Measuring the contribution to systemic risk of sectors in the United States, the UK and Germany using ΔCoVaR

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Abstract

The objective of this paper is to assess the contribution of the financial and non-financial sectors of an economy to systemic risk. To that end, the ΔCoVaR of 10 sectors is estimated for the United States, the UK and Germany using a quantile regression. The estimated ΔCoVaRs of the sectors are subsequently tested for significance and dominance to classify sectors as systemically relevant and to obtain a formal ranking of the sectors in terms of contribution to systemic risk. We divide the observation period from 1999 to 2013 into four sub-periods and determine that sector dominance changes between the sub-periods. We identify a weak link between $\widehat{VaR}$ and $\widehat{\Delta CoVaR}$ and find that $\widehat{\Delta CoVaR}$ increases disproportionately between the periods. Furthermore, we observed that even the collapse of a systemically important institution does not cause main risk indicators to soar when the financial system is stable or at least is considered to be stable. The results support the findings of previous papers that suggest the use of different policy tools or a combination thereof, depending on the phase of systemic risk.

Keywords: Systemic risk, DeltaCoVaR, Quantile regression, Financial stability, Macroprudential policy
JEL Classification: G1, G28, E5

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1. Introduction

Modern economies require a stable financial system to work smoothly and generate economic growth. The manner in which a working financial system can contribute to economic growth (Levine (1997)) can have fatal impacts on the economy, as shown in the financial crisis of 2008. A financial event can impact the real economy through disruptions in the payment system or disorders in credit flows. Moreover, economic activity may be reduced through lower wealth and higher uncertainty in the wake of collapses (Group of Ten (2001)). Schwaab et al. (2011) note that business cycle downturns and financial sector problems have occurred simultaneously, given that the business cycle and financial problems significantly influence each other.

The financial crisis of 2008 showed how trouble in a comparatively small market of the economy can escalate into a serious financial crisis with significant impacts on the entire economy. The recent crisis drove large financial institutions to the brink of bankruptcy. Other large and traditional institutions such as Bear Stearns and Lehman Brothers, whose bankruptcy shook the capital market in the US and around the globe, required government intervention or even collapsed. The intervention of policymakers and central banks had the purpose of protecting the financial system from financial firm failures to prevent systemic risk (Bullard et al. (2009)).

Despite its relevance, no definition of systemic risk is commonly accepted. The European Central Bank defines systemic risk as the risk of financial instability so widespread that it hampers the functioning of a financial system to such an extent that it substantially impacts economic growth and welfare (ECB (2009)).

The Group of Ten (2001) proposes another definition of systemic risk. According to this definition, systemic risk is considered to be the risk that a trigger event causes a loss in confidence or economic value and that problems in the financial system have significant impacts on the real economy. The Group of Ten's definition of systemic risk emphasizes the effects of a systemic financial risk event on the real economy. A financial event is regarded as impacting the real economy through three channels, such as disruptions in the payment system that lead to the illiquidity of firms and disorders in credit flows that lead to fewer investments in opportunities. Third,e economic activity is reduced through lower wealth and higher uncertainty as a consequence of the collapses in asset prices caused by a substantial reduction of the aggregate money supply (Group of Ten (2001)).

Schwarcz (2008) notes that the various definitions of systemic risk share in common a trigger event such as an economic shock or an institutional failure that leads to a series of negative consequences in the economy that may result in institution or market failures or high losses to financial firms and/or a dramatic volatility in financial market prices (Schwarcz (2008)).

Hansen (2013) considers systemic risk to be a risk of dysfunction or a breakdown in financial markets that necessitates monitoring, intervening, and regulating financial markets, whereas Billio et al. (2012) define systemic risk as a number of circumstances that jeopardize the stability of the financial system or the public's confidence in it.

The contribution of the individual financial sectors to systemic risk in the United States and Europe was studied by Bernal et al. (2014), who address the question of whether one particular sector (i.e., the banking, insurance, and financial services sector) is more risky than another and how a shock in one sector spreads to the economy as a whole by using ΔCoVaR as a systemic risk measure.

However, financial institutions and financial markets are affected not only by shocks coming from the financial industry or financial markets but also from real sector shocks (Group of Ten (2001)), a fact that is ignored by Bernal et al. (2014). In addition, the authors solely focus on the United States and the Eurozone as a whole rather than individual countries such as the UK and Germany.

This paper has the objective of extending empirical studies on systemic risk by measuring the systemic risk contribution based on the ΔCoVaR of real economy sectors and the financial sector in the United States, the UK and Germany. Section 2 provides a brief review of systemic risk measures, and the ΔCoVaR approach is described in section 3. Section 4 describes the data and methodology used in this study. The empirical results of the quantile regression for all countries under investigation and the analysis of the $\widehat{VaR} - \widehat{\Delta CoVaR}$ relationship is discussed in section 5. The time variation of $\widehat{\Delta CoVaR}$ for each country and the consequences of shock events on ΔCoVaR are discussed in section 6. Section 7 discusses policy implications, and the study's conclusions are presented in section 8.

2. Measures of Systemic Risk

Schwaab et al. (2011) state that the origin of systemic risk lies in spillover effects at the financial industry level or shocks to financial markets and the macroeconomic framework.

Systemic risk also arises from widespread financial imbalances. Given that these three sources of risk have a simultaneous effect on observed data and avoid incorrect risk attributions, they should be taken into account in measuring financial risk.

In addition, macrofinancial and credit risk conditions should be at the center of assessing systemic risk, given that macroeconomic shocks impact the situation of financial and non-financial companies. Hence, macrofinancial risk factors are systemic and cause cross-sectional dependence between defaults, resulting in default clusters that impact financial stability (Schwaab et al. (2011)).

Many authors have focused on the magnitude that a single financial institution contributes to systemic risk and for this purpose have proposed different methods such as the Systemic Expected Shortfall (SES) indicator, introduced by Acharya et al. (2010), which represents the magnitude of a negative effect that an institution imposes on the system at large. The SES, which is defined as the multiplication of the probability of an aggregate crisis and the loss of an institution conditional on such a crisis, measures the contribution of a single institution to a systemic crisis. That is, the SES depends on the likelihood of a crisis and is related to the Marginal Expected Shortfall (MES) of financial firms and their leverage. The MES is defined as the expected loss of equity per invested dollar in a specific institution given a decrease in the entire market, resulting in a higher MES when the company return is more sensitive to the market return. That is, institutions with the highest MES contribute the most to market decreases. Acharya et al. (2010) find that both components of the SES, the MES and leverage, explain a significant proportion of realized returns between July 2007 and December 2008 and show that equity and CDS data can be applied to estimate a cross-sectional measure of systemic risk (Acharya et al. (2010)).

However, the SES is static and unable to measure systemic risk ex ante, given that it requires data from actual financial crises. An alternative dynamic reduced form estimation of capital shortages is provided by Brownless and Engle (2012), who introduce the SRISK index to measure the systemic risk contribution of a financial firm and the financial system's aggregate overall systemic risk. The index is composed of a firm's leverage, size and MES, which together determine the expected capital shortage that a financial institution would suffer if a systemic event were to occur. Hence, institutions with higher SRISK values are more risky and contribute more to financial sector undercapitalization in a crisis. The components of the SRISK index suggest that information on the equity, MES and debt of a firm are necessary in the computation of SRISK. In doing so, equity and debt can easily be measured, whereas the MES must be estimated based on returns data by

using econometric methods. For this purpose, Brownless and Engle (2012) propose a conditionally heteroskedastic bivariate model that decomposes market and firm equity returns into time-varying volatility, correlation and non-linear tail dependence, and they conclude that volatile and undiversified institutions with respect to the market exhibit a high MES.

Huang et al. (2009) use data on the CDS of financial institutions to derive the probability of default (PD) of individual firms. In constructing their systemic risk measure, called the distress insurance premium (DIP), the second risk parameter, the stock return correlations among financial firms, is estimated based on the co-movements in equity prices. This risk measure represents a hypothetical insurance premium against systemic distress in the financial sector that increases in both the PD and equity return correlations. This approach can be applied to firms with CDS and equity contracts that are publicly tradeable, and it does not rely on accounting or balance sheet information (Huang et al. (2009)).

The DIP and MES quantify the contagion effects from negative extreme events but have the weakness that calculating the DIP includes simulating rare events, whereas the MES is conditional on a rare event and thus is affected by scarce data (Chao et al. (2012)).

The abovementioned risk measures estimate the magnitude of losses that an institution would experience during a market crisis and only capture systemic exposures to the degree that historical data well represent systemic losses. However, during periods of rapid financial innovation, extreme losses in one financial sector need not coincide with simultaneous losses in another financial sector even though their connectedness implies higher systemic risk (Billio et al. (2012)).

With an analysis focused on the spillover effects among financial firms, Adams et al. (2011) suggest state-dependent sensitivity VaR (SDSVaR), which measures the spillover effects, depending on the state of the economy. Using a system of quantile regressions of financial institutions such as commercial banks, investments banks, hedge funds and insurance companies, the authors find a remarkable change in the spillover effects among financial firms from normal periods to volatile times and conclude that different market states must be taken into account to obtain reliable estimates of the spillover effects (Adams et al. (2011)).

Empirical studies on systemic risk measures are based on different data. Some analyses focus on the market equity data and balance sheet data of individual banks (e.g., Adrian and Brunnermeier (2011), López-Espinosa et al. (2012), López-Espinosa et al. (2012a),

Brownless and Engle (2012)), whereas other researchers use equity price data and CDS data (e.g., Huang et al. (2009), Acharya et al. (2010)).

3. The ΔCoVaR Approach

Adrian and Brunnermeier (2011) take a perspective similar to that of Acharya et al. (2010) and Brownlees and Engle (2012); they who capture the degree of contribution of a single institution to the entire financial system with a measure called CoVaR. Adrian and Brunnermeier (2011) interpret the difference between CoVaR conditional on an awkwardly situated financial firm and the CoVaR when the institution is in the median state as the institution's marginal contribution to the entire systemic risk, referred to as ΔCoVaR. That is, ΔCoVaR measures the contribution of a single institution to systemic risk rather than the risk of individual institutions in isolation, enabling regulators to impose stricter rules on institutions with a higher contribution to systemic risk even when their VaRs do not differ from firms with a lower systemic risk contribution. Furthermore, ΔCoVaR accounts for the risk spillovers between institutions across the financial network in that it captures the risk increase of an institution when another firm is in a stressed state. Although GARCH models can be used in estimating ΔCoVaR, Adrian and Brunnermeier (2011) prefer to use quantile regressions based on weekly changes in the market-valued total assets of publicly traded financial firms.

The VaR of institution j conditional on institution's i event $C(X^i)$ is represented by $CoVaR_q^{j|i}$, which is defined by quantile q of the conditional probability distribution, where

$$q = P\left(X^j \le CoVaR_q^{j|C(X^i)} \middle| C(X^i) \right). \quad (1)$$

The CoVaR measures the reis spillover and is the lower the higher the potential loss to the system with a probability q (Roengpitya and Rungcharoenkitkul (2010).

Adrian and Brunnermeier (2011) consider the contribution of a single firm to systemic risk and therefore attribute j to the system and analyse the case when the portfolio return of all financial institutions is at its VaR level. Letting $\hat{X}_q^{system,i}$ denote the predicted value for a quantile conditional on firm i, the qth-quantile is defined as $\hat{X}_q^{system,i} = \hat{\alpha}_q^i + \hat{\beta}_q^i X^i$, and the relationship $VaR_q^{system} \middle| X^i = \hat{X}_q^{system,i}$ is derived from the definition of VaR. In words, the

financial system's VaR conditional on X^i is given by the predicted value from the quantile regression of the system on firm i, given that the conditional quantile is the VaR_q given X^i. The $CoVaR_q^i$ measure is obtained by using a particular value of $X^i = VaR_q^i$, where the CoVaR measure is represented by $CoVaR_q^{system|X^i=VaR_q^i} := VaR_q^{system}\left|VaR_q^i = \hat{\alpha}_q^i + \hat{\beta}_q^i VaR_q^i\right.$.

The $\Delta CoVaR_q^i$ is then calculated by using

$$\Delta CoVaR_q^{j|i} = CoVaR_q^{j|X^i=VaR_q^i} - CoVaR_q^{j|X^i=median^i} \quad (2)$$

which is the difference between j's CoVaR when i is at its VaR level and in its median state. Given that this study is focused on the systemic risk contribution of sectors, i represents a sector instead of a firm or institution, as in Adrian and Brunnermeier (2011).

The ΔCoVaR concept is applied to the empirical study conducted in this work because (i) it can be used to estimate the magnitude negative events within a particular sector that are transmitted to the system and (ii) it is a highly reactive measure of systemic risk due to its reliance on high-frequency financial market data (Bernal et al. (2014)). Furthermore, ΔCoVaR can be used as a measure for ranking financial institutions and gauging the interconnectedness in the financial system (Castro and Ferrari (2014)).

The ΔCoVaR measure has been used to identify and rank systemically important institutions by developing a significance test and a test of dominance, as in Castro and Ferrari (2014), who demonstrate the importance of statistical testing when ΔCoVaR is being used to gauge interconnectedness and rank systematically important financial institutions (SIFIs). By deriving two hypothesis tests and their test statistics within a linear quantile regression framework, Castro and Ferrari (2014) develop a significance test that makes it possible to determine whether a financial firm is systemically important in terms of its contribution to systemic risk and a test of dominance that aims to determine whether one financial firm contributes more to systemic risk than another. They conclude that a larger ΔCoVaR makes a significant contribution to systemic risk more likely but does not necessarily imply that an institution's contribution is significant and that the results of pairwise tests of dominance should also be considered.

Despite its prominence, the ΔCoVaR risk measure has faced critiques in the literature. Danielsson et al. (2011) argue that ΔCoVaR does not bring any advantages to VaR, given that both measures convey a similar signal. Furthermore, it is not possible to identify the

systemically riskier institution (or sector) because the confidence intervals underlying ΔCoVaR estimates are somewhat large (Danielsson et al. (2011)).

In the same vein, Jäger-Ambrożewicz (2013) notes that ΔCoVaR may give rise to an incorrect ranking of systemic risk in the sense that it attributes a lower systemic risk where a higher systemic risk should be detected (Jäger-Ambrożewicz (2013)).

In coping with the absence of a formal test to compare each financial sector's relative contribution, I implement a bootstrap Kolmogorov-Smirnov test that makes it possible to rank the individual financial sectors according to their relative contribution to systemic risk.

The concept of CoVaR is a type of correlation and is therefore a measure of co-dependence that is based on a quantile regression and does not explain by which channel an institution's risk impacts the risk measurement of another institution. The ΔCoVaR is sensitive to changing VaR estimates, which is the reason why institutions with higher changes in portfolio returns seem to contribute more to systemic risk than entities with larger engagements in these investments but fewer changing returns, as Arias et al. (2010) conclude for Colombian financial institutions (Arias et al. (2010)).

As a distribution-based statistical measure, CoVaR is mostly based on equity return data and only measures physical systemic risk. It does not ex ante take the size of an institution into account (Black et al. (2013)).

Boucher et al. (2013) argue that main systemic risk measures are highly sensitive to measurement errors. These authors claim that the systemic rankings are arbitrary and random, and they propose a corrected version of CoVaR that systemically highlights institutions that differ from the non-corrected CoVaR. Hence, the calculation of CoVaR and other systemic risk measures such as the MES and SRISK should also account for model risk (Boucher et al. (2013)).

López-Espinosa et al. (2012a) show that the asymmetric effect of positive and negative shocks to bank balance sheets on the financial system may result in an underestimation of systemic risk when markets are declining. These authors extend the model proposed by Adrian and Brunnermeier (2011)[1] by allowing the functional form that characterizes the conditional quantile of the system to be non-linearly dependent on positive and negative individual returns. That is, the original CoVaR model is supplemented by the terms $\delta_{1,i}X^{-}_{t,\,i}$ and $\delta_{2,i}X^{+}_{t,\,i}$, where $\delta_{1,i}$ and $\delta_{2,i}$ capture the co-movements between the system portfolio and the individual portfolio when it is declining or increasing, represented by $X^{-}_{t,\,i}$ and $X^{+}_{t,\,i}$,

[1] This assumes a linear relationship between system and individual returns.

respectively. Hence, if ($\delta_{1,i}$, $\delta_{2,i}$) > 0, then a sudden individual asset change will non-linearly transmit into the system (López-Espinosa et al. (2012a)).

4. Data and Methodology

The objective of this section is to investigate the contribution of sectors in the economy to systemic risk in the investigated countries. In doing so, the influences of the 10 BIC industry-level sectors on systemic risk are examined and ranked according to their $\widehat{\Delta CoVaR}$.

4.1 Data and sectors

Based on the empirical studies by Bernal et al. (2014), Castro and Ferrari (2014), Bjarnadottir (2012), and Girardi and Ergün (2013), this study has the objective of determining which sectors can be classified as being important to systemic risk and ranking the sectors in accordance with their systemic risk contribution.

The sectors are shown in Table 2. which follows the Industry Classification Benchmark (ICB), categorizing companies into 10 industries, 19 supersectors and 41 sectors, with the financial industry comprising banking, insurance and other financial services.

Following Bernal et al. (2014), Castro and Ferrari (2014) and Girardi and Ergün (2013), national stock market indices are considered as a proxy to represent the system for the countries under investigation. To that end, the S&P 500 index is used for the United States, whereas the FTSE All-Share index is used for the UK. The CDAX index is used as proxy for the system in Germany. From these indices, those companies that belong to the sector under examination are excluded so that shocks to a certain sector do not mechanically affect the index, despite the lack of spillover effects between the sector and the global index. Therefore, the system is represented by so-called ex indices. Given that 10 sectors are considered in this study, there are 10 ex indices, namely, the ex Consumer Goods index, the ex Consumer Services index, the ex Energy index, the ex Financials index, the ex Healthcare index, the ex Industrials index, the ex Technology index, the ex Basic Materials index, the ex Telecommunication index and the ex Utilities index. These indices are obtained from Bloomberg by using the CIX function and are based on ICB.

In addition, economic state variables that represent market states are incorporated into the analysis to estimate the time-varying $CoVaR_t$ and VaR_t at time t, which capture the time-varying dynamics of expected returns and/or the conditional volatility, as in Adrian and

Brunnermeier (2011). In addition, the return of the market portfolio (represented by the equity index returns), the liquidity spread and the yield spread change, which is defined as the difference between the 10-year bond rate and the 3-month bond rate of a country, are included. Furthermore, the credit spread change is incorporated, in addition to the difference between a country's 3-month bond rate in time t and the 3-month bond rate in time t-1, represented by the 3-month T-bill spread variation. Finally, real estate returns and the implied volatility in the stock market, represented by a volatility index, are taken into account. The state variables for the USA are the same as in Adrian and Brunnermeier (2011) and Fan et al. (2013).

Following empirical studies such as those by Adrian and Brunnermeier (2011), Chao et al. (2012), Hautsch et al. (2011) and Bjarnadottir (2012), the volatility index is used instead of the volatility index returns to represent the volatility in the markets. Whaley (2000) considers the VIX as a measure of fear that spikes during turbulent periods. A rise in volatility causes stock prices to fall, and high levels of VIX coincide with high degrees of market turbulence (Whaley (2000)). Other papers argue that the higher uncertainty estimated by VIX leads to a downturn in economic activity and output. Bloom (2009) and Munenzon (2010) find important implications of the VIX levels for all asset class return expectations.

Following Ali (2012), who suggests using VSTOXX when the portfolio is composed of European stocks, given that VSTOXX measures the core European market, here, VIX is only used to gauge uncertainty in the US, whereas for the UK, the FTSE 100 volatility index is considered the most accurate volatility measure. To account for the volatility of each geographical area, the VDAX New index is used for Germany.

The analysis uses daily observations for a time horizon that spans from November 1999 to August 2013, resulting in 3,435 daily observations for the United States and 3,486 for Germany. For the UK, the time period spans from January 2000 to December 2012, leading to 3,244 observations. The stock market indices are summarized in Table 2 for each country under investigation, in addition to the corresponding state variables used in the quantile regression analysis.

In the subsequent analysis, the sample period is divided into four periods, which are referred to as difficult, calm, crisis and the recovery period and defined as follows:

difficult period	8th November 1999 - 30th April 2003
calm period	1st May 2003 - 31st July 2007
crisis period	1st August 2007 - 30th October 2009

recovery period	1st November 2009 - 9th August 2013

Table 1: Definition of periods for US and Germany

The periods are similarly defined for the UK, with the difference that the difficult period begins on 5 January 2000 and the recovery period ends on 31 December 2012.

Insert Table 2 here

4.2 Methodology

The empirical analysis is conducted in a six-step procedure that begins with the τ%-quantile regression:

$$R_t^i = \alpha^i + \gamma^i M_t + \varepsilon_t^i \quad (3)$$

with the daily market return of sector i at time t (R^i_t) as the dependent variable and a vector of state variables M_t, where in this analysis tau is 2.5%[2]. Thus, (3) represents the 2.5%-quantile regression. The error term ε_t^i is assumed to be independent of M_t and iid with a mean 0 and a unit variance. The symbols α^i and γ^i denote the constant and the parameter vector, respectively. The quantile regression can be seen as a linear programming problem which can be solved using linear programming methods such as the simplex algorithm (Koenker and Hallock (2001)). Koenker (2015) proposes to use the Frisch-Newton algorithm for problems with a few thousand observations and a Frisch-Newton algorithm after preprocessing for extremely large problems. We us e the simplex algorithm as fitting method in the quantile regression as our problem is of moderate size.

The estimation of this linear model using a quantile regression provides the coefficients $\widehat{\alpha^i}$ and $\widehat{\gamma^i}$ (ε_t^i is assumed to be 0), which are used in step 2 to compute the predicted τ% VaR for each sector i. That is, the predicted VaR (τ%) of sector i is:

$$\widehat{VaR_t^i} = \widehat{\alpha^i} + \widehat{\gamma^i} M_t \quad (4)$$

with M_t representing the vector of the state variables.

[2] Adrian and Brunnermeier (2011) use a vector of lagged state variables M_{t-1}.

Step 3 models the system returns R_t^{system} as a linear function of state variables M_t and sector return i. Thus,

$$R_t^{system} = \alpha^{system|i} + \beta^{system|i} R_t^i + \gamma^{system|i} M_t + \varepsilon_t^{system|i} \quad (5)$$

with R_t^i as the return of sector index i and a vector of state variables M_t. Again, the employment of the 2.5%-quantile regression provides the estimates of $\alpha^{system|i}$, $\beta^{system|i}$ and $\gamma^{system|i}$.

Step 4 calculates the VaR of the system conditional on a distress in sector i. In doing so, the VaR estimated in step 2 is included in the estimation of $\widehat{CoVaR}_t^{system}$, in addition to the vector of state variables M_t. That is, the coefficients $\widehat{\alpha^{system|i}}$, $\widehat{\beta^{system|i}}$ and $\widehat{\gamma^{system|i}}$ estimated in step 3 are applied and the predicted CoVaR of the system represented by:

$$\widehat{CoVaR}^{system|i} = \hat{\alpha}^{system|i} + \hat{\beta}^{system|i} \widehat{VaR}_t^i + \hat{\gamma}^{system|i} M_t.$$

Adrian and Brunnermeier (2011) define ΔCoVaR as the difference between the system's VaR conditional on a distress in sector i and the VaR of the same system conditional on the normal situation (i.e., the median state) of sector i.

Therefore, step 5 computes the contribution of sector i to systemic risk as the difference between the predicted CoVaR at the τ%-quantile CoVaR and the 50%-quantile CoVaR, which is mathematically expressed as:

$$\widehat{\Delta CoVaR}_t(q)^{system|i} = \widehat{CoVaR}_t(\tau\%)^{system|i} - \widehat{CoVaR}_t(50\%)^{system|i} \quad (6)$$

The 50%-quantile CoVaR is determined by conducting steps 1 to 4 for a 50%-quantile, i.e., by applying the same methodology with τ=0.5. It is important to note that sectors with larger absolute $\widehat{\Delta CoVaR}$ contribute relatively more to systemic risk in turbulent periods.

The ΔCoVaR approach is extended by the Kolmogorov-Smirnov test (KS) based on bootstrapping that makes it possible to check whether a certain sector significantly contributes to systemic risk. This significance test is supplemented by a test of dominance with the objective of evaluating whether a certain sector's contribution to systemic risk is larger than that of another. It is important to note that $\widehat{VaR}$ and $\widehat{\Delta CoVaR}$ denote the predicted values of VaR and ΔCoVaR, which are obtained by applying the procedure

discussed above. However, VaR and ΔCoVaR without the bar only describe the VaR and ΔCoVaR in general. Thus, the subsequent discussion uses the notation with bars to refer to the values of VaR and ΔCoVaR, which were estimated by the author in the context of this study by using the five steps discussed so far. The same applies to CoVaR.

