a positive impact on the equity premium.

De Long, Shleifer, Summers, and Waldmann (1990) present a simple overlapping generations model of an asset market containing irrational and rational traders. Irrational traders falsely believe that they have special information about the future price of the risky asset. They may get their pseudo-signals from technical analysis, stock brokers, or economic consultants, and irrationally believe that these signals carry information, leading them to have incorrect stochastic beliefs about the price of the risky asset. Irrational traders select their portfolios on the basis of such incorrect beliefs and both affect prices and expected returns. Prices can diverge significantly from fundamental values and irrational traders can earn higher expected returns than rational traders do. Although this interpretation of irrationality is specific, the impact of the risk coming from irrationality on the equity premium is ambiguous.

We introduce alternative definitions of pessimism and doubt in the setting of an overlapping generations (OLG) model of two assets markets: a risky asset and a safe asset, with agents who live for two periods. Each generation consists of a representative agent. The source of pessimism and doubt is analogous to the source of irrationality described in De Long, Shleifer, Summers, and Waldmann (1990). We define the subjective beliefs about the dividend of a risky asset to be pessimistic if they differ from the objective process of the dividend by a normal process with negative mean. The subjective beliefs about the dividend are said to have doubt if they differ from the objective process of the dividend by a normal process with zero mean. In the same spirit as Abel (2002), we show that pessimism and doubt tend to increase the average equity premium and so they can be seen as possible explanations for the equity premium puzzle.

The contribution of the present paper is twofold. First, we introduce a very simple theoretical model replicating Abel's (2002) results on the effects of doubt and pessimism. Second, we apply the theoretical framework to a novel cross-sectional study using the SHARE data. We can partly confirm the theoretical considerations and find that pessimism indeed increases the average equity premium.

The remainder of this paper is structured as follows: In Section 2, we develop a simple model of asset pricing in which beliefs about the process of the dividend of a risky asset differ from the objective process by a normal random variable. We use this model in Section 3 to show that pessimism reduces the equilibrium price and increases the average equity premium. We



perform for doubt, in Section 4, the same analysis as in Section 3. In light of the equity premium puzzle discussed by Mehra and Prescott (1985), we comment in Section 5 on the effects of pessimism and doubt in reducing the equity premium puzzle. In Section 6, we present the empirical results. We present the conclusions in Section 7.

## 2 The Model

### 2.1 The Basic Framework

Our basic model is an overlapping generations model (Samuelson 1958) with agents who live for two periods. Time is discrete, indexed by  $t$ , and there is no final period. Each generation consists of a representative agent. In each period, one agent is born and lives two periods, so at every period  $t$  there is always one young agent, called worker  $t$ , and one old agent. For simplicity, there is no consumption in the first period, worker  $t$  supplies one unit of labor inelastically to the market and receives a wage  $w_t$ . The only decision the agent  $t$  makes is to choose their portfolio when young. The economy has two assets. One of the assets, the risk-free asset, is in perfectly elastic supply and its price equals unity. It pays a constant dividend  $r > 0$  (constant risk-free rate). The other asset, the risky asset, is in net supply equal to 1 and its price at  $t$  is denoted by  $p_t$ . The dividend process  $d_t$  is normal i.i.d.:

$$d_t \rightarrow N(d, \sigma_d^2), \quad (1)$$

where  $d > r$ . We denote by  $c_{2,t+1}$  agent  $t$ 's consumption when old. The agent's utility is

$$U_t = u(c_{2,t+1}), \quad (2)$$

where  $u$  is CARA with as coefficient of absolute risk aversion. Agent  $t$  is born with no capital, and when young, receives pseudosignals about the future price of the dividend of the risky asset and falsely believes that these signals contain information, thus misperceiving the dividend process of the risky asset by an independent and identically distributed normal random variable  $\epsilon_t$ :

$$\epsilon_t \rightarrow N(\epsilon, \sigma_\epsilon^2). \quad (3)$$

We assume that  $\epsilon_t$  is uncorrelated with  $d_s$  for every  $t$  and  $s$ . Therefore, this agent has the erroneous beliefs that the next period dividend on the risky asset is  $d_{t+1} + \epsilon_t$ , and divides their portfolio between the risk-free asset

and the risky asset, in order to maximize the expected utility. The budget constraint faced at  $t$  is