Step 6 has the objective of ranking the sectors with respect to their contribution to systemic risk by testing the significance and stochastic dominance of the $\widehat{\Delta CoVaRs}$ estimated in the previous step. To find a systemically risky sector, whether the $\widehat{\Delta CoVaR}$ conditional on sector i is significantly different from zero is checked by using the bootstrap Kolmogorov-Smirnov test. Abadie (2002) notes that two distributions can be compared testing the hypothesis of equality as well as the first-order or second-order stochastic dominance. Using two empirical distribution functions, the Kolmogorov-Smirnov statistic is a natural way to test the hypothesis of equal distributions and is defined as

$$\hat{D} = \left(\frac{mn}{m+n} \right)^{\frac{1}{2}} \sup_x \left| F_m(\tau) - G_n(\tau) \right| \tag{7}$$

with $F_m(\tau)$ and $G_n(\tau)$ as the 2.5% and 50%-quantile $\widehat{CoVaRs}$ CDFs and sample size m and n (Abadie (2002)). In other words, it is tested whether the CDFs of the 2.5%-quantile $\widehat{CoVaRs}$ and the 50%-quantile $\widehat{CoVaRs}$ are different from each other, where the 50%-quantile $\widehat{CoVaR}$ represents the VaR of the system in a normal situation. Thus, the $\widehat{\Delta CoVaR}$ is tested whether it statistically equals 0, which would suggest that the corresponding sector is not statistically risky. Therefore, the null hypothesis H_0 is:

$$H_0 : \widehat{CoVaR}_t(2.5\%)^{system|i} = \widehat{CoVaR}_t(50\%)^{system|i} \tag{8}$$

and the alternative hypothesis H_1 is:

$$H_1 : \widehat{CoVaR}_t(2.5\%)^{system|i} < \widehat{CoVaR}_t(50\%)^{system|i}. \tag{9}$$

The null hypothesis is rejected if the p-value lies below a significance level of 5%. To obtain a formal ranking of the sectors according to their contribution to systemic risk and to check whether sector i contributes less (i.e., has a smaller $\widehat{\Delta CoVaR}$) to systemic risk than sector j, a dominance test is conducted. In this case, the $\widehat{\Delta CoVaRs}$ related to each sector

are bootstrapped, and the CDFs of two sectors are compared to test whether one sector has a higher systemic risk contribution than another sector.

Using a bootstrap strategy is also supported by Abadie (2002) who notes that the test statistic's asymptotic distributions are in general unknown under the null and proposes a bootstrap strategy to get over this problem.

To determine the alternative hypothesis that both sectors have an equal systemic risk contribution, the following two null hypotheses are tested:

$$H_0 : \widehat{\Delta CoVaR}_t(\alpha)^{system|i} < \widehat{\Delta CoVaR}_t(\alpha)^{system|j} \tag{10}$$

and

$$H_0 : \widehat{\Delta CoVaR}_t(\alpha)^{system|j} < \widehat{\Delta CoVaR}_t(\alpha)^{system|i} \tag{11}$$

That is, it is tested whether sector i contributes less to systemic risk and whether sector j contributes less to systemic risk, which means that the alternative hypothesis

$$H_1 : \widehat{\Delta CoVaR}_t(\alpha)^{system|j} = \widehat{\Delta CoVaR}_t(\alpha)^{system|i} \tag{12}$$

of non-dominance can be accepted if both null hypotheses are rejected (Castro and Ferrari (2014)).

The test statistic for the dominance test equals that for the significance test, with the difference that the CDFs $R_m(x)$ and $S_n(x)$ of the $\widehat{\Delta CoVaR}$ relate to two sectors:

$$\widehat{D^d} = \left(\frac{mn}{m+n}\right)^{\frac{1}{2}} \sup_x \left|R_m(x) - S_n(x)\right| \tag{13}$$

with the sample sizes m and n (Bernal et al. (2014)). Again, the p-value is compared to a significance level α, as discussed above.

Both statistical tests occur in a two-sample treatment control setting where 10,000 bootstraps are performed; these are actually Monte Carlo simulations, which are conducted to ascertain the proper p-value based on the empirical data (Sekhon (2013)).

5. Empirical Results

5.1 Regression results

The results of the 2.5%-quantile regression for the United States are shown in Appendix A, where the state variables defined in Table 2 are regressed on each sector index. The

regression results are presented in one table for each sub-period. The tables consist of four panels that represent the sector index return regressions and the ex sector index returns regressions at the 2.5% and 50%-quantiles. In doing so, the first half of the tables demonstrates the 2.5%-quantile regression results, whereas the second half of the tables shows the regression results at the 50%-quantile.

The volatility index VIX has a negative and significant impact on the 2.5%-quantile sector index returns of all sectors during the difficult period, except for the Basic Materials, Consumer Services, Healthcare and Technology sectors (Table 3). Interestingly, its effect is negative and significant only for the Healthcare, Telecommunication and Technology sectors during the calm period and, except for the Energy and Utilities sectors, affects all sectors significantly during the crisis period, as shown in Table 5. Except for the Healthcare, Utilities, and Energy sectors, the influence of the VIX index remains significant during the recovery period (see Table 6). During the difficult period (Table 3), all sectors are significantly positively affected by the equity returns represented by the S&P500 returns, also revealing the largest coefficient. This observation remains valid for the other periods. The situation is different with regard to the liquidity spread, which only has a significant negative effect on the Consumer Goods, Telecommunication, Technology and Energy sectors during the difficult period and a positive effect on the Financials sector index return when the situation is calm, whereas in the crisis period (Table 5), the 2.5%-quantile Basic Materials, Technology and Energy sector index returns are negatively influenced. When the economy is recovering, Table 6 show that the liquidity spread significantly influences the Consumer Goods and Financials sector index returns, where the effect is negative and positive, respectively. Examining the changes in the T-bill spread and yield spread, we find a significantly negative impact of the yield spread changes on the 2.5%-quantile Telecommunication index sector returns but positive coefficients for the Industrials and Healthcare sectors, whereas changes in the T-bill spread affect the Healthcare and Utilities sector index returns positively and the Telecommunication sector index returns negatively during the difficult period (Table 3).

Furthermore, as shown in Table 4, changes in the T-bill spread and yield spread do not significantly influence the 2.5%-quantile sector index returns during the calm period, except for the Utilities sector index returns, which are negatively affected by the yield spread changes. This observation changes slightly when the economy is in a state of crisis in the sense that changes in the T-bill spread have a significant impact on the returns of the Basic Materials, Consumer Services and Energy sectors, whereas yield

spread changes significantly impact the Consumer Goods, Consumer Services and Telecommunication sector index returns. In contrast to the T-bill spread changes, which do not affect the sector index returns at the 2.5%-quantile during the recovery period, changes in the yield spread have a significant effect on the sector index returns of the Consumer Services, Healthcare and Technology sectors during this period. During the difficult period, credit spread changes significantly influence the Technology sector index returns and the Energy sector index returns, where the effect for the latter sector returns is positive. When the economy is in a calm state, this state variable is related to significant coefficients for the Healthcare and Utilities sector index returns, whereas changes in the credit spread significantly impact the 2.5%-quantile sector index returns of the Basic Materials, Industrials, Consumer Services and Utilities sectors during the period of crisis (Table 5). This significant influence remains with respect to the Consumer Goods and Consumer Services sector index returns during the recovery period, where the influence for the former is negative.

The 2.5%-quantile regression results show a significant effect of real estate returns during the difficult period for five sector index returns; it is negative only for the Technology sector, which is also significantly negatively affected during the calm and crisis periods. During the crisis period, we find significant coefficients for the Financials, Consumer Services, Healthcare and Technology sector index returns, where the effect on the Financials and Consumer Services sectors is positive. During the recovery period, real estate returns significantly negatively impact the sector index returns of the Basic Materials, Healthcare and Technology sectors.

As discussed above, the system returns are approximated by ex sector indices that exclude the sector under investigation to obtain the effect of one particular sector on the system, resulting in 10 ex sector quantile regressions. The state variables are the same as before without the S&P500 returns including the sector i returns.

This similarity is shown in Appendix A for the ex sector 2.5%-quantile index returns, which are affected by real estate returns and the returns of sectors i over all four periods. That is, both state variables have a positive influence on all ex sector 2.5%-quantile index returns over all periods. Excluding the Consumer Services sector, volatility has a negative influence on all ex sector indices during the difficult period, whereas its impact is significantly negative on all ex sector 2.5%-quantile sector returns when the economy is in a crisis state. Excluding the Industrials and Consumer Services sectors, volatility does not

have a significant influence during the calm period, but it affects all ex sector 2.5%-quantile index returns significantly when the financial market is recovering.

During the difficult period, excluding the Financials sector, changes in the liquidity spread have a significant impact on ex sector returns. Table 4 shows the significant coefficients of this state variable for the ex Basic Materials, Financials, Healthcare, Consumer Goods, Technology and Energy sector returns for the calm period, and except for the ex Industrials, Telecommunication, Utilities and Energy sector returns, its significant effect remains during the crisis period. When the financial market is recovering, excluding the Consumer Services sector, the regression results return a significant coefficient (Table 6).

Excluding the Financials and Healthcare sectors, changes in the T-bill spread and the yield spread both significantly influence the ex sector index returns, whereas the yield spread changes alone impact the ex Energy sector index returns only during the difficult period. Similarly, excluding the Consumer Services sector, the ex sector index regression returns a significant T-bill spread variation coefficient for the same period. Both state variables together have a significant coefficient for the ex Consumer Goods sector index returns in a calm state. In addition, the T-bill spread changes significantly affect the ex Healthcare, ex Consumer Services and ex Technology sector index returns, whereas, excluding the Utilities sector, the yield spread changes have a significant positive effect. Running the 2.5%-quantile regression for the crisis period returns insignificant coefficients for the T-bill spread variable except for the ex Utilities, ex Telecommunication, ex Technology, ex Healthcare and ex Energy sector index returns. Furthermore, excluding the Financials, Consumer Goods and Consumer Services sectors, we obtain insignificant coefficients for the yield spread change variable. During the recovery period, only the ex Industrials and ex Consumer Goods sector index returns are significant and positively influenced by T-bill spread changes, whereas, excluding the ex Financials sector index returns, changes in the yield spread are related to significant coefficients. The regression results also show that, during difficult times, excluding the ex Consumer Services sector index returns, the ex sector index returns are significantly affected by credit spread changes. The influence of credit spread changes still exists in calm times with respect to the ex Financials, ex Healthcare, and ex Consumer Goods sector index returns. For the crisis period, excluding the Financials, Consumer Goods, Consumer Services and Energy sectors, the regression results return significant coefficients for the ex sector index returns, whereas during the recovery period, the ex Basic Materials, ex Consumer Goods, ex

Consumer Services, ex Technology, ex Utilities and ex Energy sector index returns are not significantly affected by credit spread changes.

The 50% regression results of the sectors are shown in the second half of the tables shown in Appendix A. In contrast to the 2.5% regression results, volatility has a negative influence only on the Utilities 50%-quantile returns when the economy is in a difficult state, whereas its influence on the Energy and Basic Materials 50%-quantile returns during calm times is significant. When the economy enters a crisis state, the volatility index has a significant impact on the Financials, Healthcare and Utilities 50%-quantile sector index returns. The effect during the recovery period with regard to the Basic Materials, Consumer Services and Telecommunication sector index returns is significant at the 50%-quantile.

The 50%-quantile sector index regressions return a significant coefficient of the liquidity spread with respect to the Telecommunication sector during the difficult state and the Industrials sector when the situation is calm. When the economy is in a stress period, we find a significant impact on the Utilities 50%-quantile sector index returns. The liquidity spread significantly influences the Financials sector index returns at the 50%-quantile when the economy is recovering. Both state variables, equity returns and real estate returns, together have a significant effect on all 50%-quantile sector index returns during the difficult period, except in the case of the Consumer Services and Energy sector index returns, which are significantly influenced by the S&P500 returns only. This observation holds during the calm period, where the 50%-quantile returns are not significantly affected by real estate returns with regard to the Industrials, Healthcare, Telecommunication, Technology and Energy sector index returns. When the financial market is in a crisis situation, both state variables together have significant coefficients on all 50%-quantile sector index returns, except in the case of the Industrials, Consumer Goods and Technology sectors, which are only significantly affected by equity returns. Equity returns affect all 50%-quantile sector index returns significantly at the 1% level during the recovery period, whereas real estate returns have a significant impact on the Financials, Consumer Goods, Telecommunication, Technology, Utilities and Energy sector index returns at the 50%-quantile.

Changes in the T-bill spread affect the Financials and Consumer Goods sector 50%-quantile index returns significantly during difficult times, whereas yield spread changes coefficients are significant with respect to the Financials and Energy sector index returns. When the situation is calm, variations in the T-bill spread significantly affect the Consumer

Goods and Utilities sector index returns at the 50%-quantile, whereas changes in the yield spread significantly influence the Consumer Goods, Technology, Utilities and Energy 50%-quantile sector index returns. In times of the crisis, T-bill spread changes significantly influence the 50%-quantile sector index returns related to Healthcare, whereas changes in the yield spread have a significant effect on the Basic Materials, Healthcare and Energy sector index returns. The significant influence diminishes during the recovery period in the sense that changes in the yield spread solely affect the Financials 50%-quantile sector index returns, whereas changes in the T-bill spread have no significant effect at all.

The 50%-quantile regression returns a significant coefficient for the credit spread change with respect to the Consumer Goods sector index returns during difficult times and for the Consumer Goods and Utilities sector index returns during the calm period. When the financial market is in crisis, credit spread changes significantly affect the 50%-quantile returns related to the Healthcare sector, but its significant effect disappears when the financial market is recovering, and we find no significant effect of this state variable.

The last panel of Table 3 demonstrates that the ex sector 50%-quantile index returns are not significantly influenced by the VIX index during the difficult period when the Industrials, Financials, Utilities and Energy sectors are excluded. Volatility has no significant impact on the ex Energy, ex Basic Materials and ex Industrials 50%-quantile sector index returns when the economy is in a calm state, and its influence remains insignificant during the crisis period with respect to the ex Industrials, ex Healthcare, ex Consumer Goods and ex Technology 50%-quantile sector index returns. Excluding the ex Financials and ex Healthcare sector index returns at the 50%-quantile, the VIX index has a significant effect on all ex sector 50%-quantile index returns when the financial market is recovering. Examining the liquidity spread, we find a significant effect on the ex Technology 50%-quantile sector index returns during the difficult period and a significant impact during the calm period when the Energy sector is excluded. Although the liquidity spread has no significant effect at all in the crisis period, it affects the ex Technology 50%-quantile sector index returns when the financial market is recovering.

During the difficult state, all 50%-quantile ex sector index returns have in common that they are significantly positively influenced by sector i returns and real estate returns. This observation holds for the other periods, except in the case of the ex Financials 50%-quantile sector index returns, which are not significantly affected by real estate returns during the crisis and recovery period. The ex Industrials 50%-quantile sector index returns are not significantly affected by changes in yield spread when the situation is difficult, and

in the calm state, excluding the Basic Materials, Industrials and Technology sectors, we find no significant influence on the 50%-quantile ex sector returns. When the financial market is in a crisis state, excluding the Industrials and Consumer Goods sectors, the regression results at the 50%-quantile return an insignificant coefficient of the yield spread change variable. Changes in the yield spread have a significant impact on all 50%-quantile ex sector index returns during the recovery period. The ex Industrials and ex Technology 50%-quantile sector index returns are not significantly affected by credit spread changes in a difficult state, whereas during the calm period, excluding the Financials and Energy sectors, changes in the credit spread significantly influence the 50%-quantile ex sector index returns. In turbulent times, credit spread changes do not significantly affect the ex Basic Materials, ex Industrials, ex Consumer Services and ex Utilities 50%-quantile sector index returns and have a significant effect only on the ex Basic Materials 50%-quantile sector index returns during the recovery period.

Excluding the Industrials, Consumer Services and Consumer Goods sectors, we find no significant effect of T-bill spread changes on the 50%-quantile ex sector index returns during the difficult period. Changes in the T-bill spread influence the ex Healthcare and ex Utilities sector index returns at the 50%-quantile when the economy is in a calm state, whereas all 50%-quantile ex sector index returns are significantly influenced by variations in the T-bill spread during the crisis period. During the recovery period, the influence of T-bill spread changes is equated in the sense that five of the ten 50%-quantile ex sector index returns are significantly influenced, namely, the 50%-quantile ex sector index returns excluding the Basic Materials, Industrials, Consumer Goods, Consumer Services and Telecommunication sectors.

The regression results for the UK are shown in Tables 7-10 in Appendix B, and those for Germany are shown in Tables 11-14 in Appendix C. The interpretation of the quantile regression results for the UK and Germany follows the same manner as described above for the United States. The regression results contain all state variables of interest. We sequentially eliminate the insignificant state variables and re-run the quantile regressions until only significant explanatory variables remain. The remaining significant variables were used to estimate the $\widehat{\Delta \text{CoVaRs}}$. At the 2.5%-quantile, this method faced no problems, and we obtained only significant coefficients after a number of regressions in

case of the United States and the UK.[3] As shown, excluding the Healthcare, Telecommunication and Energy sectors, the ex sector index regressions return no significance at the 2.5%-quantile during the calm period for Germany (Table 12), and we obtain no significance of the ex Basic Materials 2.5%-quantile sector index returns for the second regression. In these cases the regressions were started with one variable and kept if there was significant at the 10% level. Then, the second variable was added, and the regression was re-run with two significant variables. The insignificant variables were eliminated, and the third variable was added before the regression was re-run with only the significant variables of the previous regression. This procedure was followed until all state variables were included in the quantile regression. Using this method, we obtained significant variables for the remaining ex sector index returns.

The same issue arose for the difficult period of the ex Technology 2.5%-quantile sector returns regression, and the state variables were added to the quantile regression in a stepwise manner, as described above (Table 11). However, we find no significance regarding the ex Healthcare sector index return regressions at the 2.5%-quantile.[4]

5.2 Statistical test results

Following the definition in Adrian and Brunnermeier (2011), ΔCoVaR measures the marginal contribution of a sector to systemic risk. Hence, $\widehat{\Delta \text{CoVaR}}$ is used to assess each sector's contribution to systemic risk in the sense that $\widehat{\Delta \text{CoVaR}} \neq 0$ means that a particular sector is systemically relevant. In doing so, the significance test is conducted under the null hypothesis of equal CDFs of the $\widehat{\text{CoVaR}}$s at the 2.5% and 50%-quantile, i.e., $\widehat{\Delta \text{CoVaR}} = 0$. The resulting bootstrapped p-values of 0.0000 for all US sectors indicate that the null hypothesis could be rejected at the 1% significance level for all periods. Testing for the significance of the examined sectors for the UK and Germany signals that, during all periods, all sectors have a significant impact on the economy, as indicated by the p-values of the bootstrap Kolmogorov-Smirnov test.

The stochastic dominance test tests the null hypothesis that sector i contributes less to systemic risk than sector j. The resulting p-values are shown in a matrix, with the column

[3] At the 1%-quantile, there were no significant coefficients with respect to the Utilities sector index returns for the UK during the calm period

[4] We find that the ex Healthcare sector index returns are significantly influenced at the 5%-quantile by real estate returns if insignificant variables are sequentially eliminated beginning with all state variables.

representing sector i and the line representing sector j. The implication is that the sectors are compared in a pairwise manner in the dominance test (Castro and Ferrari (2014)).

Using a matrix, we observe the p-values of the dominance test, indicating if sector i's ΔCoVaR is smaller than sector j's ΔCoVaR and hence contributes less to the risk of the real economy than sector j. However, in some cases the CoVaR CDFs of two sectors either overlap or are very close to each other, meaning that there is no significant difference between them. Hence, we conclude that there is a non-dominance between the pair under investigation. Given that the $\widehat{\Delta CoVaRs}$ are estimated at the 2.5% quantile, we obtain negative $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$. The subsequent interpretation centres on absolute $\widehat{\Delta CoVaR}$ values, i.e., more negative $\widehat{\Delta CoVaRs}$ are referred to as larger $\widehat{\Delta CoVaRs}$.

Table 15 summarizes the number of dominated sectors per period and the median $\widehat{\Delta CoVaRs}$. for the US. As shown, the dominant sectors differ between periods. That is, in turbulent times, the Consumer Services sector dominates most sectors, indicating its strong effect on systemic risk during such periods, and it is of less systemic relevance during calm and recovering periods. By contrast, the Utilities sector dominates all other sectors during the calm period, and its dominance remains the highest during the crisis period. The Industrials sector represents little contribution to systemic risk, and therefore, it seems to be of little systemic relevance, given that it dominates five sectors only in the difficult period. It is interesting to observe that the Financials sector dominates no sectors during calm and growing periods but only during turbulent periods.

Insert Table 15 here

The scatter plots in Figures 1a-1d in Appendix D graphically represent $\widehat{\Delta CoVaRs}$. and show the link between the sector risk in isolation (VaR) and the sector contribution to systemic risk for the four periods.

Insert Figures 1a-1d here

The $\widehat{\Delta CoVaR}$ and the $\widehat{VaR}$ plotted in the scatter plots represent the median measure over the respective period. Comparing the scatter plots shows that the levels of the median $\widehat{\Delta CoVaR}$ change across periods. In addition, the sectors with the highest (i.e., most negative) $\widehat{\Delta CoVaR}$ differ across periods. That is, the Consumer Services sector reveals the highest $\widehat{\Delta CoVaR}$ in the crisis and difficult periods, whereas its $\widehat{\Delta CoVaR}$ ranks fifth in

the calm period. By contrast, the Telecommunication sector turns out to be the systemically most relevant sector over the recovery period, given that its median $\widehat{\Delta CoVaR}$ is the highest compared to the remaining sectors and has the seventh highest $\widehat{\Delta CoVaR}$ in calm times whereas it ranks ninth in the crisis period. Surprisingly, the systemic risk contribution of the Financials sector is the sixth highest during the crisis period and declines in relation to the other sectors when the situation is recovering. The $\widehat{\Delta CoVaR}$ is even the smallest during the calm period. The systemic risk contribution of the Industrials sector is relatively low over different periods; that is, its $\widehat{\Delta CoVaR}$ is high in terms of the median $\widehat{\Delta CoVaR}$ and compared to the other sectors in the difficult period but low in the crisis and recovery periods and thus can be considered to be of relatively little systemic relevance. The scatter plots all have in common that the dots do not lie on a straight diagonal line, which means that the $\widehat{\Delta CoVaR}$s do not go hand in hand with the $\widehat{VaR}$s, and the $\widehat{\Delta CoVaR} / \widehat{VaR}$ ratios were calculated to underpin the weak link between these measures, as shown in Table 16.

Insert Table 16 here

Values greater than 1 are those where the value of $\widehat{\Delta CoVaR}$ exceeds that of $\widehat{VaR}$, meaning that there is not a one-to-one relationship between them. Hence, a high ratio can be the result of either a high value of $\widehat{\Delta CoVaR}$ and/or a low value of $\widehat{VaR}$. For instance, the Consumer Goods sector reveals the highest ratio during the calm period even though its $\widehat{\Delta CoVaR}$ is only the third lowest due to the low $\widehat{VaR}$. Surprisingly, the Consumer Goods and Technology sectors reveal the highest ratio during the crisis period, given that their $\widehat{\Delta CoVaR}$s increase disproportionately compared to their $\widehat{VaR}$s. During the recovery period, the Financials sector again shows the highest ratio due to the strong decline in $\widehat{VaR}$ relative to the decline of $\widehat{\Delta CoVaR}$. Summarizing the observations of Table 4, we observe that the increases in the $\widehat{\Delta CoVaR}$ between the periods exceed those of the $\widehat{VaR}$ and that the ratios of the sectors change between periods, which means that the degree of externalities seems to change from period to period. These results suggest that, for some sectors, significant externalities that are not taken into account by $\widehat{VaR}$ exist, leading to the weak observed relationship. Our interpretation is consistent with Roengpitya and

Rungcharoenkitkul (2010) who plot the average ΔCoVaRs and average VaRs of Thai banks and conclude that significant externalities may be present.

Examining the UK, Table 17 demonstrates the number of dominated sectors according to the dominance test and the respective median $\widehat{\Delta CoVaR}$. The Financials sector dominates most sectors only in the difficult period and only five sectors in the crisis period, whereas the Utilities sector dominates most sectors in the crisis and the recovery periods. Similar to the results for the US, the value of the median $\widehat{\Delta CoVaR}$ does not necessarily reveal the degree of dominance over other sectors which justifies the application of a statistical dominance test to rank the sectors in accordance with their dominance.

Insert Table 17 here

Figures 2a-2d also show a weak relationship between the $\widehat{\Delta CoVaR}$ of the sectors and their $\widehat{VaR}$s. In contrast to the US, the Financials sector has the largest $\widehat{\Delta CoVaR}$ in the difficult and crisis periods; it remains among the four highest $\widehat{\Delta CoVaR}$s during the calm and recovering periods. The Industrials sector seems to contribute the least to systemic risk during the crisis period, and its contribution remains low during the recovery period.