$$s_t + p_t u_t = w_t, \quad (4)$$

where  $s_t$  and  $u_t$  are, respectively, the quantities of the risk-free asset and risky asset purchased. When old, the agent is retired, converts the holdings of the risk-free asset to the consumption good, and lives off of the capital income from selling these holdings of the risky asset for price  $p_{t+1}$  to the young generation. The budget constraint when old is

$$c_{2,t+1} = s_t(r + 1) + u_t(d_{t+1} + \epsilon_t + p_{t+1}). \quad (5)$$

At time zero, there is an old generation (agent - 1) with capital stock. Thus, worker  $t$ 's portfolio selection problem is

$$\max_{u_t, s_t} E_t[-\exp(-\gamma c_{2,t+1})] \quad (6)$$

subject to both constraints above.

Here, the operator  $E_t$  denotes the expectation conditional on the information  $I_t$  available at time  $t$ , given the agent's opinions about the process of the dividend on the risky asset. Assuming that the conditional distribution of  $p_{t+1}$  given  $I_t$  is normal,  $p_{t+1}|I_t \rightarrow N(E_t[p_{t+1}], \text{Var}_t(p_{t+1}))$ , the future consumption  $c_{2,t+1}$  follows a normal distribution with mean  $E_t[c_{2,t+1}]$  and variance  $\text{Var}_t(c_{2,t+1})$ . Using the moment generating function for the conditional distribution of  $c_{2,t+1}$ ,

$$E_t[-\exp(-\gamma c_{2,t+1})] = -\exp[-\gamma E_t[c_{2,t+1}] + \frac{1}{2}\gamma^2 \text{Var}_t(c_{2,t+1})]. \quad (7)$$

Since the real function  $-\exp(-\gamma x)$  is strictly increasing in  $x$ , the previous maximization problem is equivalent to

$$\max_{u_t} E_t[c_{2,t+1}] - \frac{\gamma}{2} \text{Var}_t(c_{2,t+1}), \quad (8)$$

where

$$E_t[c_{2,t+1}] - \frac{\gamma}{2} \text{Var}_t(c_{2,t+1}) = w_t(1+r) + [E_t[p_{t+1}] + d + \epsilon_t - p_t(1+r)]u_t - \frac{\gamma}{2} (\text{Var}_t(p_{t+1}) + \sigma_d^2)u_t^2$$

.

The optimality condition of the previous problem is

$$E_t[p_{t+1}] + d + \epsilon_t - p_t(1+r) - \gamma(\text{Var}_t(p_{t+1}) + \sigma_d^2)u_t = 0, \quad (9)$$

which means that the optimal demand of the risky asset is

$$\implies u_t = \frac{E_t[p_{t+1}] + d + \epsilon_t - p_t(1+r)}{\gamma(\text{Var}_t(p_{t+1}) + \sigma_d^2)}. \quad (10)$$

Given the subjective beliefs about the dividend on the risky asset, we define the perceived excess return on the risky asset as of time  $t$  as  $p_{t+1} + d_{t+1} + \epsilon_t - p_t(1+r)$ . The term  $p_{t+1} + d_{t+1} + \epsilon_t$  is the random payment of the risky asset at  $t+1$ , plus the subjective misperception  $\epsilon_t$  of the dividend.  $p_t(1+r)$  is the discounted opportunity cost of not investing in the safe asset. The true excess return on the risky asset as of time  $t$  is  $p_{t+1} + d_{t+1} - p_t(1+r)$ . According to Eq. (10), the demand for the risky asset is proportional to the expected value of the perceived excess return and inversely proportional to its perceived variance.

## 2.2 The Pricing Function

Since the holdings of the old agent are sold, the demand of the young must be unity in equilibrium. From Eq. (10) and the equilibrium condition  $u_t = 1$ , the equilibrium price is

$$p_t = \frac{E_t[p_{t+1}] + d + \epsilon_t - \gamma(\text{Var}_t(p_{t+1}) + \sigma_d^2)}{(1+r)}. \quad (11)$$

The equilibrium price at period  $t$  of the risky asset is a function of the expected value of the perceived dividend, of its expected variability and of the parameters  $\gamma$  and  $r$ . I consider only steady-state equilibria by imposing the condition that the unconditional distribution of  $p_{t+1}$  be identical to the distribution of  $p_t$ . It turns out that  $\text{Var}_{t+j}(p_{t+j+1}) = \text{Var}_t(p_{t+1})$  holds for every  $j$ .