Insert Figures 2a-2d here

Examining the plots, the levels of the $\widehat{\Delta CoVaR}$ seem to be higher on average in the US, and the $\widehat{\Delta CoVaR} / \widehat{VaR}$ ratios are smaller for the UK during the difficult and calm periods, indicating higher externalities in the US during these periods. This observation holds for the crisis period. The high ratios for the Financials sector in the UK over all periods leads to the conclusion that, for the Financials sector, significant externalities may exist, indicating that this sector is the systemically riskiest sector in the UK (see Table 18).

Insert Table 18 here

Table 19 presents the number of dominated sectors for Germany. The Industrials sector dominates most sectors over all periods except for the crisis period, during which the Utilities sector seems to be systematically risky. The Financials sector contributes more to systemic risk during the difficult and calm periods whereas its contribution drops in the crisis period and remains low thereafter.

Insert Table 19 here

Again, in examining Figures 3a-3d, we observe a weak link between $\widehat{\Delta CoVaR}$ and $\widehat{VaR}$. The Industrials sector reveals a high median $\widehat{\Delta CoVaR}$ in absolute terms during the first two observation periods, whereas its $\widehat{VaR}$ is low compared with the other sectors. This observation also holds for the recovery period, indicating high externalities related to this sector.

Insert Figures 3a-3d here

Table 20 confirms this observation in the sense that the Industrials sector exhibits the highest $\widehat{\Delta CoVaR} / \widehat{VaR}$ ratios over all periods. By contrast, the Consumer Goods sector is related to high $\widehat{VaR}$ values (in three periods, even the highest value) but a low $\widehat{\Delta CoVaR}$ in absolute terms, indicating that this sector may be risky in isolation but contributes little to systemic risk and hence is less risky for the real economy. The ratios presented in Table 20 underpin this observation. Note that the negative ratio for Healthcare during the difficult period arises from the positive $\widehat{VaR}$ value for this period, given that we find no significance at the 2.5% quantile for the system's returns and obtain $\widehat{\Delta CoVaR}$ values of 0. Therefore, the results for the Healthcare sector during the difficult period should be treated with caution.

Insert Table 20 here

The results observed for the cases presented above are consistent with those of Adrian and Brunnermaier (2011) in the sense that there is no one-to-one relationship between $\widehat{\Delta CoVaR}$ and $\widehat{VaR}$ and that low $\widehat{\Delta CoVaR}$ sectors may contribute more to systemic risk. Roengpitya and Rungcharoenkitkul (2010) define systemic risk as micro risk with large macro implications which is akin to the notion of externalities. Given this definition, we interpret that a more systemically important sector can be considered as sector with higher externalities on the system.

6. Changes in ΔCoVaR over Time

Movements in equity markets are accompanied by movements in the daily $\widehat{\Delta CoVaRs}$, as illustrated for each country in Figures 4-6.

Insert Figure 4 here

Insert Figure 5 here

Insert Figure 6 here

All countries under investigation have in common that the period between 2003 and mid-2007 was characterized by relatively low $\widehat{\Delta CoVaRs}$.

The massive change in $\widehat{\Delta CoVaRs}$ that followed the Lehman collapse misleads many people into believing that the financial crisis was caused by the Lehman bankruptcy and the sharp drop in the S&P500 index and that the downturn in output and the massive capital injection to save the financial system would have been avoided if Lehman had been rescued. However, according to Cochrane and Zingales (2009), this belief is not correct because the Lehman failure was only one event that did not occur in isolation from other preceding and subsequent failures, such as the AIG bailout. The main risk indicators, i.e., bank CDS spreads and the Libor-OIS spread, did not soar after the Lehman bankruptcy, but they did in the wake of the TARP (Troubled Asset Relief Program) speeches by Henry Paulson and Ben Bernanke on September 23 and 24 in which they vented that the financial system would be at the brink of a collapse without knowing the reason (Cochrane and Zingales (2009)).

The conclusion of Cochrane and Zingales (2009) permits the conclusion that even the collapse of large financial institutions such as Lehman Brothers need not trigger a widespread financial crisis but that unstable financial conditions play an essential role in acute financial tensions and higher risk levels. These factors are a feature of the 2008 financial crisis and the turmoil in the wake of the sovereign debt crisis that set in in 2010, with Greece at the centre of the crisis. The fear of an uncontrolled default by Greece prompted policymakers to act to avoid financial turmoil and a major crisis. The situation in Greece raised concerns about the ability of banks to suffer losses on Greek bonds and the transmission of the crisis to the European financial sector, which would have increased its instability (Nelson et al. (2011)).

The $\widehat{\Delta CoVaRs}$ did not slump in the aftermath of the devastating earthquake that hit Japan in March 2011, despite the concern that the high public debt to finance the reconstruction could drive Japan into a sovereign debt crisis similar to that in Greece. The negative effects of the earthquake and the nuclear crisis on Japan's economy had a lesser impact on financial markets and global GDP (Nanto et al. (2011)).

The global financial markets were very stable during this period even though the Japanese financial system was surrounded by high uncertainty about future developments such as the European debt crisis. The CoVaR and the MES measure had been decreasing since their highs and rose only temporarily after this event in March 2011. Additionally, in 2011, the Financial Cycle Indices represented by the leading index and the lagging index did not indicate either instability in the Japanese financial system or instability in the near future (BoJ (2012)).

Therefore, it is reasonable to assume that trigger events lead to financial crises if there is instability in the financial system and that Central Banks play an essential role in ensuring a stable financial sector.

Dovern and van Roye (2013) note the quick transmission of financial stress shocks from the US to other countries. Their analysis comprises 20 countries in Asia, America and Europe over a sample period from 1970 to 2012, and the authors compute a cross-country correlation for all countries that shows an increasing correlation over the sample period. This observation indicates rising international financial integration and tendentially more co-moving financial cycles. The respective pairwise correlation between Germany, the UK and the US is high, where US financial stress is generally highly correlated with all other countries, leading to the assumption that the US is a very important source of financial stress in the UK and Germany.

Dovern and van Roye (2013) identify the financial openness of a country as an important factor that explains the differences in exposure to financial stress. It turns out that the degree of financial openness is positively correlated with the correlation of financial stress and that countries such as the UK, the US and Germany reveal a high correlation with other countries' financial stress indices and are highly financially integrated. The correlation of financial stress among countries is time-varying and is particularly strong during episodes of global financial stress (Dovern and van Roye (2013)).

Balakrishnan et al. (2009) note that transmission can occur through common or country-specific channels, depending on country-specific financial and trade linkages as well as

other factors, and they ascribe the co-movement of financial stress indices to the existence of common factors.

We capture the findings of Dovern and van Roye (2013) and assume that the US is an important source of financial stress in an international setting and implement a pooled OLS regression to identify the main drivers of systemic risk contribution measured by $\widehat{\Delta CoVaR}$. In doing so, the individual quarterly median $\widehat{\Delta CoVaR}$s of the sectors are regressed on quarterly observations of independent variables that account for sector-specific and market-related characteristics. Following Borri et al. (2012), the independent variables include VaR, size, leverage, volatility and financial stress. To identify the sources of risk in a more granular manner, we run the pooled OLS for all sectors and for the 6 most dominant and 4 least dominant sectors according to their $\widehat{\Delta CoVaR}$. The weak average correlations indicate that multicollinearity is not a major problem[5]. The correlation between VaR and volatility is high in all cases and has its maximum when the most dominant sectors are considered. In addition, volatility is most correlated with $\widehat{\Delta CoVaR}$, especially when considering the least dominant sectors. On average, the correlation between $\widehat{VaR}$ and $\widehat{\Delta CoVaR}$ is weak, which is consistent with the discussion above. The results of the pooled OLS panel regression are reported in Table 21 with the quarterly median $\widehat{\Delta CoVaR}$ as the dependent variable, where the regression includes robust standard errors. Panel A in Table 21 shows the results for all 10 sectors. All variables included have a significant effect, and the adjusted R^2 is 53.5%. Columns (2) and (4) indicate that the size effect increases when leverage is introduced. Size and leverage seem to strengthen each other, given that both variables together yield a higher coefficient than each variable individually. That is, the introduction of leverage does not contribute much more to the explanation than the $\widehat{VaR}$ and volatility variables alone.

To answer the question why some sectors are systemically more relevant, the 10 sectors are divided into two groups of sectors, where the first group contains the 6 most dominant sectors. The second group consists of the 4 remaining sectors. Leverage has a smaller coefficient than size but seems to have more explanatory power than size, given that leverage has more effect on the adjusted R^2 than size in the most dominant sectors. In none of the scenarios in Panel B does $\widehat{VaR}$ significantly influence the risk contribution of the most dominant sectors. A significant effect of the financial conditions on the most

[5] The correlation matrices are available upon request.

dominant sectors is found to be relatively small in terms of its coefficient but increases the adjusted R^2 by more than 4%. Panel C represents the results for the least dominant sectors, which show a low coefficient of $\widehat{\text{VaR}}$ compared with volatility and size. Again, larger sectors in terms of their book value of equity seem to increase the contribution to systemic risk, whereas leverage does not improve the explanatory power much compared to $\widehat{\text{VaR}}$ and volatility. The ANFCI index has a negative and significant coefficient, indicating a negative relationship between the systemic risk contribution of the least dominant sectors and the financial conditions that is weaker compared to Panels A and B. Brave and Butters (2011) show that financial crises are closely linked to tightness peaks and that financial condition indices contain future economic activity information and are able to forecast GDP growth.

The regression results indicate that the most dominant sectors depend more on financial conditions than the least dominant sectors and are therefore more prone to financial crises. Furthermore, our findings underpin that $\widehat{\text{VaR}}$ seems to play a minor role in explaining $\widehat{\Delta\text{CoVaR}}$. $\widehat{\text{VaR}}$ turns out to have more impact on the least dominant sectors than $\widehat{\Delta\text{CoVaR}}$ has on the most dominant sectors. That is, in Panel A, the regression that includes only volatility yields an adjusted R^2 of 35.9% and an adjusted R^2 of 28.6% when $\widehat{\text{VaR}}$ is the only independent variable. The regression in Panel C yields an adjusted R^2 of 59.9% with $\widehat{\text{VaR}}$ as the only independent variable and an adjusted R^2 of 51.9% when only volatility is included. By contrast, we obtain an adjusted R^2 of 15.9% when VaR is the only explanatory variable for the most dominant sectors and an adjusted R^2 of 26.0% when only volatility is included.

Insert Table 22 here

7. Policy Implications

The recent financial crisis demonstrates the important role played by financial stability and shows that price stability as the primary goal of monetary policy is not a sufficient condition to ensure financial stability. The introduction of macroprudential policy in the wake of the financial crisis has also been led by the insight that a systemic approach is needed to maintain financial stability. Although financial stability is the goal of macroprudential policy tools, monetary policy authorities should bear financial stability in mind (Smets (2014)).

Monetary policy faced severe challenges in the wake of the economic crisis of 2007-2009 and changed monetary policy behaviour during the crisis. Martin and Milas (2013) found that monetary policy in the UK can be described by a simple Taylor rule in the pre-financial crisis period. When the financial crisis set in, the Taylor rule no longer prevailed in the sense that there was no significant link between the policy rate and inflation but a very strong reaction to financial stress measures. Thus, Martin and Milas (2013) distinguished between a no-crisis regime and a financial crisis regime over the period 1992-2010. Although the no-crisis regime was a simple Taylor rule, the interest rate fell sharply during the financial crisis, reflecting the necessity of responding to the crisis. Empirically estimated time-varying monetary policy rules note the changing behaviour of central banks when confronting financial stress.

This reaction is mainly inherent in decreasing policy rates, where the size fluctuates over time and from country to country, for example, as noted by Baxa et al. (2013), who analyse the response of central banks in the US and the UK over a 28-year period. They find an effect of financial stress on the interest rate that is insignificant when financial stress is low but that becomes significant during financial stress. Financial stability concerns account for approximately 50% of the policy rate decline in the UK during the financial crisis, whereas in the US, the majority of the policy rate decrease is driven by low inflation and an output that is below its potential (Baxa et al. (2013)).

The results of Martin and Milas (2013) tell us nothing about the reasons why the monetary policy rules changed, but they seem to be reasonable in light of the recent financial crisis. A crisis is related to a confidence loss, a downturn in asset values and higher volatility, enhancing the demand for money. To satisfy the increased money demand and to avoid high interest rates, central banks adjust the monetary base. If central banks satisfy the increased money demand by adjusting the monetary base, then they avoid shocks to the money demand and prevent dramatic losses in asset values (Goodhart et al. (2011)).

The liberalization of financial markets has increased their pro-cyclicality and their vulnerability to booms and busts. In good times, economic agents accept higher risks or underestimate the risk of their decisions and cause a vicious cycle if they misinterpret the state of the economy. Financial imbalances and systemic risk build up unobserved, leading to a recession when the economy weakens and the cycle turns around. The financial cycle can result in a vicious cycle in the contraction phase, with a rapid and destabilizing downward movement and the materialization of systemic risk. Hence, the

time element of systemic risk is driven by the financial cycle, whose evolution is described by leverage (Frait and Komárková (2011)).

Macroprudential policy aims at achieving greater financial system stability, and it assists in reducing the systemic risk that evolves over the financial cycle by applying regulatory instruments to counteract an exorbitant rise in leverage and credit and growth in asset prices (Reserve Bank of New Zealand (2015)).

Various papers have focused on countercyclical capital buffers as a policy response to reduce the likelihood of a financial crisis rather than considering the role of debt financing that applies not only to banks but also across the financial system. Schoenmaker and Wierts (2015) suggest using the leverage ratio as basis for a maximum debt financing requirement in the system and show that a countercyclical leverage ratio stabilizes the financial cycle. Introducing a minimum leverage ratio prevents the endogenous creation of financial imbalances and dampens the financial cycle. As a consequence of the recent financial crisis, the focus is on the financial system, which strengthens financial shocks as it reveals pro-cyclicality that motivates macroprudential policy tools (Schoenmaker and Wierts (2015)).

Macroprudential policy offers tightening instruments when asset prices or leverage levels are increasing quickly, helping policymakers strengthen the stability of the financial system and weaken the consequences of the downturn (Dunstan (2014)).

Lim et al. (2011) find that countries use credit-, liquidity-, and capital-related macroprudential policies, which are often adjusted countercyclically, to address systemic risk. Further macroprudential tools are, e.g., caps on the loan-to-value (LTV) ratio, caps on the debt-to-income (DTI) ratio, ceilings on credit growth or credit, countercyclical capital requirements and reserve requirements (for a comprehensive list of macroprudential instruments and how they are used, see Lim et al. (2011)). Lim et al. (2011) find that, to a large extent, economic and financial cycle fluctuations and the scope of interconnectedness between financial firms and markets drive systemic risk. Procyclicality can be reduced by using tools such as caps, reserve and countercyclical capital requirements and ceilings on credit growth or credit, where the type of shocks affect the effectiveness of the tools. Using panel regressions, the authors find that capital-related tools such as LTV or DTI caps reduce the procyclicality of leverage whereas credit growth-limiting measures (e.g., ceilings on credit growth) also have an effect on leverage growth, where the procyclical behaviour of leverage and credit growth seems to be dampened by dynamic provisioning (Lim et al. (2011)).

In addition, caps on LTV and DTI ratios can reduce the risks associated with fire-sale dynamics and increase stability (Claessens (2014)).

Financial stability must be included in policy to ensure that macroeconomic stability, even financial imbalances, can evolve under stable price levels. Monetary policy is not appropriate for coping with specific sources of financial imbalances, thus necessitating macroprudential tools that absorb shocks ex post. However, macroprudential policy cannot fully compensate financial imbalances or shocks and faces constraints that attribute a greater role to monetary policy in saving financial stability. However, monetary policy may face constraints such as those that apply to small open economies, raising the demand for macroprudential policies. Executing both policies requires a consideration of the mutual effects, given that it is rarely optimal to compensate for weaknesses in monetary policy through macroprudential policies (IMF (2013)).

The implementation of marcroprudential instruments may foster the efficiency of achieving price stability and improve the likelihood of an unconstrained monetary policy. However, there can be interactions between monetary policy and macroprudential tools that can offset the effects on financial stability. Therefore, both policy areas need to be coordinated (Smets (2014), Dunstan (2014)).

Recent studies suggest that monetary policy and macroprudential policy are somewhat complementary[6]. The need for different policy tools or a combination thereof is influenced by the dimensions and development phases of systemic risk. When systemic risk materializes, the focus is on preventing the escalation of elements of instability and reducing the negative impacts of worsened conditions. For this purpose, countercyclical buffers serve as an important macroprudential instrument. Once a systemic crisis has set in, it may be necessary to implement a range of monetary and macroprudential instruments such as tools for crisis management or built-in stabilizers. Communicating with the financial market to reduce concerns about the stability of the financial sector is also included. In the preventive phase, the target should be constraining the contribution of different sectors to systemic risk by reducing the contributions of sectors or imposing a limit on them (Frait and Komárková (2011)).

Given the empirical results of this paper, it is reasonable to use sectorally adjusted macroprudential instruments to address the financial stability concerns associated with sectors. That is, sectoral tools such as sectoral capital requirements are more appropriate

[6] For example, Bruno et al. (2015) find that macroprudential policies which complement monetary policy are more successful as they contribute to monetary tightening.

than aggregate tools if systemic risk stems from a particular sector and can have an effect on the credit demand-side or the credit supply-side. However, sectoral capital measures may be circumvented and consequently suffer a loss of effectiveness, given that banks could hold more capital than required or debtors could approach non-banks and seek off-balance-sheet solutions (IMF (2013a)). The IMF paper (IMF (2013a)) argues that this risk of circumvention will be mitigated by combining multiple sectoral instruments, improving effectiveness. The study finds that countries actually employ a number of instruments simultaneously, but it also notes the importance of choosing the most effective combination of tools to avoid high costs to financial firms and households (IMF (2013a)).

8. Conclusions

This paper investigates the contribution of sectors in an economy to systemic risk using the ΔCoVaR introduced by Adrian and Brunnermeier (2011). The economies of the United States, the UK and Germany are divided into 10 different sectors. The estimated $\widehat{\Delta\text{CoVaRs}}$ of these sectors are tested for statistical significance and dominance to classify sectors as systemically relevant and to rank the sectors with respect to their systemic risk contribution. The empirical results show that systemic risk is affected by real economy sectors, where the most dominant sectors differ between countries and the state of the economy with respect to statistical dominance.

The movements of $\widehat{\Delta\text{CoVaRs}}$ over time suggest that $\widehat{\Delta\text{CoVaRs}}$ rose remarkably when the financial system was confronted with difficulties and the financial system was considered to be unstable. Hence, even financial shocks or shocks to the real economy need not impact systemic risk if the financial system is stable. The $\widehat{\Delta\text{CoVaRs}}$ of the analysed countries seem to be positively correlated, and we find a weak relationship between the $\widehat{\text{VaR}}$ and $\widehat{\Delta\text{CoVaRs}}$ for all countries and all sub-periods. The $\widehat{\Delta\text{CoVaRs}}$ increase disproportionately compared with their $\widehat{\text{VaRs}}$ between the sub-periods. Surprisingly, the pooled OLS regression for the United States indicates that those sectors which influence systemic risk most over the entire period are not significantly influenced by $\widehat{\text{VaR}}$ in contrast to less dominant sectors. The time element of systemic risk is driven by the financial cycle and macroprudential policy tools help reduce systemic risk which evolves over the financial cycle. Regulators need to be aware of the current state of the economy and adjust their tools accordingly rather than implementing standard aggregate tools if

systemic risk stems from a particular sector and the economic situation changes. The empirical results support the use of sectorally adjusted macroprudential instruments to account for financial stability concerns associated with sectors.

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Variables USA		Variables UK		Variables Germany	
Variable	**Source of Data**	**Variable**	**Source of Data**	**Variable**	**Source of Data**
R: Daily market returns of the sectors and the system		*R: Daily market returns of the sectors and the system*		*R: Daily market returns of the sectors and the system*	
System	S&P 500 index excluded the sector under investigation	System	FTSE All Share index excluded the sector under investigation	System	CDAX index excluded the sector under investigation
Consumer Goods	S&P 500 Consumer Goods Index	Consumer Goods	FTSE ALL-SHARE Cons Goods Index	Consumer Goods	CDAX Consumer Goods Index
Consumer Services	S&P 500 Consumer Services Index	Consumer Services	FTSE ALL-SHARE Cons Services Index	Consumer Services	CDAXConsumer Services Index
Energy	S&P 500 Energy Index	Energy	FTSE ALL-SHARE Oil & Gas Index	Energy	CDAX Energy Index
Financials	S&P 500 Financials Index	Financials	FTSE ALL-SHARE Financials Index	Financials	CDAX Financials Index
Health Care	S&P 500 Health Care Index	Health Care	FTSE ALL-SHARE Health Care Index	Health Care	CDAX Health Care Index
Industrials	S&P 500 Industrials Index	Industrials	FTSE ALL-SHARE Industrials Index	Industrials	CDAX Industrials Index
Information Technology	S&P 500 Information Technology Index	Information Technology	FTSE ALL-SHARE Information Technology Index	Information Technology	CDAX Information Technology Index
Basic Materials	S&P 500 Basic Materials Index	Basic Materials	FTSE ALL-SHARE Basic Materials Index	Basic Materials	CDAX Basic Materials Index
Telecommunications	S&P 500 Telecommunication Index	Telecommunications	FTSE ALL-SHARE Telecomm Index	Telecommunications	CDAX Telecommunications Index
Utilities	S&P 500 Utilities Index	Utilities	FTSE ALL-SHARE Utilities Index	Utilities	CDAX Utilities Industry Index
M: State variables		*M: State variables*		*M: State variables*	
VIX	Volatility index	FTSE100 Volatility Index	Volatility index	VDAX	Volatility index
Liquidity Spread	Difference between the 3-month repo rate and the 3-month T-Bill rate	Liquidity Spread	Difference between the 3-month repo rate and the 3-month UK nominal spot curve	Liquidity Spread	Difference between the 3-month repo rate and the 3-month German bond rate
3-month T-bill spread variation	Difference between the 3-month T-Bill rate in time t and the 3-month T-Bill rate in time t-1	3-month Treasury bill spread variation	Difference between the 3-month UK nominal spot curve in time t and the 3-month UK nominal spot curve in time t-1	3-month T-bill spread variation	Difference between the 3-month German bond rate in time t and the 3-month German bond rate in time t-1
Yield spread change	Difference between the 10-year Treasury Bonds rate and the 3-month T-Bill rate	Yield spread change	Difference between the 10-year Treasury Bonds rate and the 3-month UK nominal spot curve	Yield spread change	Difference between the 10-year German bond rate and the 3-month German bond rate
credit spread change	Difference between the 10-year Macrobond BBB US corporate bonds rate and the 10-year US Treasury Bonds rate	credit spread change	Difference between the 10-year Macrobond BBB UK corporate bonds rate and the 10-year UK Treasury Bonds rate	credit spread change	Difference between the 10-year Macrobond BBB German corporate bonds rate and the 10-year German bond rate
Market return	S&P 500 index return	Market return	FTSE All Share index return	Market return	CDAX index return
Real estate returns	Return generated by the Dow Jones U.S. Real Estate index	Real estate returns	Daily return of the FTSE REITS Index	Real estate returns	Daily returns of DIMAX index interpolated from weekly returns
Period	8/11/1999 – 9/8/2013	Period	5/1/2000 – 31/12/2012	Period	10/11/1999 – 9/8/2013

Table 2: State variables and indices of the considered countries. The 3-month T-bill rate for the UK is not available on a daily basis for the entire time period. For this reason, the 3-month UK nominal spot curve is used as a proxy for the T-bill rate. To be correct, the tables show the 10 industries of the ICB that can be decomposed into supersectors such as banks and Insurance companies. The subsequent analysis considers these industries as sectors so that, in the empirical study below, the industries are referred to as sectors.

	difficult period		calm period		crisis period		recovery period	
	ΔCoVaR	**dominated sectors**	**ΔCoVaR**	**dominated sectors**	**ΔCoVaR**	**dominated sectors**	**ΔCoVaR**	**dominated sectors**
Consumer Services	-2.5037	9	-1.3240	4	-2.1605	7	-1.2466	5
Healthcare	-2.3368	8	-1.4625	7	-2.0548	4	-1.1942	3
Consumer Goods	-2.2647	7	-1.1173	2	-1.9967	3	-1.1088	2
Financials	-2.1869	5	-0.9029	0	-1.9934	4	-1.1230	0
Industrials	-2.1735	5	-1.0563	0	-1.5960	0	-0.9485	0
Basic Materials	-1.8843	4	-1.2682	3	-1.9724	3	-1.2328	5
Telecommunication	-1.6901	2	-1.2068	1	-1.7755	1	-1.3955	7
Technology	-1.6637	2	-1.3474	5	-2.1172	6	-1.0416	1
Energy	-1.4965	1	-1.5078	8	-1.7919	1	-1.2104	3
Utilities	-1.4805	0	-1.6932	9	-2.1331	8	-1.2165	4

Table 15: Number of dominated sectors, the United States. The number of dominated sectors was estimated using the bootstrap Kolmogorov-Smirnov test. The sectors were compared in a pairwise manner and the resulting p-values indicate whether sector i contributes less to systemic risk than sector j. The ordering of the sectors follows the number of dominated sectors during the difficult period. The $\widehat{\Delta CoVaRs}$ represent the median $\widehat{\Delta CoVaRs}$ of the daily $\widehat{\Delta CoVaRs}$ over the sub-period.

	difficult	**calm**	**crisis**	**recovery**
Basic Materials	0.7646	0.9863	0.7090	1.0798
Industrials	1.7943	1.7916	1.4430	1.7725
Financials	1.2641	1.6638	1.5999	2.8490
Consumer Goods	1.2358	2.0731	2.4218	1.8215
Consumer Services	1.4284	1.6129	1.6427	1.4418
Healthcare	0.9778	1.6218	1.5283	1.3072
Telecommunication	0.7103	1.0127	1.1950	1.1279
Technology	0.3754	1.1619	1.7059	0.9525
Utilities	0.7112	1.5534	0.9203	1.1356
Energy	0.4591	0.6888	0.5543	1.0879

Table 16: $\widehat{\Delta CoVaR} / \widehat{VaR}$ ratios per period for the USA. The ratios represent the median $\widehat{\Delta CoVaR}$ divided by the median $\widehat{VaR}$ of the corresponding period.

	difficult period		calm period		crisis period		recovery period	
	ΔCoVaR	**dominated sectors**	**ΔCoVaR**	**dominated sectors**	**ΔCoVaR**	**dominated sectors**	**ΔCoVaR**	**dominated sectors**
Financials	-1.9101	9	-0.9798	5	-2.2330	5	-1.2815	6
Industrials	-1.6745	6	-0.8983	3	-1.3467	0	-1.1190	0
Technology	-1.6701	6	-0.7414	1	-1.8459	4	-1.3444	7
Telecommunication	-1.2658	2	-1.0576	9	-1.5889	2	-1.0259	0
Consumer Goods	-1.3395	2	-0.9068	3	-1.3969	1	-1.1937	4
Utilities	-1.3248	2	-0.9634	5	-1.9582	7	-1.4962	9
Energy	-1.3420	2	-0.6802	0	-1.8527	3	-1.1723	3
Healthcare	-1.1873	0	-0.8659	2	-1.9429	6	-1.3839	6
Consumer Services	-1.1641	0	-1.0379	8	-1.8649	6	-1.1894	3
Basic Materials	-0.9446	0	-1.0186	5	-1.6519	2	-1.1162	2

Table 17: Number of dominated sectors, the United Kingdom. The number of dominated sectors was estimated using the bootstrap Kolmogorov-Smirnov test. The sectors were compared in a pairwise manner and the resulting p-values indicate whether sector i contributes less to systemic risk than sector j. The ordering of the sectors follows the number of dominated sectors during the difficult period.

	difficult	**calm**	**crisis**	**recovery**
Basic Materials	0.4331	0.5887	0.4878	0.6512
Industrials	1.7747	1.4291	1.1963	1.4644
Financials	2.5619	3.0829	2.8992	3.5103
Consumer Goods	0.9477	1.2374	1.0076	1.6342
Consumer Services	1.1328	1.4870	0.8754	1.4321
Healthcare	0.5105	0.7267	1.3020	1.3281
Telecommunication	0.2293	0.5938	0.9842	0.8326
Technology	0.3931	0.6295	0.7878	0.9575
Utilities	0.6334	0.7806	0.8967	1.2254
Energy	0.6308	0.5731	0.9553	1.0729

Table 18: $\widehat{\Delta\text{CoVaR}}/\widehat{\text{VaR}}$ ratios per period for the UK. The ratios represent the median $\widehat{\Delta CoVaR}$ divided by the median $\widehat{VaR}$ of the corresponding period.

	difficult period		calm period		crisis period		recovery period	
	ΔCoVaR	**dominated sectors**	**ΔCoVaR**	**dominated sectors**	**ΔCoVaR**	**dominated sectors**	**ΔCoVaR**	**dominated sectors**
Industrials	-4.8265	8	-2.8232	9	-3.1913	5	-3.1187	7
Basic Materials	-4.2393	7	-1.8566	4	-3.1054	5	-2.8275	6
Financials	-4.2958	7	-2.7062	8	-2.1025	1	-1.5574	1
Telecommunication	-3.8267	6	-1.8140	2	-3.1737	5	-2.5056	3
Utilities	-3.2612	4	-1.8934	2	-3.9654	9	-1.9242	2
Consumer Services	-3.1601	2	-2.3695	6	-1.9851	0	-3.0166	7
Energy	-3.1601	2	-1.2301	0	-2.7889	3	-2.5567	3
Consumer Goods	-3.3117	1	-1.4347	1	-2.1582	1	-1.1365	0
Technology	-2.5490	1	-2.3625	6	-2.8097	3	-3.1472	8
Healthcare	0.1798	0	-1.8399	3	-3.2426	6	-2.6227	5

Table 19: Number of dominated sectors, Germany. The number of dominated sectors was estimated using the bootstrap Kolmogorov-Smirnov test. The sectors were compared in a pairwise manner and the resulting p-values indicate whether sector i contributes less to systemic risk than sector j. The ordering of the sectors follows the number of dominated sectors during the difficult period. The $\widehat{\Delta CoVaRs}$ represent the median $\widehat{\Delta CoVaRs}$ of the daily $\widehat{\Delta CoVaRs}$ over the sub-period.

	difficult	**calm**	**crisis**	**recovery**
Basic Materials	2.2260	1.1876	1.7808	2.7544
Industrials	2.9345	2.9438	2.4845	3.9413
Financials	2.3477	1.3852	0.9795	1.6067
Consumer Goods	0.8263	0.3477	0.3408	0.1919
Consumer Services	0.4984	1.6339	0.9815	3.0184
Healthcare	-0.0329	1.3291	1.6030	2.1157
Telecommunication	0.9070	1.0214	0.9967	1.3456
Technology	0.4652	1.0337	1.5111	2.8997
Utilities	2.1232	1.0811	1.1814	0.7749
Energy	0.5554	0.3357	0.5454	0.7509

Table 20: $\widehat{\Delta\text{CoVaR}}/\widehat{\text{VaR}}$ ratios of per period, Germany. The ratios represent the median $\widehat{\Delta CoVaR}$ divided by the median $\widehat{VaR}$ of the corresponding period.

Panel A: All sectors					
	1	2	3	4	5
Intercept	-0.1783*	-1.6054***	-0.1396	-1.9683***	-2.3156***
VaR	0.1445***	0.0812***	0.1648***	0.1088***	0.1330***
Volatility	-0.5242***	-0.6163***	-0.4964***	-0.5800***	-0.4533***
Size		0.7727***		1.0188***	1.0574***
Leverage			-0.0191***	-0.0450***	-0.0476***
ANFCI					-0.1528***
Observations	540	540	540	540	540
adj. R-squared	0.3924	0.4569	0.4002	0.4968	0.5351
Panel B: Six most dominant sectors					
	1	2	3	4	5
Intercept	-0.3885***	-2.4125***	0.5449***	-1.0372***	-1.5015***
VaR	0.0404	-0.0164	0.0453	0.0048	0.0356
Volatility	-0.5088***	-0.5693***	-0.6014***	-0.6269***	-0.4918***
Size		1.0302***		0.7192***	0.7850***
Leverage			-0.2596***	-0.2126***	-0.1951***
ANFCI					-0.1597***
Observations	324	324	324	324	324
adj. R-squared	0.2624	0.3578	0.3983	0.4393	0.4803
Panel C: Four less dominant sectors					
	1	2	3	4	5
Intercept	0.0483	-0.6772***	0.0722	-2.0952***	-2.2511***
VaR	0.4022***	0.3175***	0.4189***	0.2265***	0.2288***
Volatility	-0.4930***	-0.6155***	-0.4647***	-0.7242***	-0.6785***
Size		0.4563***		1.4288***	1.4558***
Leverage			-0.0129**	-0.0699***	-0.0716***
ANFCI					-0.0554*
Observations	216	216	216	216	216
adj. R-squared	0.6756	0.6951	0.6788	0.7745	0.7741

Table 21: Regression results pooled OLS for the USA over the period from November 1999 to August 2013. The dependent variable is the median $\widehat{\Delta CoVaR}$ of daily $\widehat{\Delta CoVaRs}$ within a quarter t. The independent variables are VaR, volatility, size, leverage and ANFI. VaR is defined as the median of daily 2.5%-$\widehat{VaRs}$ of sector i within quarter t. Size is defined as sector market value at quarter t. Leverage is the average ratio of the total assets to equity in sector i at quarter t and volatility of sector i is the realized volatility calculated from daily squared sector within a quarter following Christiansen et al. (2012). Christiansen et al. (2012) estimate the realized volatility by summing the squared daily returns in month t using $\sum_{d=1}^{M_t} r_{d,t}^2$ with $r_{d,t}$ as the d-th daily return in month t and M_t as the number of trading days during month t. The realized volatility is defined as the log of the square root leading to $RV_t = \ln\sqrt{\sum_{d=1}^{M_t} r_{d,t}^2}$. In our case $r_{d,t}$ is the daily return within quarter t. The ANFI is defined as financial market stress index as provided by Federal Reserve Bank of St. Louis at quarterly frequency. Size and leverage were taken from Bloomberg at quarterly frequency.

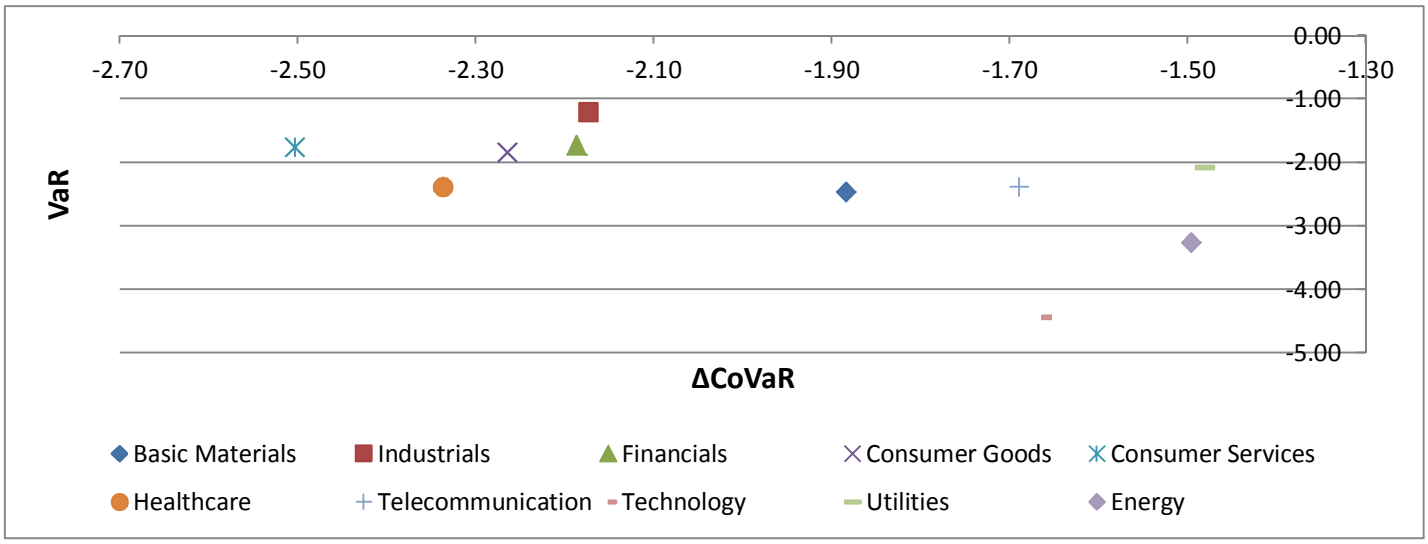

Figure 1a: Scatter plot difficult period, the USA. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the difficult period as defined in Table 1.

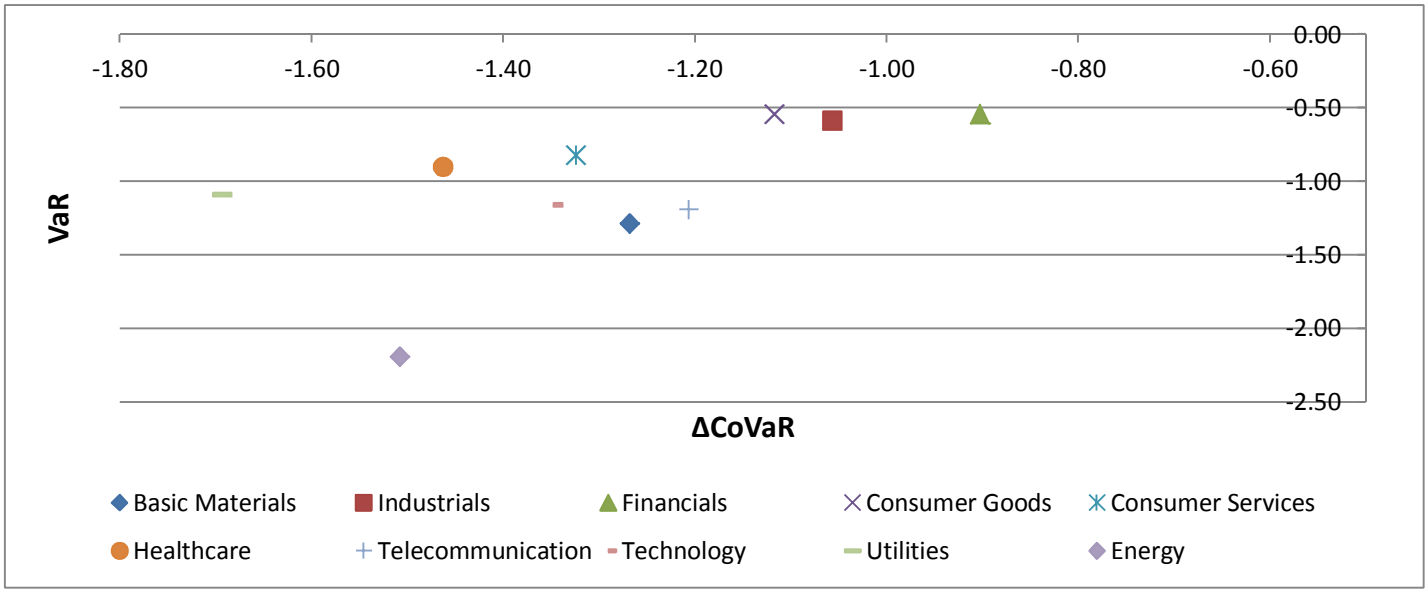

Figure 1b: Scatter plot calm period, the USA. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the calm period as defined in Table 1.

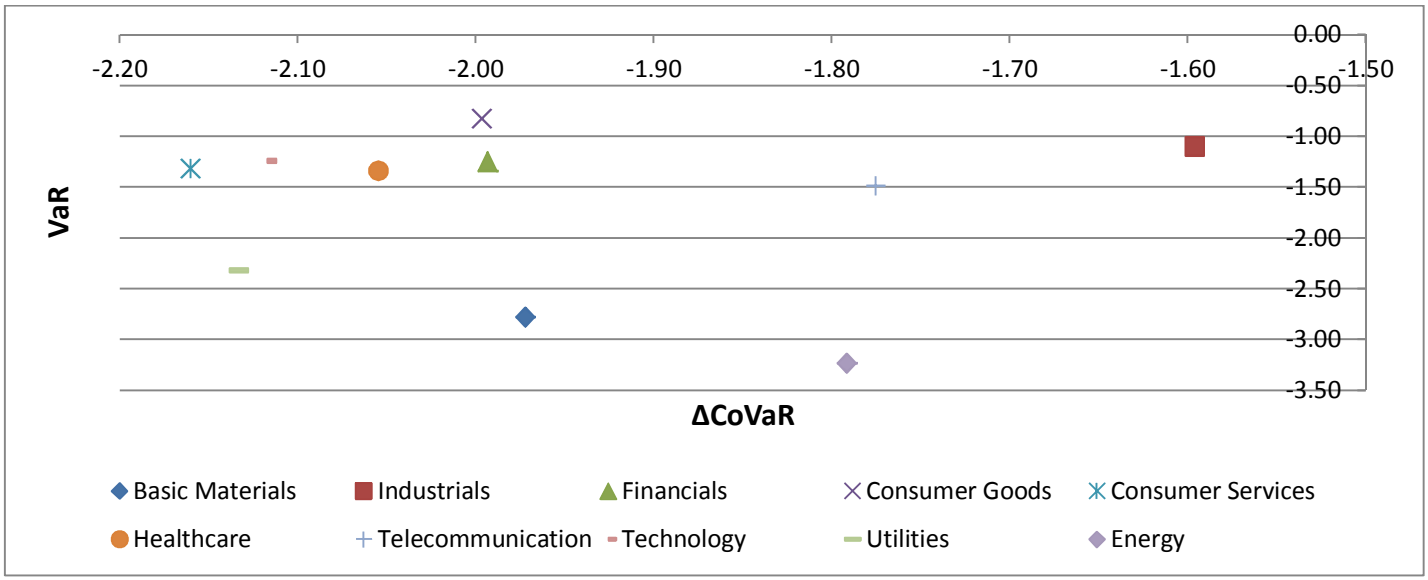

Figure 1c: Scatter plot crisis period, the USA. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the crisis period as defined in Table 1.

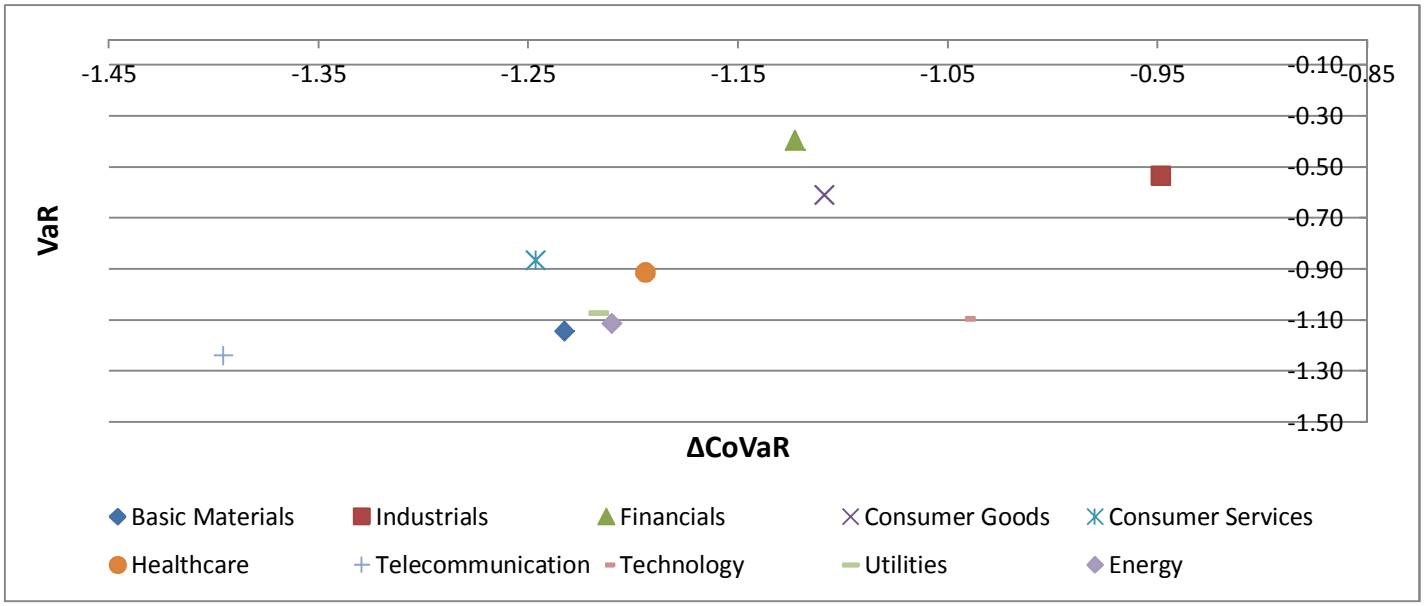

Figure 1d: Scatter plot recovery period, the USA. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the recovery period as defined in Table 1.

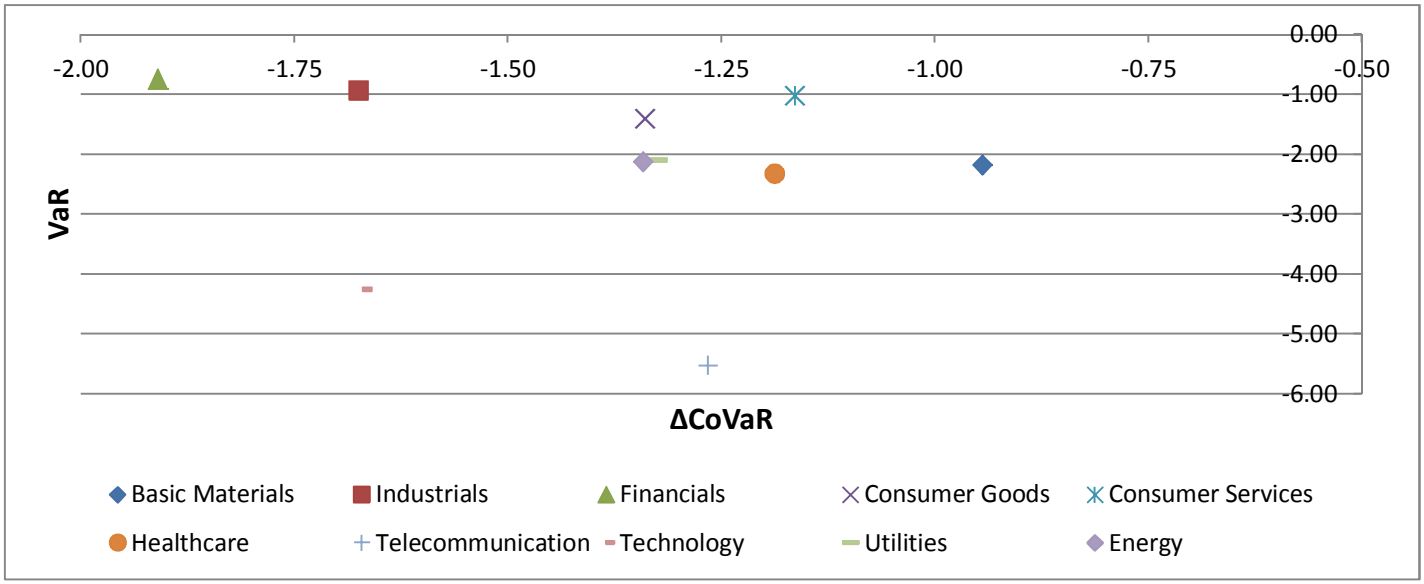

Figure 2a: Scatter plot difficult period, the UK. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the difficult period from January 2000 to April 2003.

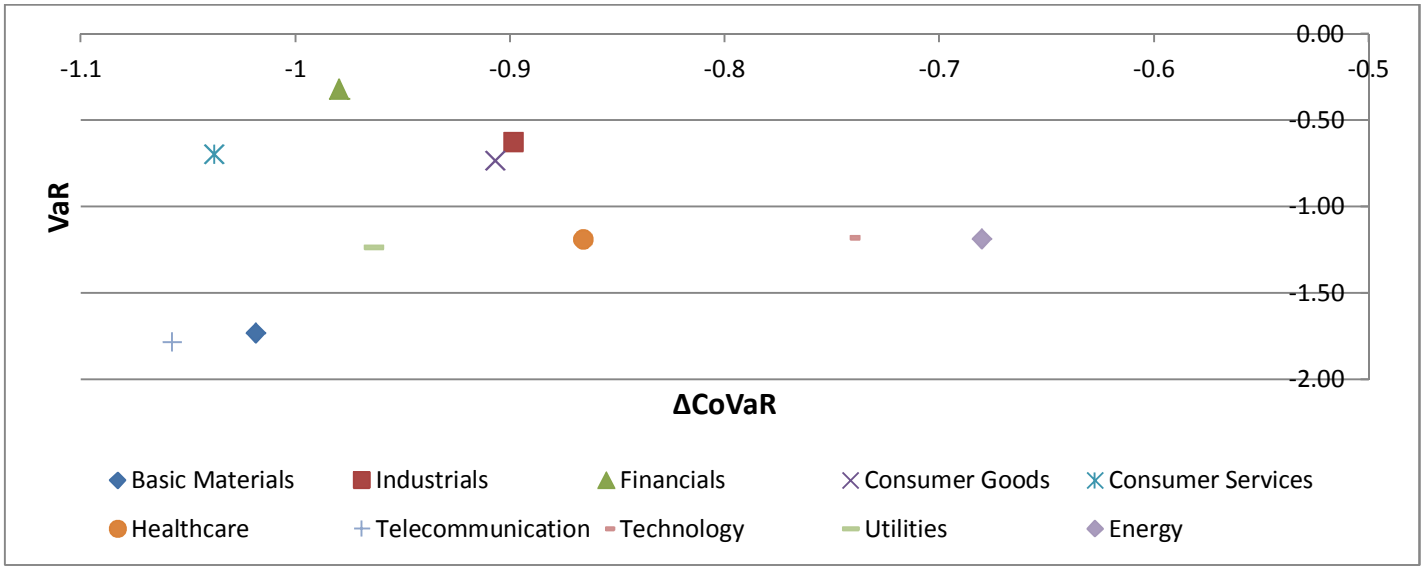

Figure 2b: Scatter plot calm period, the UK. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the calm period from May 2003 to July 2007..