Solving Eq. (11) by forward recursion, the pricing rule for the risky asset at time  $t$  is

$$p_t = \lim_{j \rightarrow \infty} \frac{E_t[p_{t+j}]}{(1+r)^j} + \frac{d}{r} + \frac{\epsilon_t - \epsilon}{1+r} + \frac{\epsilon}{r} - \frac{\gamma(\text{Var}_t(p_{t+1}) + \sigma_d^2)}{r}. \quad (12)$$

I assume that the bubble term is zero,  $\lim_{j \rightarrow \infty} \frac{E_t[p_{t+j}]}{(1+r)^j} = 0$ . The one-step ahead variance of  $p_t$  takes the form

$$\text{Var}_t(p_{t+1}) = \text{Var}(p_{t+1}) = \frac{\sigma_\epsilon^2}{(1+r)^2}. \quad (13)$$

So, the final form of the pricing rule for the risky asset is

$$p_t = \frac{d}{r} + \frac{\epsilon_t - \epsilon}{1+r} + \frac{\epsilon}{r} - \frac{\gamma}{r} \left[ \frac{\sigma_\epsilon}{(1+r)^2} + \sigma_d^2 \right]. \quad (14)$$

The last three terms of Eq. (14) show the impact of the misperception of the dividend on the random price of the risky asset. As the distribution of  $\epsilon_t$  converges to a point mass at zero, the equilibrium price converges to its fundamental value of  $\frac{d}{r}$  minus  $\frac{\gamma}{r}\sigma_d^2$ .

Only the second term is variable; it captures the fluctuations in the price of the risky asset due to the variations in consumer opinion. The third term captures the average deviation of  $p_t$  from its fundamental value. The last term says that the real variability of the dividend process and the subjective variability of the consumer's misperception drive the price down via the consumer's coefficient of risk aversion. It is worth mentioning the equilibrium price is linear in the average dividend  $d$ , in the random opinion  $\epsilon_t$ , in the mean misperception  $\epsilon$ , and in the variances  $\sigma_\epsilon$  and  $\sigma_d^2$ .

### 2.3 The Standard Setting

I take as the standard setting the case when the consumer has rational expectations about the dividend process  $d_t$ . In this case, the next period dividend on the risky asset is accurately perceived:  $d_{t+1}$ . The pricing formula (14) becomes

$$p_t^B = \frac{d}{r} - \frac{\gamma}{r}\sigma_d^2. \quad (15)$$

The expected excess return  $R_{t+1}^B$  on the risky asset is

$$R_{t+1}^B = E_t[p_{t+1}^B + d_{t+1} - p_t^B(1+r)] = \gamma\sigma_d^2. \quad (16)$$

At this point, I observe that all the agents earn a constant return of  $r$  on their investments in the risk-free asset. Therefore, the average equity premium is equal to the expected return on the risky asset minus  $r$ .

## 3 The Effects of Pessimism on the Financial Equilibrium

We say that consumer beliefs about the future dividend on the risky asset are pessimistic if

$$\epsilon_t \rightarrow N(\epsilon, \sigma_\epsilon^2), \quad (17)$$

where  $\epsilon < 0$ . On average, consumers underestimate the dividends on the risky asset. It follows that the subjective beliefs  $d_{t+1} + \epsilon_t$  are dominated by the true process  $d_{t+1}$  in the sense of first degree stochastic dominance.

The equilibrium price of the risky asset that prevails under pessimism is

$$p_t^P = \frac{d}{r} + \frac{\epsilon_t - \epsilon}{1+r} + \frac{\epsilon}{r} - \frac{\gamma}{r} \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} + \sigma_d^2 \right] = p_t^B + \frac{\epsilon_t - \epsilon}{1+r} + \frac{\epsilon}{r} - \frac{\gamma}{r} \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} \right], \quad (18)$$

with  $\epsilon < 0$ . When one generation of consumers is more pessimistic than the average generation, the second term in (18) is strictly negative, so, the risky asset is priced below the value that it would have under rational expectations. In general, since  $\epsilon_t$  tends to cluster around its mean  $\epsilon$ , the third term in (18) tends to dominate the second one, leading pessimistic consumers to underprice the risky asset.