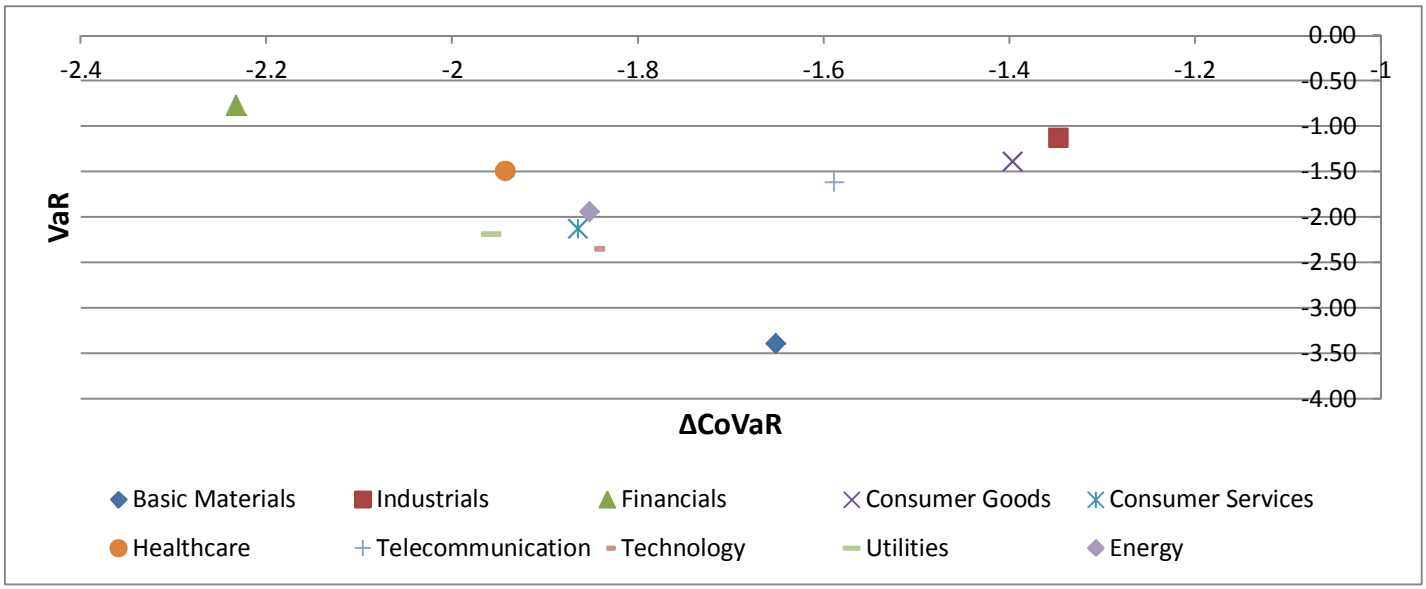

Figure 2c: Scatter plot crisis period, the UK. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the crisis period from August 2007 to October 2009.

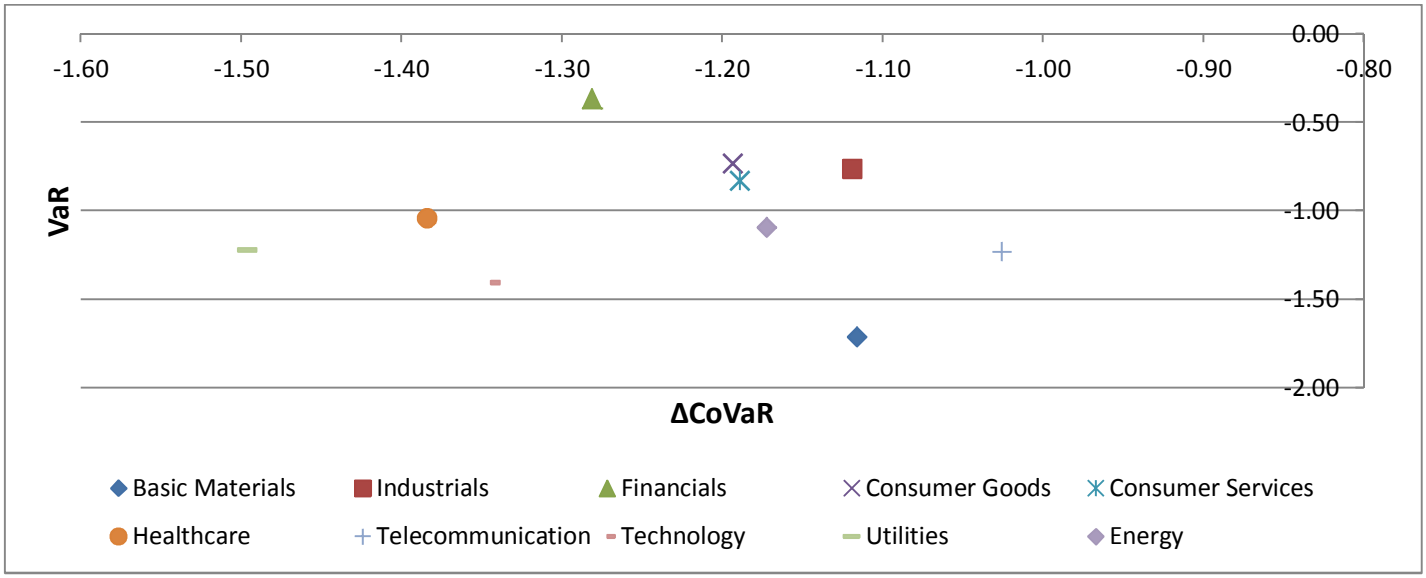

Figure 2d: Scatter plot recovery period, the UK. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the recovery period from November 2009 to December 2012.

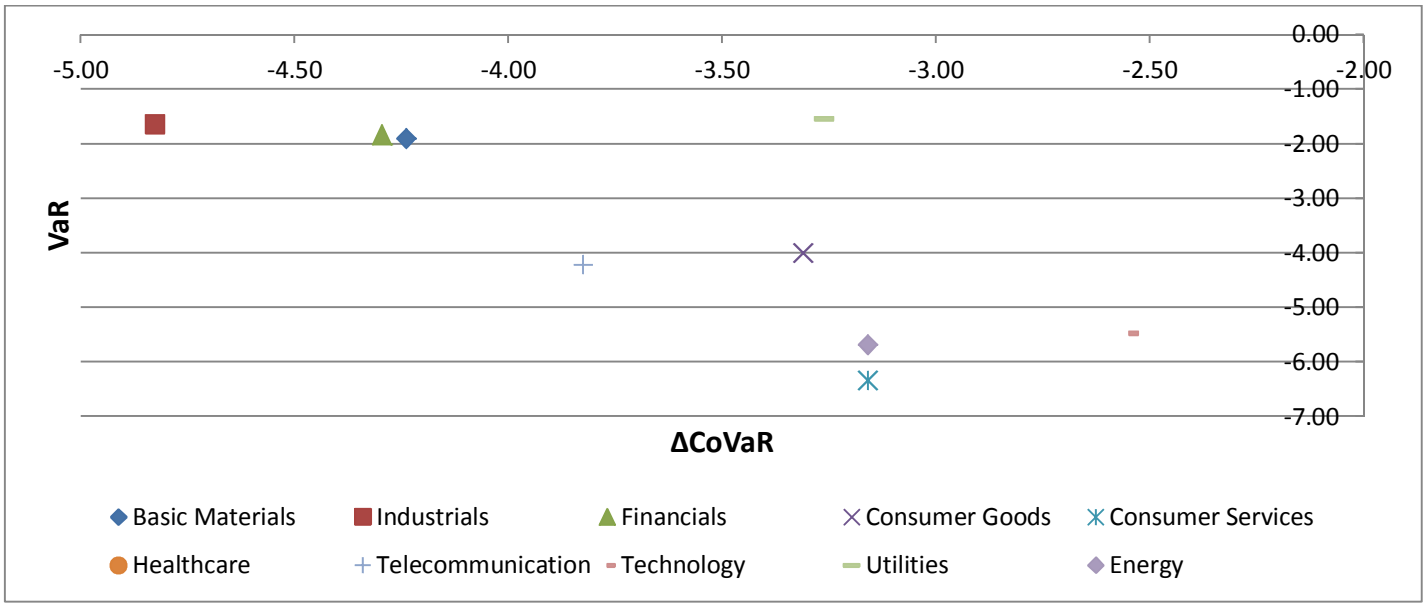

Figure 3a: Scatter plot difficult period, Germany. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the difficult period as defined in Table 1.

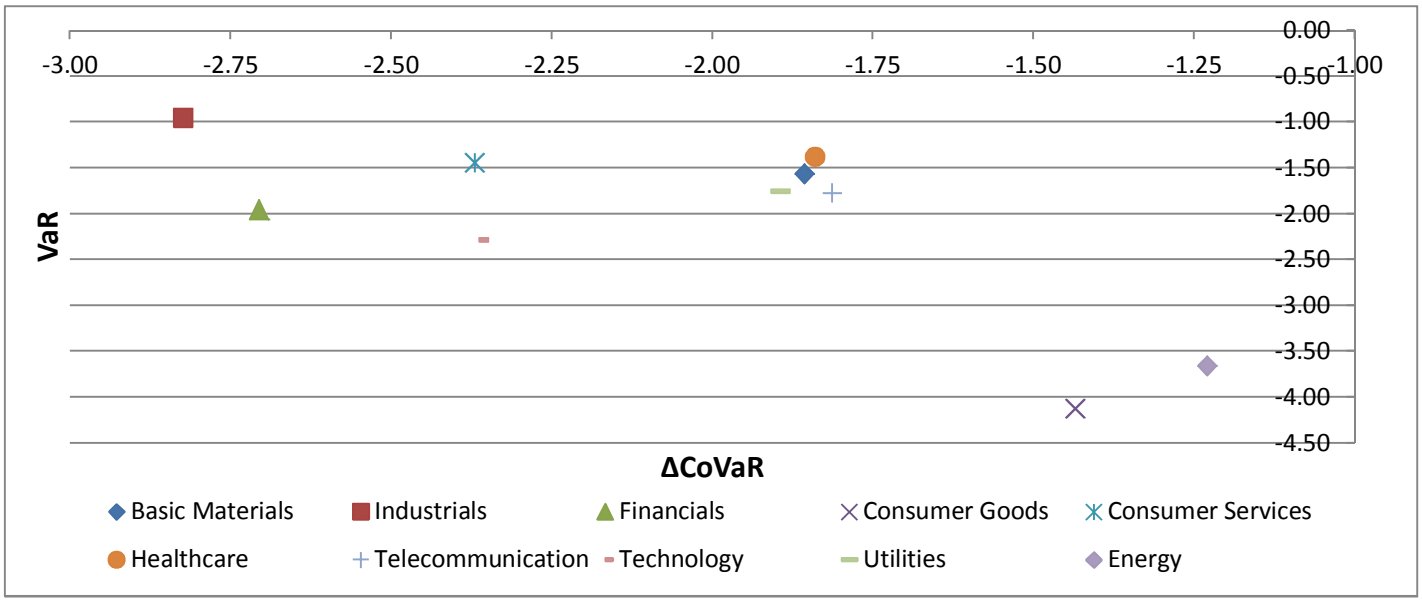

Figure 3b: Scatter plot calm period, Germany. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the calm period as defined in Table 1.

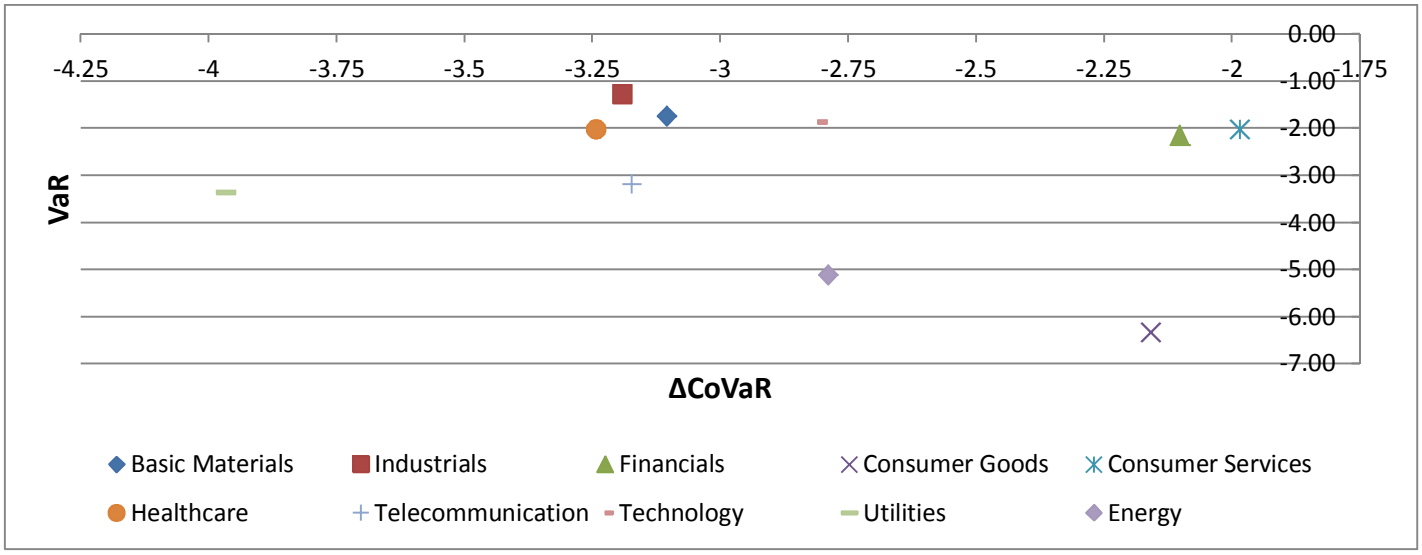

Figure 3c: Scatter plot crisis period, Germany. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the crisis period as defined in Table 1.

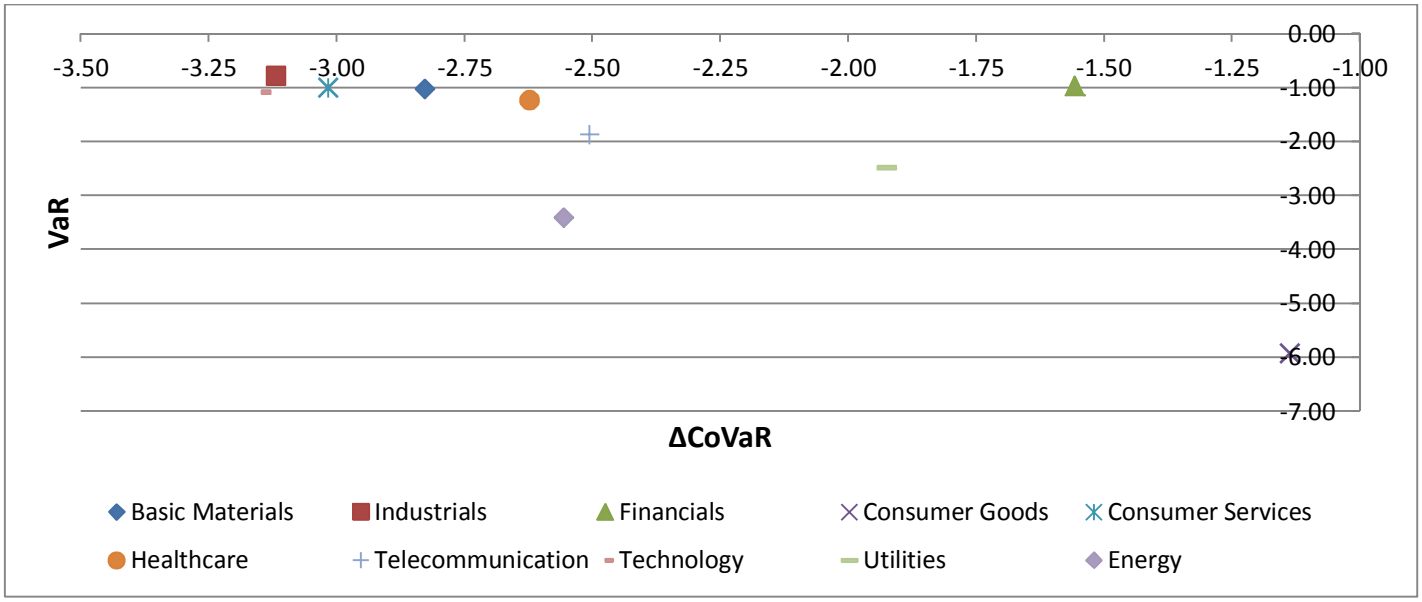

Figure 3d: Scatter plot recovery period Germany. The $\widehat{\Delta CoVaRs}$ and the $\widehat{VaRs}$ represent the median values of the daily $\widehat{\Delta CoVaRs}$ and $\widehat{VaRs}$ over the recovery period as defined in Table 1.

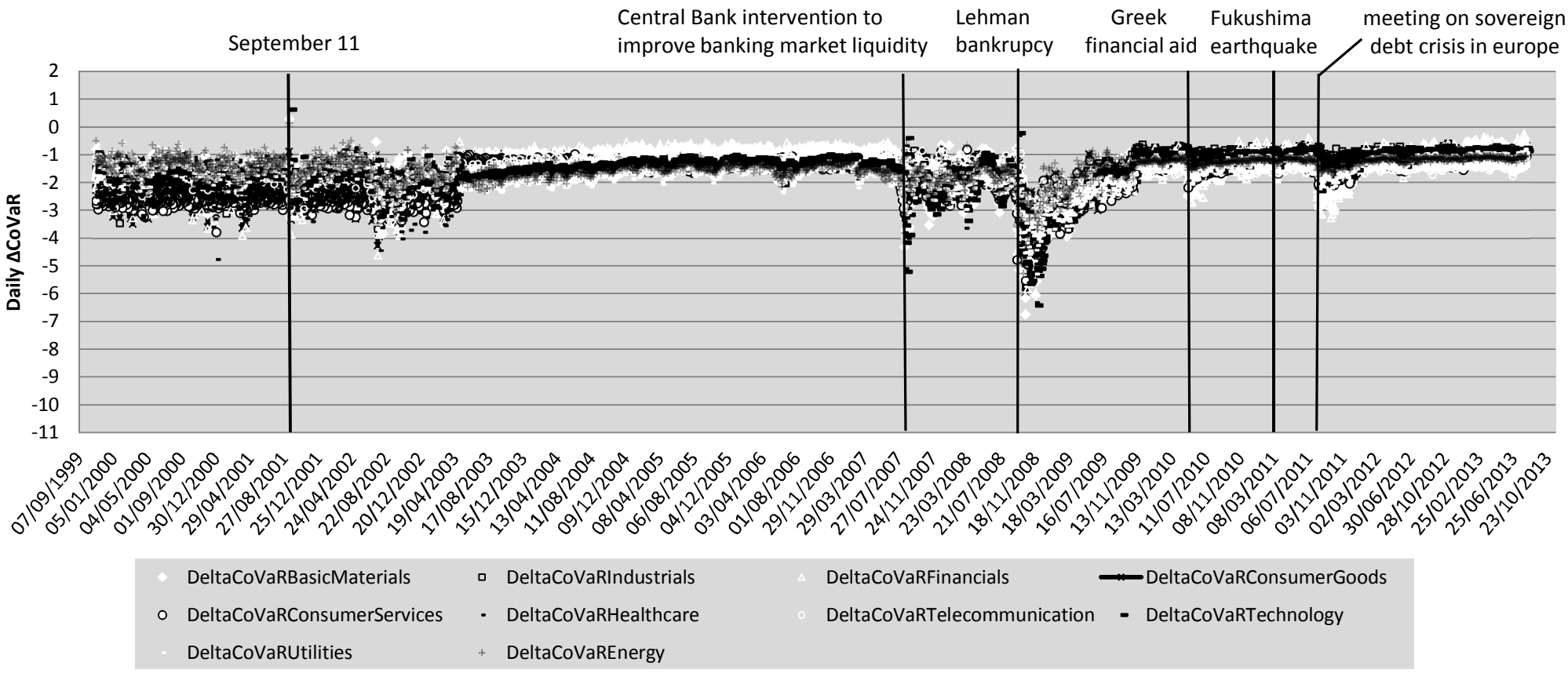

Figure 4: Daily $\widehat{\Delta CoVaRs}$, the United States. The $\widehat{\Delta CoVaRs}$ were estimated individually for each sub-period and were finally put together to generate a history of the $\widehat{\Delta CoVaRs}$ over the entire period from November 1999 to August 2013. The quantile regressions over the entire period generate less accurate $\widehat{\Delta CoVaRs}$ with respect to the $\widehat{\Delta CoVaR}$ differences between the sub-periods.

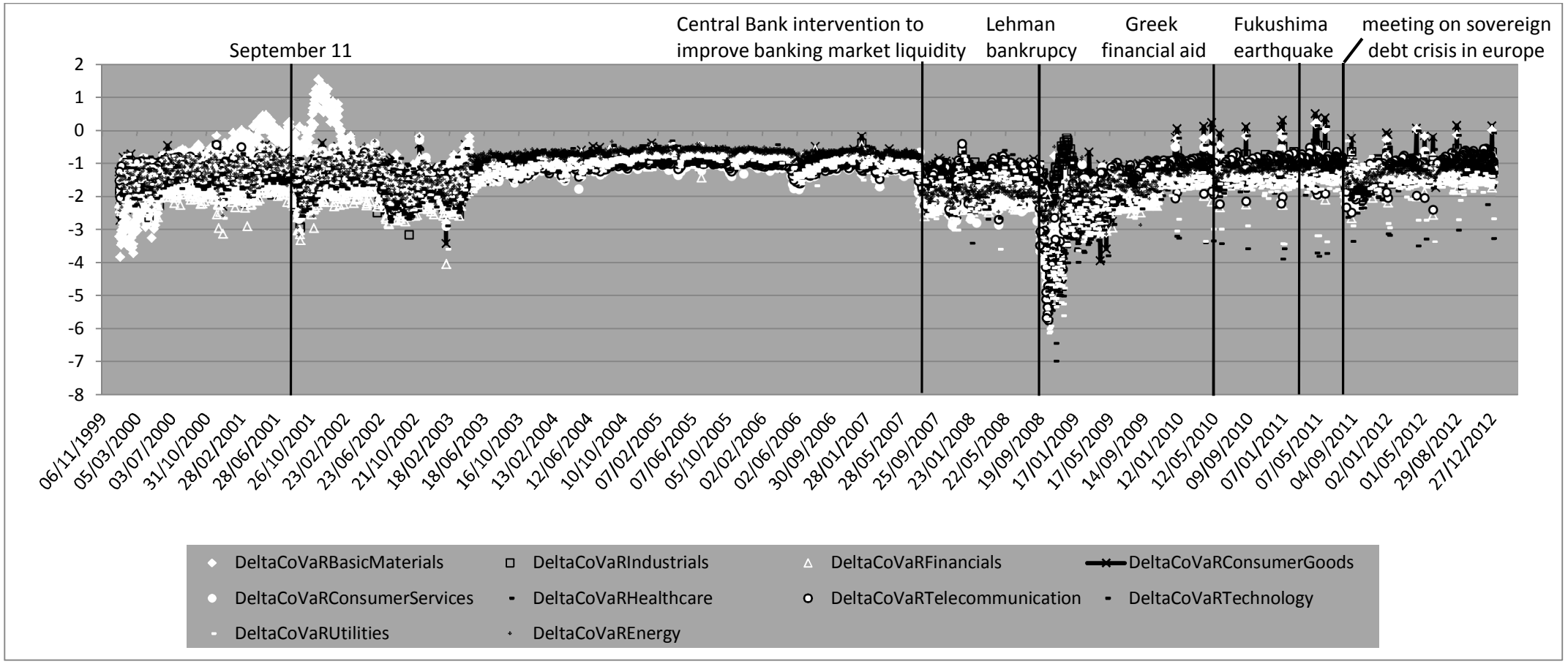

Figure 5: Daily $\widehat{\Delta CoVaRs}$, the United Kingdom. The $\widehat{\Delta CoVaRs}$ were estimated individually for each sub-period and were finally put together to generate a history of the $\widehat{\Delta CoVaRs}$ over the entire period from January 2000 to December 2012. The quantile regressions over the entire period generate less accurate $\widehat{\Delta CoVaRs}$ with respect to the $\widehat{\Delta CoVaR}$ differences between the sub-periods.