Taking the unconditional expectation of (18) yields

$$E[p_t^P] = p_t^B + \frac{\epsilon}{r} - \frac{\gamma}{r} \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} \right]. \quad (19)$$

On average, there is a bias towards a price of the risky asset lower than that of the standard setting. The subjective expected return on the risky asset as of time  $t$  is defined by

$$R_{t+1}^P = E_t[p_{t+1}^P + d_{t+1} + \epsilon_t - p_t^P(1+r)] = \gamma \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} + \sigma_d^2 \right], \quad (20)$$

and the average return on the risky asset is defined by

$$E[p_{t+1}^P + d_{t+1} - p_t^P(1+r)] = \gamma \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} + \sigma_d^2 \right] - \epsilon. \quad (21)$$

Eqs. (20) and (21) show that the return subjectively expected by consumers is biased downwards because the perceived excess return incorporates the misperception  $\epsilon_t$  of the dividend, realized at the price formation. Pessimistic consumers requires a larger expected return (20) than they would in a rational expectation equilibrium (16), due to the volatility of their opinions. Comparing Eqs. (16) and (20), pessimism increases the average return by  $\gamma \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} \right] - \epsilon$ . Bearing a disproportionate amount of risk derived from pessimism enables pessimistic consumers to earn a higher expected return than do rational consumers.

## 4 The Effects of Doubt on the Financial Equilibrium

If

$$\epsilon_t \rightarrow N(0, \sigma_\epsilon^2), \quad (22)$$

we say that consumers have doubt about the future dividend on the risky asset. Doubtful consumers overestimate the uncertainty of the future dividend on the risky asset because their opinions are volatile. From (22), it follows that subjective beliefs are a mean-preserving spread of the objective dividend, or, second-order stochastically dominated by the true dividend process. In the presence of doubt, the pricing formula (14) becomes

$$p_t^D = \frac{d}{r} + \frac{\epsilon_t}{1+r} - \frac{\gamma}{r} \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} + \sigma_d^2 \right] = p_t^B + \frac{\epsilon_t}{1+r} - \frac{\gamma}{r} \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} \right]. \quad (23)$$

When one generation of consumers underestimates the future dividend of the risky asset,  $p_t^D$  is below  $p_t^B$ . The average price is

$$E[p_t^D] = p_t^B - \frac{\gamma}{r} \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} \right]. \quad (24)$$

On average, doubtful consumers buy the risky asset at a lower price than  $p_t^B$ , and above the price determined by pessimistic consumers (18). The subjective expected return on the risky asset as of time  $t$  is

$$E[p_{t+1}^D + d_{t+1} - p_t^D(1+r)] = \gamma \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} + \sigma_d^2 \right], \quad (25)$$

because on average, the consumer beliefs about the dividend are not biased. The rewards from holding the risky asset are increasing in the variance of the consumer opinion about the dividend process. Doubt increases the average excess return by  $\gamma \left[ \frac{\sigma_\epsilon^2}{(1+r)^2} \right]$  over the average excess return in the standard setting.

## 5 The Mehra–Prescott Puzzle

Mehra and Prescott (1985) show that the realized average return on US equities over the last 60 years has been around 8%, and the realized real return on safe bonds only around zero. In order to reconcile the much higher returns of stocks compared to government bonds in the US, individuals must have a

very large coefficient of risk aversion according to the standard representative consumer applied to US data. If we interpret the risky asset in our model as the aggregate stock market and the riskfree asset as short term bonds, the fact that pessimism and doubt tend to increase the average excess return on the risky asset can help resolve the Mehra–Prescott puzzle or the equity premium puzzle. Since the risk derived from doubt and pessimism can drive down the average price of the risky asset significantly, the return on equities is greater than the constant return on the risk-free asset, leading to a large value for the equity premium.

## 6 Empirical Analysis

To empirically test our explanation of the equity premium puzzle, we perform a cross-sectional exercise. If the theory holds, pessimism and doubt have an effect on the equity premium in addition to risk aversion. Therefore, we use a cross-section of 14 European countries that allows us to test the theory.

### 6.1 Data

We assume that the risk free rate is the same across the whole sample and thus avoid a noisy estimate of the risk free rate and take returns directly. We calculate the weekly returns using the MSCI indexes of each country and extract the information from Datastream Advance. The sample of weekly returns starts with January 1996 and ends on November 19, 2010. To find measures for pessimism and doubt, we use the SHARE database. We construct the variable for doubt using individual evaluation’s of the trust of strangers, ranging from one to ten, with ten being the most trusting.