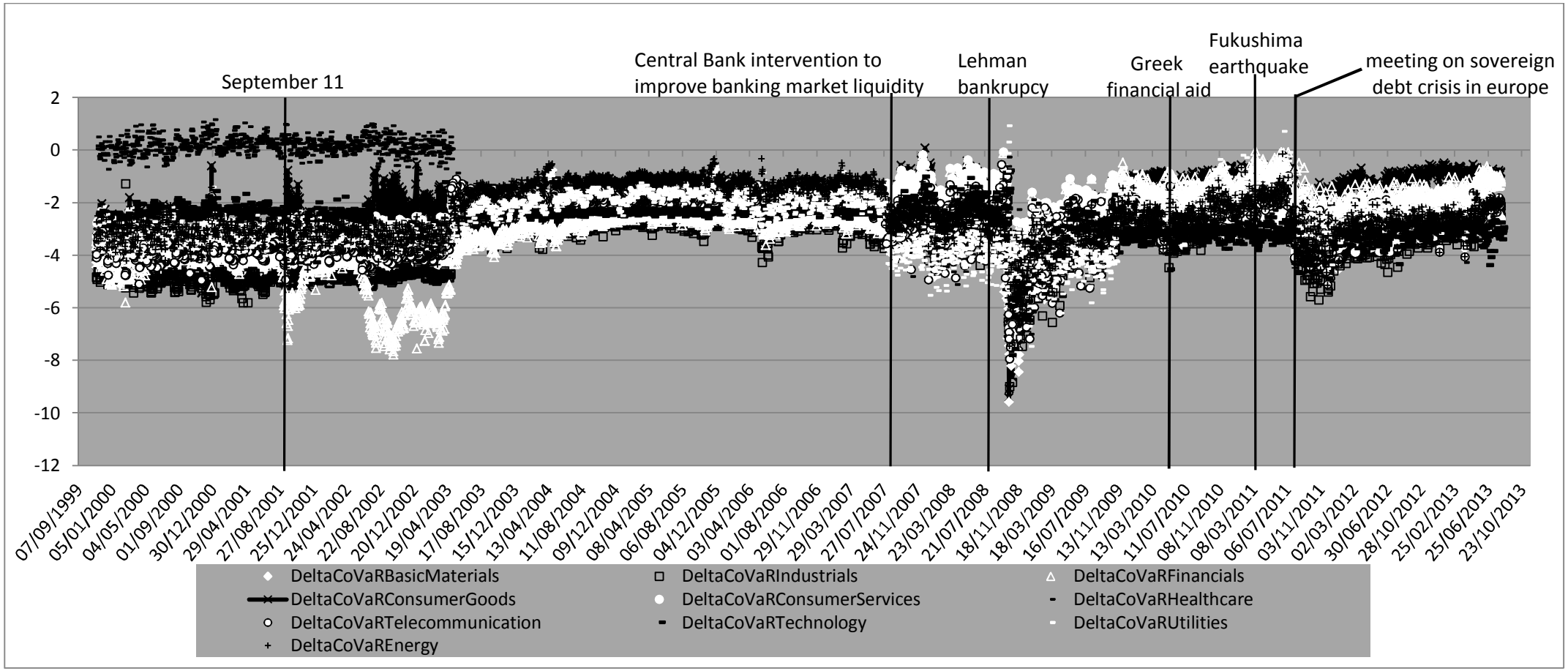

Figure 6: Daily $\widehat{\Delta CoVaRs}$, Germany. The $\widehat{\Delta CoVaRs}$ were estimated individually for each sub-period and were finally put together to generate a history of the $\widehat{\Delta CoVaRs}$ over the entire period from November 1999 to August 2013. The quantile regressions over the entire period generate less accurate $\widehat{\Delta CoVaRs}$ with respect to the $\widehat{\Delta CoVaR}$ differences between the sub-periods.

Appendix A: Regression results USA

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-1.6749	-0.7822	-0.1334	-0.5463	-1.4930	-2.4473	-0.8146	-3.4525	-0.2865	0.7157
	0.1024	*0.0000*	*0.7968*	*0.0886*	*0.0060*	*0.0042*	*0.2784*	*0.0010*	*0.7311*	*0.1071*
VIX	-0.0331	-0.0153	-0.0625	-0.0378	-0.0043	0.0054	-0.0831	-0.0344	-0.0835	-0.1464
	0.3922	*0.0148*	*0.0015*	*0.0019*	*0.8354*	*0.8665*	*0.0035*	*0.3849*	*0.0082*	*0.0000*
Liquidity spread variation	-0.0006	-0.0004	-0.0060	-0.0046	-0.0039	-0.0008	-0.0097	-0.0140	-0.0074	-0.0070
	0.9437	*0.7528*	*0.1348*	*0.0647*	*0.3542*	*0.9034*	*0.0944*	*0.0836*	*0.2490*	*0.0398*
T-bill spread variation	0.0291	0.0022	-0.0307	0.0234	0.0321	0.1461	-0.0709	0.0276	0.0816	-0.0015
	0.5857	*0.7959*	*0.2560*	*0.1614*	*0.2560*	*0.0010*	*0.0703*	*0.6129*	*0.0606*	*0.9490*
Yield spread change	-0.0006	0.0136	-0.0237	-0.0043	-0.0157	0.0675	-0.0654	0.0233	0.0409	-0.0099
	0.9888	*0.0480*	*0.2700*	*0.7492*	*0.4848*	*0.0560*	*0.0359*	*0.5912*	*0.2369*	*0.5920*
Credit spread change	0.0711	0.0180	-0.0299	0.0284	-0.0467	0.0742	-0.0609	-0.1396	0.0838	0.0782
	0.3511	*0.1451*	*0.4375*	*0.2342*	*0.2461*	*0.2417*	*0.2761*	*0.0729*	*0.1770*	*0.0180*
Return S&P 500	0.5352	0.7384	0.8141	0.4860	0.6764	0.4617	0.6795	1.7401	0.2382	0.2954
	0.0018	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0012*	*0.0000*	*0.0000*	*0.0865*	*0.0001*
Return real estate	0.0538	0.1499	0.3037	0.0765	0.2800	0.3427	0.3345	-0.9037	0.4874	-0.0986
	0.8508	*0.0013*	*0.0360*	*0.3927*	*0.0644*	*0.1500*	*0.1112*	*0.0020*	*0.0366*	*0.4264*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.3524	-0.8182	-0.4785	-0.5611	-1.1805	-0.3154	-0.5355	-0.1398	-0.5050	-0.5315
	0.3484	*0.0086*	*0.0214*	*0.3226*	*0.0020*	*0.2568*	*0.3382*	*0.6428*	*0.2031*	*0.0390*
VIX	-0.0549	-0.0201	-0.0487	-0.0447	-0.0147	-0.0511	-0.0487	-0.0552	-0.0572	-0.0503
	0.0001	*0.0867*	*0.0000*	*0.0373*	*0.3082*	*0.0000*	*0.0214*	*0.0000*	*0.0001*	*0.0000*
Liquidity spread variation	-0.0037	-0.0033	-0.0048	-0.0034	-0.0003	-0.0029	0.0001	0.0004	-0.0005	0.0001
	0.2003	*0.1681*	*0.0026*	*0.4311*	*0.9264*	*0.1727*	*0.9844*	*0.8802*	*0.8650*	*0.9798*
T-bill spread variation	0.0101	0.0263	0.0404	-0.0122	0.0383	0.0356	0.0113	0.0183	0.0249	0.0201
	0.6054	*0.1040*	*0.0002*	*0.6794*	*0.0539*	*0.0138*	*0.6957*	*0.2424*	*0.2225*	*0.1312*
Yield spread change	-0.0005	0.0090	0.0271	-0.0160	0.0247	0.0211	0.0078	0.0158	0.0248	0.0195
	0.9738	*0.4827*	*0.0014*	*0.4925*	*0.1143*	*0.0639*	*0.7342*	*0.2034*	*0.1252*	*0.0653*
Credit spread change	-0.1013	-0.0459	-0.0398	-0.1195	0.0005	-0.0384	-0.0756	-0.0428	-0.0977	-0.0930
	0.0003	*0.0470*	*0.0102*	*0.0046*	*0.9853*	*0.0622*	*0.0684*	*0.0568*	*0.0009*	*0.0000*
Return real estate	0.4118	0.3085	0.2510	0.3945	0.4179	0.4064	0.4991	0.3813	0.4636	0.4887
	0.0001	*0.0005*	*0.0000*	*0.0105*	*0.0001*	*0.0000*	*0.0007*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.2004	0.5921	0.2770	0.4304	0.4473	0.2532	0.1515	0.0787	0.1319	0.0614
	0.0001	*0.0000*	*0.0000*	*0.0001*	*0.0000*	*0.0000*	*0.0115*	*0.0000*	*0.0166*	*0.0510*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.0383	0.2017	0.0695	-0.0142	-0.0434	0.1830	-0.0890	-0.2804	0.4963	-0.1594
	0.8681	*0.0723*	*0.6245*	*0.9104*	*0.8184*	*0.3644*	*0.7399*	*0.5372*	*0.0297*	*0.5568*
VIX	0.0026	-0.0060	-0.0023	0.0012	0.0042	-0.0038	0.0008	0.0098	-0.0203	0.0080
	0.7681	*0.1599*	*0.6729*	*0.8086*	*0.5602*	*0.6174*	*0.9337*	*0.5684*	*0.0189*	*0.4358*
Liquidity spread variation	-0.0005	0.0009	0.0003	0.0006	0.0001	0.0015	-0.0064	-0.0029	0.0004	0.0030
	0.7903	*0.3139*	*0.8138*	*0.5577*	*0.9538*	*0.3487*	*0.0019*	*0.4015*	*0.8293*	*0.1553*
T-bill spread variation	0.0109	0.0050	-0.0128	0.0149	0.0053	0.0156	0.0172	-0.0042	-0.0173	0.0054
	0.3652	*0.3885*	*0.0849*	*0.0230*	*0.5904*	*0.1368*	*0.2177*	*0.8600*	*0.1460*	*0.7003*
Yield spread change	0.0069	0.0052	-0.0123	0.0025	0.0010	0.0085	0.0165	0.0067	-0.0035	0.0225
	0.4694	*0.2655*	*0.0375*	*0.6321*	*0.9024*	*0.3079*	*0.1383*	*0.7237*	*0.7136*	*0.0457*
Credit spread change	-0.0082	0.0018	-0.0085	0.0193	0.0033	0.0230	0.0042	-0.0483	0.0104	0.0133
	0.6341	*0.8291*	*0.4193*	*0.0393*	*0.8143*	*0.1261*	*0.8341*	*0.1527*	*0.5410*	*0.5088*
Return S&P 500	0.6614	0.8395	0.8897	0.5825	0.7967	0.6369	0.8088	1.8088	0.3112	0.5256
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	0.3098	0.1389	0.2446	0.1383	0.0515	0.1814	0.1960	-0.2961	0.1810	0.1136
	0.0000	*0.0000*	*0.0000*	*0.0001*	*0.3292*	*0.0013*	*0.0090*	*0.0198*	*0.0046*	*0.1338*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.2316	0.0114	0.2086	0.2368	0.3249	0.2813	0.3301	0.2798	0.2493	0.1460
	0.1675	*0.9373*	*0.2580*	*0.1560*	*0.0139*	*0.1470*	*0.1430*	*0.1096*	*0.2752*	*0.5027*
VIX	-0.0114	-0.0007	-0.0079	-0.0111	-0.0151	-0.0151	-0.0142	-0.0115	-0.0120	-0.0077
	0.0712	*0.9008*	*0.2552*	*0.0788*	*0.0025*	*0.0395*	*0.0954*	*0.0820*	*0.1644*	*0.3509*
Liquidity spread variation	-0.0008	-0.0001	0.0019	0.0004	0.0009	0.0003	0.0029	0.0024	0.0006	0.0001
	0.5573	*0.9478*	*0.1911*	*0.7346*	*0.4017*	*0.8530*	*0.1006*	*0.0808*	*0.7254*	*0.9552*
T-bill spread variation	0.0329	0.0093	0.0272	0.0135	0.0107	0.0228	0.0263	0.0247	0.0382	0.0493
	0.0002	*0.2177*	*0.0043*	*0.1187*	*0.1198*	*0.0237*	*0.0245*	*0.0064*	*0.0012*	*0.0000*
Yield spread change	0.0253	0.0028	0.0233	0.0242	0.0151	0.0266	0.0260	0.0165	0.0363	0.0356
	0.0003	*0.6401*	*0.0020*	*0.0004*	*0.0053*	*0.0008*	*0.0049*	*0.0225*	*0.0001*	*0.0001*
Credit spread change	-0.0267	-0.0128	-0.0325	-0.0343	-0.0215	-0.0313	-0.0363	-0.0046	-0.0432	-0.0301
	0.0320	*0.2367*	*0.0179*	*0.0057*	*0.0288*	*0.0296*	*0.0300*	*0.7261*	*0.0107*	*0.0624*
Return real estate	0.4964	0.1857	0.2801	0.3812	0.3851	0.5216	0.6060	0.6537	0.7159	0.7207
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.4094	0.7795	0.5236	0.7233	0.6506	0.4465	0.2611	0.1308	0.2003	0.2020
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 3: Quantile regression results USA over the difficult period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$.

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-1.2255	-0.5089	-0.5777	-0.4176	-0.9661	-0.5753	0.6808	-0.2969	-0.6703	-2.8564
	0.0044	*0.0223*	*0.0001*	*0.0108*	*0.0087*	*0.0046*	*0.1453*	*0.4481*	*0.0196*	*0.0008*
VIX	-0.0133	-0.0102	-0.0087	-0.0117	0.0014	-0.0288	-0.1337	-0.0924	-0.0282	0.0405
	0.6267	*0.4693*	*0.3574*	*0.2611*	*0.9537*	*0.0259*	*0.0000*	*0.0002*	*0.1225*	*0.4526*
Liquidity spread variation	0.0029	-0.0028	0.0091	-0.0003	0.0066	0.0052	-0.0051	0.0091	-0.0082	0.0050
	0.7270	*0.5123*	*0.0015*	*0.9275*	*0.3452*	*0.1834*	*0.5646*	*0.2213*	*0.1361*	*0.7595*
T-bill spread variation	-0.0266	0.0007	0.0055	-0.0079	0.0030	-0.0124	-0.0343	-0.0280	-0.0171	-0.0363
	0.4016	*0.9650*	*0.6214*	*0.5138*	*0.9123*	*0.4089*	*0.3217*	*0.3342*	*0.4196*	*0.5626*
Yield spread change	-0.0268	0.0077	0.0000	-0.0042	-0.0009	0.0074	-0.0012	0.0133	-0.0297	-0.0141
	0.1378	*0.4112*	*0.9960*	*0.5373*	*0.9527*	*0.3849*	*0.9534*	*0.4194*	*0.0137*	*0.6915*
Credit spread change	-0.0569	-0.0260	0.0023	-0.0164	-0.0071	0.0363	0.0035	-0.0290	-0.0505	-0.0084
	0.2043	*0.2634*	*0.8808*	*0.3375*	*0.8529*	*0.0867*	*0.9424*	*0.4780*	*0.0919*	*0.9248*
Return S&P 500	1.2994	0.9941	0.9118	0.8639	0.8860	1.0674	0.7120	1.5339	0.5045	1.1006
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	0.0610	0.0632	0.1739	0.0655	0.0874	0.0045	-0.0811	-0.1419	0.2798	-0.0294
	0.5113	*0.1892*	*0.0000*	*0.0641*	*0.2722*	*0.9175*	*0.4221*	*0.0937*	*0.0000*	*0.8725*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.3846	-0.3408	-0.2297	-0.3041	-0.5521	0.0826	-0.2330	0.1142	0.2338	-0.3187
	0.0053	*0.0411*	*0.0826*	*0.0000*	*0.0009*	*0.6561*	*0.3853*	*0.4282*	*0.1703*	*0.1495*
VIX	-0.0248	-0.0164	-0.0369	-0.0258	-0.0173	-0.0625	-0.0499	-0.0679	-0.0809	-0.0525
	0.0048	*0.1230*	*0.0000*	*0.0000*	*0.1009*	*0.0000*	*0.0035*	*0.0000*	*0.0000*	*0.0002*
Liquidity spread variation	0.0060	0.0040	-0.0047	0.0037	0.0034	0.0060	0.0049	0.0058	-0.0008	0.0126
	0.0220	*0.2120*	*0.0619*	*0.0037*	*0.2771*	*0.0896*	*0.3438*	*0.0357*	*0.7993*	*0.0028*
T-bill spread variation	0.0102	0.0003	-0.0046	0.0093	-0.0245	0.0269	0.0092	0.0253	0.0129	0.0210
	0.3164	*0.9835*	*0.6364*	*0.0591*	*0.0459*	*0.0501*	*0.6442*	*0.0179*	*0.3086*	*0.1989*
Yield spread change	-0.0013	-0.0009	-0.0028	0.0112	-0.0042	0.0121	0.0098	0.0087	0.0161	0.0121
	0.8176	*0.9002*	*0.6102*	*0.0001*	*0.5498*	*0.1183*	*0.3823*	*0.1512*	*0.0252*	*0.1888*
Credit spread change	-0.0070	0.0069	-0.0568	-0.0221	-0.0220	-0.0335	-0.0159	-0.0016	-0.0183	-0.0140
	0.6240	*0.6922*	*0.0000*	*0.0015*	*0.2056*	*0.0846*	*0.5700*	*0.9178*	*0.3057*	*0.5425*
Return real estate	0.2457	0.1892	0.1369	0.1613	0.3185	0.2504	0.3175	0.2921	0.3024	0.3345
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.4009	0.6351	0.5798	0.7945	0.5248	0.4789	0.2108	0.2863	0.3186	0.2100
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0001*	*0.0000*	*0.0000*	*0.0000*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.4820	0.1476	0.0212	-0.0152	0.0366	0.0860	0.0099	-0.0285	0.1785	0.4193
	0.0026	*0.0373*	*0.6845*	*0.8159*	*0.6744*	*0.3573*	*0.9323*	*0.8548*	*0.0747*	*0.0271*
VIX	-0.0282	-0.0059	-0.0026	0.0026	-0.0027	-0.0036	-0.0002	0.0052	-0.0098	-0.0221
	0.0057	*0.1921*	*0.4360*	*0.5274*	*0.6250*	*0.5439*	*0.9743*	*0.6032*	*0.1225*	*0.0667*
Liquidity spread variation	-0.0022	-0.0029	0.0008	-0.0003	-0.0006	-0.0013	0.0011	-0.0018	-0.0019	0.0004
	0.4789	*0.0312*	*0.4248*	*0.8413*	*0.7429*	*0.4706*	*0.6146*	*0.5537*	*0.3131*	*0.9022*
T-bill spread variation	0.0032	-0.0004	0.0024	-0.0084	0.0035	-0.0088	-0.0111	0.0019	-0.0143	0.0014
	0.7899	*0.9351*	*0.5374*	*0.0828*	*0.5844*	*0.2018*	*0.2016*	*0.8679*	*0.0539*	*0.9222*
Yield spread change	0.0097	0.0019	0.0021	-0.0083	0.0049	-0.0018	-0.0053	0.0179	-0.0303	-0.0217
	0.1508	*0.5304*	*0.3487*	*0.0026*	*0.1773*	*0.6422*	*0.2804*	*0.0062*	*0.0000*	*0.0064*
Credit spread change	-0.0070	-0.0120	0.0020	-0.0183	-0.0090	-0.0039	-0.0132	0.0045	-0.0309	-0.0111
	0.6761	*0.1047*	*0.7134*	*0.0074*	*0.3238*	*0.6919*	*0.2797*	*0.7828*	*0.0031*	*0.5756*
Return S&P 500	1.1242	1.0473	0.8481	0.8250	0.8343	0.8945	0.7262	1.3500	0.5615	0.9625
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	0.0923	0.0186	0.1943	0.0706	0.0503	0.0199	0.0265	-0.0088	0.1880	-0.0280
	0.0077	*0.2244*	*0.0000*	*0.0000*	*0.0077*	*0.3250*	*0.2948*	*0.7948*	*0.0000*	*0.4940*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.0376	0.0446	0.1486	0.1749	0.1801	0.1627	0.2419	0.2433	0.2350	0.1205
	0.6565	*0.4848*	*0.0208*	*0.0089*	*0.0221*	*0.0761*	*0.0167*	*0.0033*	*0.0097*	*0.2463*
VIX	-0.0017	-0.0042	-0.0072	-0.0124	-0.0115	-0.0126	-0.0166	-0.0157	-0.0141	-0.0090
	0.7490	*0.3014*	*0.0773*	*0.0035*	*0.0217*	*0.0303*	*0.0097*	*0.0029*	*0.0143*	*0.1728*
Liquidity spread variation	0.0004	0.0011	0.0004	0.0004	0.0022	0.0019	0.0014	0.0003	0.0001	0.0038
	0.7956	*0.3804*	*0.7533*	*0.7303*	*0.1485*	*0.2774*	*0.4841*	*0.8371*	*0.9589*	*0.0551*
T-bill spread variation	-0.0066	-0.0054	-0.0075	0.0033	-0.0094	0.0130	0.0001	-0.0007	0.0111	0.0016
	0.2938	*0.2551*	*0.1131*	*0.5113*	*0.1059*	*0.0554*	*0.9943*	*0.9145*	*0.0978*	*0.8330*
Yield spread change	0.0010	-0.0027	0.0054	0.0113	0.0064	0.0096	0.0094	0.0032	0.0218	0.0142
	0.7790	*0.3164*	*0.0447*	*0.0001*	*0.0535*	*0.0120*	*0.0258*	*0.3629*	*0.0000*	*0.0011*
Credit spread change	-0.0126	-0.0032	-0.0172	0.0064	0.0026	-0.0055	-0.0086	-0.0098	-0.0061	-0.0278
	0.1519	*0.6327*	*0.0103*	*0.3615*	*0.7511*	*0.5698*	*0.4156*	*0.2581*	*0.5231*	*0.0104*
Return real estate	0.2331	0.1433	0.0337	0.1194	0.2269	0.2688	0.3722	0.2892	0.2897	0.4143
	0.0000	*0.0000*	*0.0260*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.3980	0.7056	0.7520	0.8570	0.6080	0.5779	0.3451	0.2958	0.3778	0.1549
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 4: Quantile regression results USA over the calm period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$.

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.4955	0.0866	-0.1603	-0.5053	-0.5736	0.0952	-0.9704	-0.5796	-1.3814	-1.6376
	0.2928	*0.8042*	*0.6224*	*0.0231*	*0.0000*	*0.6647*	*0.0000*	*0.0335*	*0.0139*	*0.0391*
VIX	-0.0896	-0.0451	-0.0514	-0.0205	-0.0339	-0.0511	-0.0269	-0.0294	-0.0225	-0.0344
	0.0000	*0.0000*	*0.0000*	*0.0010*	*0.0000*	*0.0000*	*0.0000*	*0.0001*	*0.1503*	*0.1206*
Liquidity spread variation	-0.0318	-0.0031	0.0007	0.0014	0.0053	-0.0035	0.0074	-0.0107	-0.0006	-0.0289
	0.0000	*0.5272*	*0.8738*	*0.6505*	*0.0024*	*0.2619*	*0.0008*	*0.0054*	*0.9394*	*0.0098*
T-bill spread variation	-0.0800	-0.0220	0.0270	-0.0069	-0.0111	-0.0157	0.0077	-0.0198	-0.0224	-0.0917
	0.0016	*0.2394*	*0.1210*	*0.5626*	*0.0902*	*0.1809*	*0.3524*	*0.1748*	*0.4557*	*0.0308*
Yield spread change	-0.0161	-0.0062	0.0094	-0.0163	-0.0225	-0.0120	-0.0119	-0.0171	-0.0046	-0.0330
	0.4236	*0.6756*	*0.5001*	*0.0856*	*0.0000*	*0.1993*	*0.0723*	*0.1425*	*0.8469*	*0.3293*
Credit spread change	-0.0835	-0.0596	-0.0124	-0.0170	-0.0192	0.0054	0.0055	-0.0203	-0.0760	-0.0972
	0.0189	*0.0238*	*0.6121*	*0.3078*	*0.0382*	*0.7431*	*0.6358*	*0.3215*	*0.0719*	*0.1036*
Return S&P 500	1.2113	0.8928	0.7989	0.6919	0.6578	0.8192	0.8657	1.0717	0.6376	1.4315
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0011*	*0.0000*
Return real estate	-0.0431	-0.0059	0.4312	0.0540	0.1373	-0.0902	-0.0034	-0.0810	-0.0326	-0.1576
	0.5511	*0.9122*	*0.0000*	*0.1134*	*0.0000*	*0.0077*	*0.8877*	*0.0531*	*0.7051*	*0.1956*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.0622	-0.0852	0.3137	-0.6986	-0.3812	-0.0700	-0.3066	-0.0236	0.0619	-0.1770
	0.8004	*0.5634*	*0.0792*	*0.0000*	*0.0211*	*0.7070*	*0.4269*	*0.8902*	*0.8003*	*0.5474*
VIX	-0.0366	-0.0296	-0.0605	-0.0189	-0.0320	-0.0497	-0.0364	-0.0434	-0.0582	-0.0419
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0008*	*0.0000*	*0.0000*	*0.0000*
Liquidity spread variation	-0.0061	-0.0026	-0.0101	-0.0040	-0.0070	-0.0069	-0.0005	-0.0068	0.0032	-0.0008
	0.0794	*0.2121*	*0.0001*	*0.0141*	*0.0030*	*0.0091*	*0.9291*	*0.0048*	*0.3545*	*0.8515*
T-bill spread variation	0.0158	0.0020	-0.0092	0.0013	0.0109	0.0287	0.0357	0.0323	0.0327	0.0262
	0.2257	*0.7947*	*0.3315*	*0.8320*	*0.2077*	*0.0034*	*0.0804*	*0.0004*	*0.0120*	*0.0958*
Yield spread change	0.0023	-0.0017	-0.0186	0.0150	0.0166	0.0086	0.0202	0.0110	0.0077	0.0040
	0.8312	*0.7905*	*0.0147*	*0.0025*	*0.0180*	*0.2743*	*0.2185*	*0.1341*	*0.4616*	*0.7528*
Credit spread change	-0.0235	-0.0011	-0.0263	-0.0574	-0.0455	-0.0161	-0.0424	-0.0057	-0.0147	-0.0583
	0.2038	*0.9193*	*0.0497*	*0.0000*	*0.0003*	*0.2520*	*0.1445*	*0.6598*	*0.4273*	*0.0087*
Return real estate	0.2470	0.1501	0.0918	0.1841	0.2221	0.3729	0.2665	0.2412	0.3439	0.3396
	0.0000	*0.0000*	*0.0091*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.3175	0.6958	0.3433	0.7194	0.5432	0.2584	0.4229	0.4321	0.2510	0.1866
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0001*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.0778	0.0600	-0.1285	0.1034	-0.0030	0.1746	-0.0525	0.1659	0.1484	0.0126
	0.6700	*0.4477*	*0.1613*	*0.0580*	*0.9779*	*0.0644*	*0.6737*	*0.0620*	*0.3060*	*0.9332*
VIX	-0.0014	-0.0025	0.0043	-0.0024	0.0016	-0.0050	-0.0002	-0.0030	-0.0081	0.0023
	0.7851	*0.2499*	*0.0959*	*0.1196*	*0.6029*	*0.0595*	*0.9523*	*0.2348*	*0.0454*	*0.5783*
Liquidity spread variation	0.0031	0.0014	-0.0004	-0.0010	-0.0016	0.0010	0.0006	-0.0020	0.0036	0.0021
	0.2332	*0.2171*	*0.7504*	*0.1931*	*0.3007*	*0.4756*	*0.7356*	*0.1133*	*0.0801*	*0.3316*
T-bill spread variation	0.0081	-0.0053	0.0072	-0.0024	-0.0036	-0.0134	-0.0036	0.0031	0.0054	0.0119
	0.4067	*0.2077*	*0.1403*	*0.4178*	*0.5436*	*0.0080*	*0.5922*	*0.5138*	*0.4899*	*0.1380*
Yield spread change	0.0139	0.0008	0.0019	0.0029	-0.0002	-0.0123	-0.0077	0.0025	-0.0017	0.0166
	0.0749	*0.8034*	*0.6208*	*0.2080*	*0.9589*	*0.0023*	*0.1477*	*0.5147*	*0.7842*	*0.0098*
Credit spread change	0.0135	-0.0027	-0.0020	0.0057	-0.0040	-0.0200	0.0034	0.0030	0.0085	0.0092
	0.3274	*0.6477*	*0.7730*	*0.1647*	*0.6289*	*0.0049*	*0.7212*	*0.6533*	*0.4339*	*0.4174*
Return S&P 500	1.4642	1.0433	0.8785	0.8207	0.8190	0.7674	1.0049	0.9706	0.9051	1.4348
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	-0.0852	-0.0134	0.4149	0.0074	0.0684	-0.0430	-0.0679	0.0055	-0.1408	-0.1839
	0.0025	*0.2700*	*0.0000*	*0.3752*	*0.0001*	*0.0031*	*0.0004*	*0.6886*	*0.0000*	*0.0000*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.1176	0.0866	0.3498	0.0553	0.3588	0.1095	0.2708	0.0880	0.2313	0.2271
	0.1269	*0.1952*	*0.0028*	*0.4755*	*0.0020*	*0.2718*	*0.0028*	*0.3556*	*0.0187*	*0.0129*
VIX	-0.0040	-0.0020	-0.0109	-0.0021	-0.0123	-0.0033	-0.0080	-0.0042	-0.0059	-0.0063
	0.0650	*0.2759*	*0.0009*	*0.3387*	*0.0002*	*0.2366*	*0.0016*	*0.1137*	*0.0320*	*0.0135*
Liquidity spread variation	-0.0011	-0.0010	0.0022	0.0006	0.0006	-0.0016	-0.0013	0.0001	-0.0018	-0.0015
	0.3095	*0.2813*	*0.1784*	*0.5642*	*0.7016*	*0.2580*	*0.3234*	*0.9506*	*0.2006*	*0.2520*
T-bill spread variation	0.0158	0.0108	0.0199	0.0111	0.0153	0.0210	0.0184	0.0110	0.0154	0.0204
	0.0001	*0.0026*	*0.0014*	*0.0068*	*0.0120*	*0.0001*	*0.0001*	*0.0303*	*0.0032*	*0.0000*
Yield spread change	0.0065	0.0017	0.0122	0.0049	0.0127	0.0187	0.0140	0.0097	0.0099	0.0097
	0.0511	*0.5460*	*0.0147*	*0.1375*	*0.0101*	*0.0000*	*0.0003*	*0.0174*	*0.0179*	*0.0140*
Credit spread change	-0.0087	-0.0041	-0.0154	-0.0119	-0.0033	-0.0130	-0.0188	-0.0159	-0.0094	-0.0118
	0.1345	*0.4208*	*0.0792*	*0.0410*	*0.7021*	*0.0847*	*0.0058*	*0.0273*	*0.2039*	*0.0852*
Return real estate	0.2704	0.1280	0.0036	0.1437	0.1740	0.3067	0.2390	0.2283	0.3513	0.3221
	0.0000	*0.0000*	*0.8757*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.3426	0.7313	0.4524	0.9160	0.6494	0.5482	0.5436	0.5544	0.4243	0.2926
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 5: Quantile regression results USA over the crisis period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$.

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.7115	-0.3599	-0.0240	-0.3743	-0.2203	-0.7239	-1.8233	-0.8252	-0.8791	-1.0098
	0.0000	*0.0000*	*0.7128*	*0.0000*	*0.0670*	*0.0010*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
VIX	-0.0318	-0.0147	-0.0302	-0.0129	-0.0366	-0.0127	0.0278	-0.0145	-0.0052	-0.0094
	0.0000	*0.0000*	*0.0000*	*0.0003*	*0.0000*	*0.2070*	*0.0271*	*0.0685*	*0.5668*	*0.3145*
Liquidity spread variation	0.0164	0.0025	0.0163	-0.0164	-0.0095	-0.0089	0.0047	-0.0017	-0.0195	0.0086
	0.1176	*0.6159*	*0.0001*	*0.0010*	*0.2249*	*0.5350*	*0.7945*	*0.8839*	*0.1328*	*0.5191*
T-bill spread variation	-0.0250	-0.0012	-0.0149	0.0113	-0.0353	0.0182	-0.0680	-0.0760	-0.0778	0.0319
	0.5650	*0.9521*	*0.3948*	*0.5839*	*0.2756*	*0.7587*	*0.3583*	*0.1044*	*0.1469*	*0.5629*
Yield spread change	-0.0122	-0.0122	0.0030	-0.0015	0.0160	0.0257	-0.0047	-0.0265	-0.0142	-0.0008
	0.2079	*0.5642*	*0.4411*	*0.7382*	*0.0268*	*0.0525*	*0.7760*	*0.0113*	*0.2371*	*0.9518*
Credit spread change	0.0297	0.0023	0.0012	-0.0379	0.0544	0.0227	0.0143	-0.0149	-0.0167	0.0088
	0.1093	*0.7939*	*0.8705*	*0.0000*	*0.0001*	*0.3687*	*0.6501*	*0.4552*	*0.4639*	*0.7075*
Return S&P 500	1.4098	1.1189	0.8598	0.8443	0.8211	1.0302	0.6616	1.5532	0.5896	1.3717
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	-0.1430	-0.0079	0.2445	0.0446	0.0149	-0.1689	0.0475	-0.3101	0.0865	-0.1166
	0.0181	*0.7776*	*0.0000*	*0.1191*	*0.7399*	*0.0405*	*0.6440*	*0.0000*	*0.2461*	*0.1286*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.0648	-0.3409	0.1746	-0.1837	-0.4282	-0.1414	-0.1492	-0.1511	0.1060	-0.2143
	0.7052	*0.0000*	*0.3744*	*0.1227*	*0.0011*	*0.0444*	*0.4226*	*0.3528*	*0.6410*	*0.2383*
VIX	-0.0342	-0.0123	-0.0512	-0.0260	-0.0215	-0.0320	-0.0353	-0.0305	-0.0519	-0.0271
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0003*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0012*
Liquidity spread variation	-0.0049	0.0044	-0.0119	0.0022	0.0191	0.0016	-0.0149	0.0034	-0.0192	-0.0011
	0.6614	*0.1448*	*0.3561*	*0.7758*	*0.0244*	*0.7244*	*0.2224*	*0.7516*	*0.1983*	*0.9299*
T-bill spread variation	0.0082	0.0563	-0.0137	0.0780	0.0300	0.0075	0.0155	0.0006	-0.0097	0.0137
	0.8588	*0.0000*	*0.7960*	*0.0148*	*0.3890*	*0.6923*	*0.7581*	*0.9895*	*0.8740*	*0.7814*
Yield spread change	0.0242	0.0121	0.0161	0.0190	0.0233	0.0288	0.0327	0.0190	0.0322	0.0253
	0.0139	*0.0000*	*0.1657*	*0.0059*	*0.0016*	*0.0000*	*0.0015*	*0.0416*	*0.0104*	*0.0162*
Credit spread change	0.0173	0.0251	0.0526	0.0166	-0.0007	0.0348	0.0364	-0.0063	0.0371	0.0275
	0.3821	*0.0000*	*0.0201*	*0.2243*	*0.9644*	*0.0000*	*0.0900*	*0.7387*	*0.1576*	*0.1897*
Return real estate	0.3672	0.2638	0.1755	0.3222	0.3309	0.4030	0.4153	0.4127	0.4525	0.3514
	0.0000	*0.0000*	*0.0406*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.3208	0.5715	0.5374	0.5505	0.4290	0.4267	0.4228	0.3193	0.3226	0.3343
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0025*	*0.0000*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.1821	-0.0719	-0.0317	0.0713	0.2034	0.0038	-0.0978	-0.0511	-0.0642	0.0156
	0.0150	*0.2712*	*0.3687*	*0.1840*	*0.0047*	*0.9590*	*0.2050*	*0.4753*	*0.4058*	*0.8240*
VIX	0.0089	0.0038	-0.0005	-0.0027	-0.0068	0.0013	0.0075	0.0036	0.0029	-0.0008
	0.0091	*0.2030*	*0.7484*	*0.2670*	*0.0375*	*0.6919*	*0.0329*	*0.2673*	*0.4099*	*0.8075*
Liquidity spread variation	-0.0023	-0.0011	0.0058	-0.0027	-0.0054	0.0032	-0.0061	0.0001	0.0041	-0.0053
	0.6384	*0.8053*	*0.0119*	*0.4434*	*0.2504*	*0.5050*	*0.2262*	*0.9820*	*0.4116*	*0.2478*
T-bill spread variation	-0.0025	-0.0145	0.0095	-0.0150	-0.0188	-0.0149	-0.0073	-0.0017	-0.0068	0.0206
	0.9014	*0.4084*	*0.3165*	*0.3004*	*0.3306*	*0.4493*	*0.7253*	*0.9289*	*0.7454*	*0.2754*
Yield spread change	-0.0007	0.0050	0.0071	0.0006	-0.0011	-0.0005	-0.0047	-0.0024	-0.0015	-0.0028
	0.8854	*0.1995*	*0.0008*	*0.8633*	*0.8018*	*0.9016*	*0.3119*	*0.5756*	*0.7408*	*0.5082*
Credit spread change	0.0005	-0.0001	-0.0011	0.0014	0.0091	0.0108	-0.0057	-0.0039	0.0005	0.0049
	0.9530	*0.9945*	*0.7876*	*0.8233*	*0.2718*	*0.1986*	*0.5228*	*0.6331*	*0.9512*	*0.5384*
Return S&P 500	1.2247	1.0900	0.7678	0.8620	0.8950	0.9378	0.6388	1.1606	0.5460	1.2964
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	0.0382	0.0402	0.3635	0.0376	0.0274	-0.0412	0.0485	-0.0912	0.1085	-0.1039
	0.1721	*0.1001*	*0.0000*	*0.0611*	*0.3078*	*0.1314*	*0.0934*	*0.0007*	*0.0002*	*0.0001*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.2088	0.1395	0.1346	0.0614	0.0603	0.0228	0.2932	0.1189	0.2353	0.1310
	0.0000	*0.0000*	*0.0304*	*0.0965*	*0.2282*	*0.6682*	*0.0000*	*0.0016*	*0.0018*	*0.0367*
VIX	-0.0084	-0.0056	-0.0045	-0.0030	-0.0038	-0.0009	-0.0129	-0.0041	-0.0096	-0.0049
	0.0001	*0.0001*	*0.1158*	*0.0728*	*0.0995*	*0.7036*	*0.0000*	*0.0183*	*0.0056*	*0.0892*
Liquidity spread variation	-0.0026	-0.0011	-0.0060	0.0002	-0.0018	-0.0044	-0.0055	-0.0047	-0.0057	-0.0009
	0.3868	*0.6071*	*0.1420*	*0.9302*	*0.5809*	*0.2072*	*0.1887*	*0.0586*	*0.2503*	*0.8265*
T-bill spread variation	0.0463	0.0224	0.0031	0.0323	0.0285	0.0170	0.0519	-0.0026	0.0331	-0.0137
	0.0002	*0.0099*	*0.8551*	*0.0012*	*0.0331*	*0.2339*	*0.0027*	*0.7972*	*0.1035*	*0.4202*
Yield spread change	0.0255	0.0071	0.0182	0.0190	0.0299	0.0272	0.0467	0.0246	0.0479	0.0210
	0.0000	*0.0002*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Credit spread change	0.0166	0.0040	0.0113	0.0008	0.0010	0.0009	0.0110	0.0069	0.0129	0.0064
	0.0017	*0.2762*	*0.1133*	*0.8544*	*0.8652*	*0.8882*	*0.1348*	*0.1103*	*0.1372*	*0.3780*
Return real estate	0.3438	0.1727	0.0331	0.2029	0.3407	0.3675	0.4908	0.3820	0.5145	0.3672
	0.0000	*0.0000*	*0.2213*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.3744	0.6693	0.7044	0.7562	0.5603	0.5533	0.3215	0.4538	0.2891	0.3875
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 6: Quantile regression results USA over the recovery period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$.

Appendix B: Quantile regression results United Kingdom

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.7428	-0.2341	-0.0508	-0.1305	0.0251	-2.2429	-5.6082	-3.3041	-0.9772	-0.4901
	0.0551	*0.1665*	*0.6338*	*0.7290*	*0.9385*	*0.0003*	*0.0000*	*0.0007*	*0.0091*	*0.0149*
Volatility index	-0.0464	-0.0337	-0.0204	-0.0293	-0.0342	0.0021	0.0189	-0.0410	-0.0436	-0.0749
	0.0001	*0.0000*	*0.0000*	*0.0114*	*0.0006*	*0.9110*	*0.5375*	*0.1695*	*0.0002*	*0.0000*
Liquidity spread variation	-0.0520	-0.0021	-0.0356	-0.0873	-0.1096	0.0049	-0.0935	0.1447	0.0019	0.0097
	0.1436	*0.8910*	*0.0003*	*0.0118*	*0.0003*	*0.9321*	*0.3078*	*0.1049*	*0.9564*	*0.5969*
T-bill spread variation	0.0633	-0.0090	0.0139	-0.0398	-0.0279	0.0825	-0.0237	0.0296	-0.0255	0.0269
	0.1159	*0.6082*	*0.2100*	*0.3096*	*0.4104*	*0.2030*	*0.8195*	*0.7695*	*0.5122*	*0.1973*
Yield spread change	0.0766	-0.0069	0.0083	-0.0081	0.0298	0.0041	0.0157	-0.1154	-0.0652	0.0099
	0.0005	*0.4698*	*0.1674*	*0.7056*	*0.1057*	*0.9066*	*0.7813*	*0.0359*	*0.0021*	*0.3821*
Credit spread change	0.0250	-0.0390	-0.0096	-0.0309	0.0082	0.0292	0.1560	-0.0695	0.0046	0.0729
	0.5335	*0.0267*	*0.3878*	*0.4300*	*0.8083*	*0.6515*	*0.1332*	*0.4911*	*0.9064*	*0.0005*
Return FTSE	0.5602	0.3354	0.3995	0.2748	0.4210	0.6558	1.4852	1.2984	0.2127	0.2302
	0.0000	*0.0000*	*0.0000*	*0.0003*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0049*	*0.0000*
Return real estate	0.0568	0.6644	0.4409	0.2019	0.4741	0.0860	0.8012	-0.0797	0.2675	0.3719
	0.7596	*0.0000*	*0.0000*	*0.2642*	*0.0025*	*0.7735*	*0.0949*	*0.8643*	*0.1362*	*0.0001*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.3668	-0.4457	-0.5778	-0.2627	-0.1445	-0.2827	0.3470	0.2631	-0.3584	-0.4265
	0.2053	*0.1746*	*0.0547*	*0.3208*	*0.4222*	*0.2856*	*0.0966*	*0.1556*	*0.3313*	*0.2498*
Volatility index	-0.0151	-0.0135	-0.0082	-0.0267	-0.0183	-0.0230	-0.0487	-0.0401	-0.0231	-0.0216
	0.0893	*0.1802*	*0.3767*	*0.0010*	*0.0010*	*0.0047*	*0.0000*	*0.0000*	*0.0415*	*0.0576*
Liquidity spread variation	-0.0851	-0.0584	-0.0575	-0.0657	-0.0541	-0.0786	-0.0225	-0.0305	-0.0829	-0.0851
	0.0014	*0.0523*	*0.0376*	*0.0069*	*0.0011*	*0.0012*	*0.2381*	*0.0728*	*0.0145*	*0.0124*
T-bill spread variation	-0.0286	0.0074	-0.0458	0.0108	0.0090	-0.0164	0.0306	-0.0250	0.0136	0.0208
	0.3452	*0.8280*	*0.1443*	*0.6944*	*0.6284*	*0.5517*	*0.1553*	*0.1949*	*0.7217*	*0.5892*
Yield spread change	0.0164	0.0290	-0.0132	0.0253	0.0147	0.0236	0.0172	0.0013	0.0028	0.0229
	0.3081	*0.1064*	*0.4402*	*0.0807*	*0.1387*	*0.1060*	*0.1328*	*0.8970*	*0.8890*	*0.2623*
Credit spread change	-0.0359	0.0082	0.0107	-0.0289	-0.0256	-0.0295	-0.0271	0.0063	-0.0593	-0.0476
	0.2322	*0.8110*	*0.7322*	*0.2926*	*0.1721*	*0.2833*	*0.2093*	*0.7429*	*0.1221*	*0.2159*
Return real estate	0.6061	0.4396	-0.0685	0.6168	0.3336	0.6130	0.4307	0.4523	0.6766	0.8079
	0.0000	*0.0095*	*0.6664*	*0.0000*	*0.0002*	*0.0000*	*0.0000*	*0.0000*	*0.0001*	*0.0000*
Return sector i	0.2551	0.4946	1.2003	0.3184	0.4494	0.1288	0.0612	0.2093	0.1056	0.0321
	0.0000	*0.0000*	*0.0000*	*0.0001*	*0.0000*	*0.0023*	*0.0000*	*0.0000*	*0.1419*	*0.5974*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.0801	0.1583	0.0994	0.0292	0.0343	-0.1198	-1.3457	-0.3415	0.0903	0.1475
	0.5980	*0.0703*	*0.0741*	*0.7637*	*0.6978*	*0.5781*	*0.0023*	*0.2556*	*0.5455*	*0.3701*
Volatility index	-0.0039	-0.0065	-0.0037	0.0001	-0.0014	0.0010	0.0331	0.0097	-0.0044	-0.0063
	0.4085	*0.0151*	*0.0293*	*0.9821*	*0.6134*	*0.8861*	*0.0144*	*0.2938*	*0.3418*	*0.2129*
Liquidity spread variation	0.0169	-0.0044	-0.0053	0.0015	-0.0004	0.0237	0.0499	-0.0001	0.0181	0.0118
	0.2266	*0.5802*	*0.2958*	*0.8677*	*0.9563*	*0.2307*	*0.2165*	*0.9975*	*0.1861*	*0.4361*
T-bill spread variation	0.0461	-0.0063	0.0092	0.0063	-0.0053	0.0074	-0.0012	0.0252	-0.0145	0.0017
	0.0036	*0.4887*	*0.1121*	*0.5329*	*0.5622*	*0.7413*	*0.9785*	*0.4211*	*0.3510*	*0.9191*
Yield spread change	0.0007	-0.0055	0.0061	0.0019	-0.0031	-0.0104	-0.0301	0.0116	-0.0038	-0.0019
	0.9396	*0.2695*	*0.0523*	*0.7362*	*0.5308*	*0.3948*	*0.2268*	*0.4945*	*0.6509*	*0.8395*
Credit spread change	-0.0246	-0.0430	-0.0177	0.0022	-0.0106	0.0251	-0.0183	-0.0576	0.0301	-0.0065
	0.1197	*0.0000*	*0.0023*	*0.8281*	*0.2487*	*0.2618*	*0.6886*	*0.0656*	*0.0526*	*0.7043*
Return FTSE	0.6331	0.2922	0.3584	0.3037	0.5125	0.7981	1.5096	1.0429	0.4412	0.7143
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	0.2231	0.4325	0.3827	0.4124	0.3271	0.1203	-0.2878	0.2925	0.0383	0.1609
	0.0023	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.2450*	*0.1733*	*0.0427*	*0.5929*	*0.0418*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.0084	-0.1329	-0.1480	0.0430	-0.1127	0.0457	0.2360	0.0678	0.0719	-0.0110
	0.9236	*0.1061*	*0.0567*	*0.6750*	*0.0695*	*0.6130*	*0.0018*	*0.4072*	*0.4243*	*0.8940*
Volatility index	0.0000	0.0048	0.0035	-0.0027	0.0029	-0.0017	-0.0076	-0.0019	-0.0026	-0.0003
	0.9997	*0.0552*	*0.1469*	*0.3942*	*0.1256*	*0.5396*	*0.0011*	*0.4442*	*0.3473*	*0.8916*
Liquidity spread variation	-0.0133	-0.0060	0.0054	-0.0119	0.0032	-0.0124	-0.0094	-0.0060	-0.0144	-0.0108
	0.0960	*0.4254*	*0.4491*	*0.2057*	*0.5732*	*0.1353*	*0.1736*	*0.4244*	*0.0812*	*0.1519*
T-bill spread variation	0.0148	0.0153	-0.0010	0.0217	0.0222	0.0243	0.0238	0.0094	0.0206	0.0187
	0.1056	*0.0727*	*0.9054*	*0.0420*	*0.0006*	*0.0097*	*0.0023*	*0.2696*	*0.0276*	*0.0291*
Yield spread change	0.0224	0.0258	-0.0058	0.0264	0.0130	0.0236	0.0246	0.0134	0.0294	0.0179
	0.0000	*0.0000*	*0.1916*	*0.0000*	*0.0002*	*0.0000*	*0.0000*	*0.0033*	*0.0000*	*0.0001*
Credit spread change	-0.0204	0.0088	-0.0142	-0.0301	-0.0045	-0.0273	-0.0286	-0.0186	-0.0284	-0.0291
	0.0243	*0.3085*	*0.0785*	*0.0048*	*0.4826*	*0.0037*	*0.0003*	*0.0292*	*0.0025*	*0.0007*
Return real estate	0.5481	0.2655	0.0836	0.5486	0.2873	0.6847	0.6087	0.5239	0.7181	0.6542
	0.0000	*0.0000*	*0.0419*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.2713	0.6905	1.0355	0.3643	0.5742	0.1827	0.0927	0.1731	0.1459	0.1871
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 7: Quantile regression results UK over the difficult period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. The 3-month T-bill rate for UK is not available on a daily basis over the entire time period. Therefore, we used the 3-konth UK nominal sport curve as proxy for the T-bill rate. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$.