The first principal component of several variables from the SHARE data as depicted in Table 1 represents optimism. The probability of a better life variable is constructed by subtracting the indicated chance of having a better standard of living in the future from the chance of having a worse standard of living in the future. The “wish to be dead” dummy is unity if a respondent expressed a feeling that one would rather be dead, zero otherwise. The “enjoyment” dummy is unity if a respondent could mention any activity they enjoyed, and zero otherwise. The “hopes” dummy is unity if the individual mentions any hopes for the future and zero otherwise. The first principal component represents optimism quite well. It correlates negatively with the

dummy indicating the desire to be dead, and positively with the dummies measuring whether individuals enjoy life or have any hopes for the future. The first principal component also correlates positively with the indicated probability of having a better life.

[TABLE1]

The tabulation of all key variables for the cross-sectional analysis is displayed in Table 2. All the variables have sufficient variability to allow for a meaningful analysis. Some results are notable by themselves, such as, that Sweden and Denmark exhibit comparatively high levels of trust and optimism combined with comparatively low levels of risk aversion. Except for Spain, the level of trust is relatively low in countries with Mediterranean cultural influences (Italy, Greece, and France).

[TABLE2]

## 6.2 Empirical Model

The empirical model is

$$E_{Weekly}[Return(filtered)] = \beta_0 + \beta_1 * Pessimism + \beta_2 * Doubt + \varepsilon. \quad (26)$$

We pre-filter the mean weekly returns to avoid including too many variables, as we effectively have only 14 observations. We use simple ordinary least squares, correcting for heteroskedasticity with White's (1980) robust standard errors. The obvious hypothesis is that higher levels of pessimism and doubt increase the mean weekly returns.

## 6.3 Empirical Results

Initially, we explore the simple correlation between returns and the trust and optimism variable. The correlation of returns using a moving average with ten-year historical data is consistently negative with optimism, and mostly positive with trust. The former is the expected sign, whereas the latter sign is opposed to the theoretical model.

[FIGURE1]



Subsequently, we apply the model outlined in Eq. (26) using different filters for the mean weekly returns. The results displayed in Table 3 show that our hypothesis can be only partly confirmed. Both variables, the one for doubt and the one for pessimism, are significant at the 99% significance level. This result is robust across the different filterings of returns. The sign of the variable for doubt is not the one expected. Lower average levels of doubt lead to a lower adjusted equity premium. This result can relate to the findings in Giordani and Soderlind (2006). They show that consumers tend to be overconfident instead of doubtful and the reversed sign would confirm their finding. Higher average levels of pessimism do lead to a significantly higher adjusted risk premium. Comparing Eqs. (??) and (??) shows that theoretically the effect of pessimism should be stronger as it increases additionally the risk premium with the deviation from the objective dividend  $\epsilon$ .

[TABLE3]

Overall, the analysis shows that the equity premium decreases with increasing optimism, which is consistent with the theoretical findings. The effect of doubt on the equity premium is not as consistently visible, but the analysis shows rather the opposite effect. This is possibly owing to the difficulty of measuring doubt, which might not be correctly captured by the trust variable in the SHARE data.

## 7 Conclusion

We have used a simple OLG model to define pessimism and doubt as two departures from the hypothesis of rational expectations. The source of these concepts is also explained. We have explored the effects of pessimism and doubt on the equilibrium price and average return of a risky asset in the OLG model. The model explains how both pessimism and doubt reduce the equilibrium price of a risky asset and can help resolve the equity premium puzzle by increasing the average equity premium at equilibrium. Under pessimism, young consumers underestimate the average dividend on the risky asset and overestimate its variability, thus they respond to the fear of getting low dividends by underpricing the risky asset, compared to the rational expectations equilibrium. Pessimistic consumers require a subjective expected return that is greater than the average return under rational expectations. The average return turns out to be larger than consumers expect and hence equity returns are biased downwards under pessimism. Doubt reduces the equilibrium price by increasing the perceived risk associated with future dividends, thereby

driving consumers to pay less for the risky asset than rational consumers would. Since doubtful consumers perceive a higher degree of risk associated with the dividend payments, and thus with the equity, they require a higher expected return. The average equity premium tends to increase under pessimism and doubt because the certain return on the safe asset is constant. Therefore, they can be seen as possible explanations of the equity premium puzzle, because they move the average equity premium in the right direction.

Empirically testing the model using the SHARE database to obtain cross-sectional measurements of risk aversion, pessimism, and doubt, we can only partly confirm this theory. Pessimism moves the equity premium in the expected direction, that is to say, more pessimistic countries tend to have a higher risk premium. The variable proxying for doubt shows that countries that are on average more doubtful, have a lower risk premium. This result contradicts our theoretical predictions, but this might be partly owing to the difficulty of correctly capturing doubt.

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Table 1: Principal Component Analysis: A Measurement for Optimism

*Notes:* All variables are taken from the SHARE database and pre-filtered according to four reliability criteria. The probability of a better life variable (“prob better life”) is constructed by subtracting the indicated chance of having a better standard of living in the future (EX010) from the chance of having a worse standard of living in the future (EX011). Both variables can take on values between 0% and 100% and thus the variable “prob better life” ranges from -100 to 100. The “wish to be dead” dummy (MH004), “enjoyment” dummy (MH016), and the “hopes” dummy (MH003) are taken directly from the SHARE data.

	Wish to be dead dummy	Enjoyment dummy	Hopes dummy	Prob better life
Wish to be dead dummy	1	-0.127	-0.189	-0.068
Enjoyment dummy		1	0.214	0.047
Hopes dummy			1	0.086
Prob better life				0.026
Correl PC1	-0.59	0.61	0.69	0.4

Table 2: Statistics for Main Variables

*Notes:* The table is constructed using the SHARE database and Datastream Advance. Mean weekly returns are calculated from the corresponding MSCI indexes using weekly returns from January 1996 until November 2010. Risk Aversion is the simple country average of the variable indicating risk aversion (AS068) where 1 indicates low risk aversion and 4 a very high risk aversion. Doubt is derived from individuals' average rating of trust in people (EX026) where 0 indicates very low or no trust in people and 10 is the maximum trust level. The variable for pessimism is the first principal component as shown in Table 1. "RRA" is the average share of the stocks in the portfolio taken from the SHARE database. The data taken from the SHARE database are filtered by four different reliability criteria.

	Mean $week_r$	$R_{GDP}$	PC1 (optimism)	Trust	Risk_aversion	RRA
Austria	0.0012	0.021	2.849	5.676	3.787	0.968
Germany	0.0017	0.018	2.969	5.468	3.665	0.933
Sweden	0.0027	0.027	3.099	6.615	3.282	0.835
Netherlands	0.0014	0.013	3.073	6.418	3.667	0.931
Spain	0.0023	0.016	2.792	5.786	3.883	0.974
Italy	0.0012	0.013	2.854	4.941	3.784	0.975
France	0.0016	0.016	2.544	4.736	3.706	0.932
Denmark	0.0025	0.044	3.313	7.435	3.378	0.819
Greece	0.0012	0.007	3.092	4.793	3.722	0.955
Switzerland	0.0019	0.020	3.168	6.520	3.602	0.903
Belgium	0.0010	0.043	2.898	5.392	3.630	0.931
Czech Rep.	0.0028	0.018	2.840	5.878	3.644	0.977
Poland	0.0024	0.024	2.047	5.257	3.861	0.968
Ireland	0.0001	0.026	3.346	6.293	3.625	0.926

Table 3: The Basic Analysis

Notes: The regression applies the data illustrated in Table 2 using Eq. (26) adjusting for heteroskedasticity with White (1980) standard errors.

	Coefficient	Standard Error	<i>t</i> -statistics
Mean weekly ret, filtered by Risk aversion and GDP			
Constant	0.009	0.001	5.955
Pessimism	-0.002	0.001	-3.253
Doubt	0.001	0.000	2.450
Mean weekly ret, filtered by RRA and GDP			
Constant	0.008	0.002	5.632
Pessimism	-0.002	0.001	-3.032
Doubt	0.001	0.000	2.241
Mean weekly ret, filtered by Risk aversion			
Constant	0.009	0.001	5.894
Pessimism	-0.002	0.001	-3.186
Doubt	0.001	0.000	2.338
Mean weekly ret, filtered by RRA			
Constant	0.009	0.002	5.515
Pessimism	-0.002	0.001	-2.899
Doubt	0.001	0.000	2.014

Figure 1: Simple Correlations of Optimism and Trust

Notes: Using 10-year weekly historical data, the figure displays the moving average of the simple correlations of the returns with optimism and trust.