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.9085	-0.3752	-0.0065	-0.3768	-0.9186	-0.6315	-1.7278	-0.3895	-1.5879	-1.1895
	0.2065	*0.0001*	*0.9184*	*0.2124*	*0.0000*	*0.0837*	*0.0029*	*0.5018*	*0.0044*	*0.0001*
Volatility index	-0.0664	-0.0279	-0.0284	-0.0288	0.0054	-0.0423	-0.0075	-0.1007	0.0142	-0.0005
	0.1483	*0.0000*	*0.0000*	*0.1359*	*0.7025*	*0.0695*	*0.8400*	*0.0066*	*0.6890*	*0.9775*
Liquidity spread variation	-0.0124	0.0155	0.0014	-0.0083	0.0110	-0.0382	-0.0315	0.0063	0.0280	-0.0323
	0.8182	*0.0267*	*0.7641*	*0.7145*	*0.5051*	*0.1616*	*0.4672*	*0.8846*	*0.5016*	*0.1459*
T-bill spread variation	0.0276	0.0414	0.0169	-0.0305	0.0184	0.0052	0.0395	0.0007	0.0189	-0.0634
	0.7727	*0.0009*	*0.0443*	*0.4471*	*0.5296*	*0.9145*	*0.6076*	*0.9927*	*0.7987*	*0.1085*
Yield spread change	-0.0285	-0.0075	0.0017	0.0002	-0.0129	0.0343	0.0249	-0.0377	-0.0077	-0.0183
	0.5280	*0.2002*	*0.6633*	*0.9922*	*0.3534*	*0.1350*	*0.4947*	*0.3011*	*0.8266*	*0.3269*
Credit spread change	-0.0130	-0.0463	-0.0106	-0.0369	-0.0062	0.0793	0.0675	-0.0162	0.0536	-0.0213
	0.9104	*0.0021*	*0.2975*	*0.4474*	*0.8610*	*0.1763*	*0.4687*	*0.8618*	*0.5496*	*0.6554*
Return FTSE	1.3873	0.6580	0.4960	0.6972	0.8088	0.8976	1.3760	1.1883	0.5739	1.1427
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0058*	*0.0000*
Return real estate	0.1896	0.2055	0.2862	0.1196	0.1259	-0.2283	-0.1404	0.0007	0.0934	0.0198
	0.3884	*0.0000*	*0.0000*	*0.1956*	*0.0620*	*0.0409*	*0.4282*	*0.9969*	*0.5832*	*0.8277*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.0367	-0.0375	-0.3319	0.1024	0.0253	-0.2437	0.0663	-0.0895	0.0106	-0.3224
	0.8314	*0.6947*	*0.0003*	*0.2878*	*0.8518*	*0.0817*	*0.5696*	*0.4885*	*0.9577*	*0.1786*
Volatility index	-0.0464	-0.0281	-0.0143	-0.0476	-0.0423	-0.0310	-0.0503	-0.0398	-0.0536	-0.0254
	0.0000	*0.0000*	*0.0138*	*0.0000*	*0.0000*	*0.0005*	*0.0000*	*0.0000*	*0.0000*	*0.0972*
Liquidity spread variation	0.0101	-0.0031	-0.0111	0.0081	0.0034	0.0150	0.0061	0.0096	0.0040	0.0160
	0.4349	*0.6615*	*0.1000*	*0.2625*	*0.7373*	*0.1537*	*0.4876*	*0.3210*	*0.7892*	*0.3705*
T-bill spread variation	0.0236	0.0070	0.0309	0.0444	0.0221	0.0062	0.0021	0.0172	0.0027	-0.0011
	0.2983	*0.5793*	*0.0105*	*0.0005*	*0.2200*	*0.7397*	*0.8948*	*0.3164*	*0.9189*	*0.9728*
Yield spread change	0.0045	0.0026	-0.0033	0.0072	0.0117	0.0155	-0.0028	0.0108	0.0244	0.0154
	0.6789	*0.6659*	*0.5657*	*0.2356*	*0.1676*	*0.0773*	*0.6985*	*0.1846*	*0.0511*	*0.3022*
Credit spread change	-0.0036	-0.0124	-0.0029	0.0102	-0.0385	-0.0224	-0.0138	-0.0189	-0.0057	-0.0201
	0.8976	*0.4200*	*0.8413*	*0.5111*	*0.0780*	*0.3206*	*0.4631*	*0.3638*	*0.8602*	*0.6013*
Return real estate	0.3803	0.1841	-0.0513	0.3274	0.3061	0.4530	0.4248	0.4338	0.5015	0.3822
	0.0000	*0.0000*	*0.1554*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.1643	0.5756	1.1054	0.3916	0.5041	0.2447	0.1798	0.1335	0.0380	0.2172
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.4825*	*0.0002*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.2897	0.1202	0.1006	-0.0350	-0.1416	-0.0214	-0.1877	0.2315	0.2114	0.1654
	0.0094	*0.0995*	*0.0006*	*0.6592*	*0.0328*	*0.8339*	*0.1819*	*0.0497*	*0.0391*	*0.0701*
Volatility index	-0.0143	-0.0080	-0.0069	0.0024	0.0094	0.0005	0.0089	-0.0134	-0.0151	-0.0107
	0.0444	*0.0873*	*0.0002*	*0.6384*	*0.0271*	*0.9413*	*0.3208*	*0.0754*	*0.0214*	*0.0667*
Liquidity spread variation	-0.0138	0.0092	0.0028	0.0051	0.0068	-0.0006	-0.0013	-0.0024	-0.0001	0.0041
	0.0969	*0.0907*	*0.1988*	*0.3920*	*0.1701*	*0.9360*	*0.9003*	*0.7881*	*0.9859*	*0.5514*
T-bill spread variation	-0.0323	0.0126	0.0086	0.0098	0.0041	0.0119	0.0169	0.0256	-0.0255	-0.0165
	0.0293	*0.1926*	*0.0285*	*0.3537*	*0.6442*	*0.3813*	*0.3644*	*0.1028*	*0.0605*	*0.1747*
Yield spread change	0.0000	0.0023	0.0010	0.0001	0.0016	0.0006	-0.0003	-0.0006	-0.0163	-0.0090
	0.9987	*0.6206*	*0.6008*	*0.9833*	*0.6976*	*0.9311*	*0.9730*	*0.9359*	*0.0112*	*0.1148*
Credit spread change	0.0024	-0.0063	-0.0068	0.0000	-0.0059	0.0058	-0.0728	0.0198	0.0160	-0.0339
	0.8953	*0.5896*	*0.1490*	*0.9996*	*0.5767*	*0.7257*	*0.0013*	*0.2955*	*0.3316*	*0.0211*
Return FTSE	1.1863	0.5224	0.4401	0.5271	0.6829	0.7595	1.0505	0.8652	0.4828	0.9196
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	0.1681	0.2385	0.2766	0.2173	0.1607	-0.0580	-0.0553	0.1161	0.1684	0.0024
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0637*	*0.1980*	*0.0013*	*0.0000*	*0.9304*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.0480	0.0676	0.0336	0.1758	0.2092	0.2096	0.1956	0.1453	0.0914	0.0674
	0.3399	*0.1155*	*0.5202*	*0.0010*	*0.0000*	*0.0006*	*0.0002*	*0.0076*	*0.1241*	*0.2714*
Volatility index	-0.0034	-0.0045	-0.0020	-0.0114	-0.0136	-0.0129	-0.0126	-0.0097	-0.0056	-0.0042
	0.2895	*0.1004*	*0.5555*	*0.0008*	*0.0000*	*0.0009*	*0.0002*	*0.0051*	*0.1366*	*0.2812*
Liquidity spread variation	0.0034	-0.0026	0.0044	-0.0001	-0.0006	0.0057	0.0031	0.0042	0.0039	0.0024
	0.3696	*0.4242*	*0.2601*	*0.9905*	*0.8730*	*0.2183*	*0.4369*	*0.3057*	*0.3843*	*0.6026*
T-bill spread variation	0.0278	0.0055	0.0022	0.0123	0.0129	0.0245	0.0174	0.0144	0.0280	0.0231
	0.0000	*0.3335*	*0.7475*	*0.0814*	*0.0392*	*0.0025*	*0.0144*	*0.0465*	*0.0004*	*0.0044*
Yield spread change	0.0050	0.0041	-0.0008	0.0078	0.0030	0.0062	0.0042	0.0082	0.0074	0.0081
	0.1132	*0.1236*	*0.8047*	*0.0201*	*0.3142*	*0.1041*	*0.2064*	*0.0169*	*0.0472*	*0.0353*
Credit spread change	-0.0180	-0.0078	-0.0047	-0.0082	-0.0142	-0.0241	-0.0129	-0.0157	-0.0360	0.0007
	0.0262	*0.2592*	*0.5774*	*0.3411*	*0.0612*	*0.0145*	*0.1325*	*0.0732*	*0.0002*	*0.9439*
Return real estate	0.3721	0.2040	-0.0564	0.3021	0.2637	0.4431	0.4324	0.3860	0.4546	0.4136
	0.0000	*0.0000*	*0.0066*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.1716	0.6115	1.0838	0.4418	0.4469	0.1710	0.1491	0.1929	0.1292	0.2258
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 8: Quantile regression results UK over the calm period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. The 3-month T-bill rate for UK is not available on a daily basis over the entire time period. Therefore, we used the 3-konth UK nominal sport curve as proxy for the T-bill rate. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$.

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-2.0877	-0.2457	-0.3718	-0.9105	-1.5374	0.5653	-0.4432	-0.7236	0.2375	-1.7681
	0.0000	*0.3574*	*0.0002*	*0.0000*	*0.0022*	*0.0808*	*0.1199*	*0.0940*	*0.5734*	*0.0000*
Volatility index	-0.0482	-0.0377	-0.0124	-0.0127	-0.0114	-0.0754	-0.0534	-0.0519	-0.0861	-0.0056
	0.0010	*0.0000*	*0.0002*	*0.0574*	*0.4972*	*0.0000*	*0.0000*	*0.0004*	*0.0000*	*0.5851*
Liquidity spread variation	-0.0099	-0.0010	0.0019	-0.0154	-0.0056	-0.0095	-0.0343	-0.0933	-0.0439	-0.0498
	0.6200	*0.9325*	*0.6769*	*0.0934*	*0.8062*	*0.5247*	*0.0092*	*0.0000*	*0.0241*	*0.0004*
T-bill spread variation	-0.0276	0.0034	0.0403	-0.0319	0.0304	-0.0145	0.0348	0.0671	-0.0726	-0.0106
	0.4598	*0.8828*	*0.0000*	*0.0627*	*0.4798*	*0.6021*	*0.1562*	*0.0716*	*0.0463*	*0.6856*
Yield spread change	0.0106	-0.0041	0.0029	-0.0125	-0.0463	-0.0148	0.0137	0.0645	-0.0109	0.0172
	0.6416	*0.7708*	*0.5780*	*0.2302*	*0.0770*	*0.3830*	*0.3579*	*0.0045*	*0.6236*	*0.2811*
Credit spread change	-0.0516	-0.0124	-0.0106	-0.0059	-0.0200	0.0606	0.0046	0.0295	0.0616	-0.0334
	0.1719	*0.5924*	*0.2244*	*0.7336*	*0.6449*	*0.0316*	*0.8523*	*0.4319*	*0.0940*	*0.2082*
Return FTSE	1.6830	0.5772	0.4496	0.7202	0.5819	0.5378	0.7668	0.7130	0.3993	1.2792
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0002*	*0.0000*
Return real estate	-0.4253	0.0953	0.1950	-0.0214	0.2089	-0.0240	-0.0917	-0.0258	-0.0194	-0.3488
	0.0000	*0.0561*	*0.0000*	*0.5632*	*0.0252*	*0.6906*	*0.0849*	*0.7483*	*0.8056*	*0.0000*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.0928	-0.4532	-0.6608	-0.3843	-0.2525	-0.2798	-0.3345	0.0185	-0.2898	-1.2609
	0.6582	*0.0000*	*0.0507*	*0.2331*	*0.1664*	*0.5629*	*0.0472*	*0.9274*	*0.1263*	*0.0000*
Volatility index	-0.0336	-0.0121	-0.0181	-0.0285	-0.0305	-0.0399	-0.0306	-0.0403	-0.0355	0.0048
	0.0000	*0.0000*	*0.1103*	*0.0085*	*0.0000*	*0.0140*	*0.0000*	*0.0000*	*0.0000*	*0.4601*
Liquidity spread variation	-0.0200	-0.0070	-0.0255	-0.0009	-0.0359	-0.0043	-0.0273	0.0050	-0.0363	-0.0116
	0.0393	*0.0375*	*0.1022*	*0.9497*	*0.0000*	*0.8477*	*0.0005*	*0.5939*	*0.0000*	*0.1938*
T-bill spread variation	0.0140	0.0411	0.0136	0.0683	0.0102	0.0950	0.0098	0.0463	0.0441	0.0190
	0.4386	*0.0000*	*0.6401*	*0.0136*	*0.5159*	*0.0220*	*0.5017*	*0.0083*	*0.0073*	*0.2540*
Yield spread change	-0.0104	0.0032	0.0220	0.0218	0.0198	0.0358	0.0066	0.0230	0.0227	0.0042
	0.3392	*0.3921*	*0.2077*	*0.1918*	*0.0359*	*0.1494*	*0.4501*	*0.0283*	*0.0217*	*0.6767*
Credit spread change	-0.0269	-0.0059	-0.0172	-0.0267	-0.0380	-0.0149	-0.0122	0.0030	-0.0184	-0.0439
	0.1410	*0.3568*	*0.5604*	*0.3413*	*0.0171*	*0.7232*	*0.4038*	*0.8647*	*0.2656*	*0.0094*
Return real estate	0.2613	0.1158	-0.0091	0.1865	0.0819	0.2405	0.2103	0.2317	0.2637	0.3128
	0.0000	*0.0000*	*0.9057*	*0.0019*	*0.0207*	*0.0018*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.1906	0.6268	1.0188	0.4329	0.4456	0.3590	0.3592	0.3621	0.3185	0.3081
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0054*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.2958	0.0050	0.0146	-0.1067	-0.1486	0.1168	-0.1105	0.2187	0.1660	0.3036
	0.2318	*0.9570*	*0.7955*	*0.3822*	*0.1428*	*0.4627*	*0.5023*	*0.2971*	*0.2630*	*0.0600*
Volatility index	-0.0050	-0.0001	-0.0002	0.0022	0.0033	-0.0050	0.0053	-0.0028	-0.0058	-0.0077
	0.5486	*0.9732*	*0.9173*	*0.5925*	*0.3356*	*0.3503*	*0.3330*	*0.6855*	*0.2440*	*0.1552*
Liquidity spread variation	-0.0198	-0.0076	0.0010	-0.0039	-0.0057	0.0051	0.0074	-0.0143	0.0035	0.0024
	0.0829	*0.0779*	*0.7009*	*0.4919*	*0.2204*	*0.4910*	*0.3301*	*0.1391*	*0.6102*	*0.7506*
T-bill spread variation	0.0135	-0.0126	0.0054	-0.0176	-0.0143	-0.0218	0.0054	0.0041	0.0350	0.0077
	0.5254	*0.1169*	*0.2650*	*0.0952*	*0.1024*	*0.1122*	*0.7039*	*0.8218*	*0.0064*	*0.5789*
Yield spread change	0.0194	-0.0092	-0.0064	-0.0071	0.0007	-0.0059	0.0115	-0.0041	0.0262	-0.0021
	0.1351	*0.0590*	*0.0298*	*0.2658*	*0.9030*	*0.4823*	*0.1827*	*0.7064*	*0.0008*	*0.8069*
Credit spread change	-0.0105	-0.0052	-0.0114	-0.0022	-0.0004	-0.0165	-0.0020	-0.0217	0.0203	-0.0057
	0.6246	*0.5195*	*0.0196*	*0.8383*	*0.9684*	*0.2340*	*0.8919*	*0.2355*	*0.1171*	*0.6868*
Return FTSE	1.3863	0.6349	0.4823	0.5193	0.6656	0.5270	0.6128	0.6850	0.5742	1.1337
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	-0.1187	0.1608	0.1904	0.1192	0.2131	-0.0275	0.0238	0.1079	-0.0392	-0.1631
	0.0103	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.3551*	*0.4384*	*0.0060*	*0.1569*	*0.0000*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.0062	0.0330	0.3016	0.1384	0.2001	0.0639	0.0209	0.1186	0.0885	0.0203
	0.9317	*0.7059*	*0.0020*	*0.3231*	*0.0056*	*0.5771*	*0.8564*	*0.2015*	*0.3343*	*0.8195*
Volatility index	-0.0003	-0.0005	-0.0091	-0.0028	-0.0054	-0.0003	0.0009	-0.0048	-0.0017	-0.0016
	0.8892	*0.8643*	*0.0056*	*0.5554*	*0.0252*	*0.9468*	*0.8160*	*0.1269*	*0.5775*	*0.5848*
Liquidity spread variation	-0.0010	0.0018	-0.0095	-0.0046	0.0028	-0.0072	-0.0086	0.0060	-0.0050	-0.0003
	0.7739	*0.6562*	*0.0337*	*0.4762*	*0.4061*	*0.1702*	*0.1054*	*0.1627*	*0.2402*	*0.9444*
T-bill spread variation	0.0174	0.0194	-0.0110	0.0251	0.0151	0.0313	0.0135	0.0162	0.0111	0.0157
	0.0052	*0.0096*	*0.1911*	*0.0371*	*0.0149*	*0.0015*	*0.1749*	*0.0437*	*0.1625*	*0.0402*
Yield spread change	0.0083	0.0076	0.0115	0.0133	0.0054	0.0200	0.0089	0.0145	0.0128	0.0045
	0.0276	*0.0913*	*0.0225*	*0.0669*	*0.1502*	*0.0007*	*0.1389*	*0.0026*	*0.0074*	*0.3315*
Credit spread change	-0.0090	-0.0098	0.0109	-0.0093	-0.0028	-0.0039	-0.0146	0.0004	-0.0170	-0.0094
	0.1520	*0.1978*	*0.1999*	*0.4481*	*0.6503*	*0.6935*	*0.1474*	*0.9575*	*0.0343*	*0.2252*
Return real estate	0.3148	0.0971	-0.0559	0.2514	0.1503	0.3424	0.3429	0.2512	0.3645	0.2798
	0.0000	*0.0000*	*0.0122*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.1838	0.6850	1.1945	0.5070	0.4924	0.3589	0.2703	0.3806	0.2593	0.3322
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 9: Quantile regression results UK over the crisis period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. The 3-month T-bill rate for UK is not available on a daily basis over the entire time period. Therefore, we used the 3-konth UK nominal sport curve as proxy for the T-bill rate. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$.

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-1.0975	-0.3522	-0.2279	-0.3124	-0.2136	-0.8752	-1.0091	-0.8886	-0.8217	-0.7634
	0.0532	*0.0160*	*0.0252*	*0.0046*	*0.5390*	*0.0004*	*0.0039*	*0.0504*	*0.0001*	*0.0016*
Volatility index	-0.0361	-0.0227	-0.0108	-0.0244	-0.0328	-0.0101	-0.0349	-0.0264	-0.0207	-0.0187
	0.1711	*0.0009*	*0.0231*	*0.0000*	*0.0425*	*0.3794*	*0.0318*	*0.2110*	*0.0369*	*0.0958*
Liquidity spread variation	0.0119	-0.0184	0.0063	0.0108	-0.0256	0.0192	-0.0871	-0.0019	0.0461	0.0408
	0.8531	*0.2641*	*0.5864*	*0.3839*	*0.5153*	*0.4898*	*0.0274*	*0.9704*	*0.0559*	*0.1357*
T-bill spread variation	-0.0728	-0.1170	-0.0063	-0.0602	-0.0374	-0.1921	-0.0337	-0.1984	0.0698	0.0295
	0.6960	*0.0148*	*0.8495*	*0.0962*	*0.7433*	*0.0176*	*0.7687*	*0.1829*	*0.3180*	*0.7102*
Yield spread change	-0.0313	-0.0030	-0.0044	-0.0114	-0.0196	0.0136	-0.0385	0.0174	0.0014	-0.0184
	0.3543	*0.7320*	*0.4653*	*0.0815*	*0.3439*	*0.3520*	*0.0638*	*0.5192*	*0.9118*	*0.2021*
Credit spread change	-0.0230	-0.0167	-0.0037	-0.0015	-0.0324	0.0185	-0.0489	0.0130	0.0153	-0.0103
	0.6493	*0.1987*	*0.6844*	*0.8768*	*0.2962*	*0.3979*	*0.1158*	*0.7478*	*0.4206*	*0.6326*
Return FTSE	1.4093	0.8305	0.4357	0.6166	0.6224	0.6045	1.0262	0.8059	0.5152	1.1952
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	-0.0930	0.0445	0.1944	0.0458	0.0698	0.0048	-0.3450	0.0430	0.0148	0.0274
	0.5882	*0.3145*	*0.0000*	*0.1698*	*0.5075*	*0.9491*	*0.0011*	*0.7543*	*0.8187*	*0.7079*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.2212	-0.2722	-0.2306	-0.2714	-0.6483	-0.6150	-0.2875	0.0067	-0.6450	-0.0543
	0.1573	*0.0001*	*0.2508*	*0.0076*	*0.0000*	*0.0005*	*0.2789*	*0.9576*	*0.0271*	*0.6538*
Volatility index	-0.0471	-0.0128	-0.0267	-0.0213	-0.0018	-0.0114	-0.0323	-0.0387	-0.0154	-0.0280
	0.0000	*0.0001*	*0.0043*	*0.0000*	*0.7142*	*0.1626*	*0.0090*	*0.0000*	*0.2545*	*0.0000*
Liquidity spread variation	0.0173	0.0184	0.0248	0.0261	0.0212	0.0266	0.0688	0.0103	0.0368	0.0230
	0.3290	*0.0215*	*0.2741*	*0.0228*	*0.0708*	*0.1776*	*0.0222*	*0.4681*	*0.2642*	*0.0934*
T-bill spread variation	-0.0193	0.0302	0.0267	0.0650	0.0069	0.0765	0.0942	0.0613	0.0828	0.0192
	0.7063	*0.1922*	*0.6826*	*0.0499*	*0.8388*	*0.1798*	*0.2769*	*0.1362*	*0.3838*	*0.6288*
Yield spread change	0.0011	0.0049	-0.0006	0.0234	0.0256	0.0256	0.0271	0.0056	0.0265	-0.0048
	0.9012	*0.2297*	*0.9562*	*0.0001*	*0.0000*	*0.0104*	*0.0708*	*0.4357*	*0.1100*	*0.4934*
Credit spread change	-0.0224	0.0088	-0.0078	0.0131	0.0057	-0.0124	0.0067	0.0080	-0.0030	-0.0164
	0.1076	*0.1632*	*0.6631*	*0.1482*	*0.5393*	*0.4256*	*0.7773*	*0.4765*	*0.9089*	*0.1300*
Return real estate	0.2535	0.1930	-0.0236	0.1903	0.2965	0.3127	0.3878	0.2473	0.4707	0.2086
	0.0000	*0.0000*	*0.7326*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.1822	0.6505	1.3126	0.6450	0.5064	0.4058	0.1662	0.3936	0.2554	0.3945
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0075*	*0.0000*	*0.0046*	*0.0000*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.1462	0.1781	0.1403	0.0763	0.0654	0.0825	-0.0173	0.1798	0.0027	-0.1319
	0.2368	*0.0182*	*0.0002*	*0.2860*	*0.2343*	*0.3919*	*0.8938*	*0.0927*	*0.9802*	*0.1795*
Volatility index	0.0072	-0.0075	-0.0059	-0.0012	-0.0019	-0.0031	0.0031	-0.0064	0.0001	0.0051
	0.2087	*0.0327*	*0.0006*	*0.7135*	*0.4691*	*0.4876*	*0.6038*	*0.1989*	*0.9880*	*0.2676*
Liquidity spread variation	0.0025	-0.0035	-0.0004	-0.0010	-0.0097	-0.0074	-0.0139	-0.0310	-0.0057	-0.0080
	0.8585	*0.6806*	*0.9294*	*0.9058*	*0.1196*	*0.4980*	*0.3420*	*0.0106*	*0.6444*	*0.4711*
T-bill spread variation	0.0361	-0.0087	-0.0230	0.0143	-0.0315	-0.0204	-0.0194	0.0094	0.0175	0.0078
	0.3734	*0.7261*	*0.0589*	*0.5422*	*0.0814*	*0.5200*	*0.6484*	*0.7889*	*0.6265*	*0.8098*
Yield spread change	-0.0038	0.0016	0.0030	-0.0008	0.0037	-0.0108	-0.0014	-0.0056	0.0044	0.0005
	0.6056	*0.7293*	*0.1682*	*0.8573*	*0.2568*	*0.0612*	*0.8526*	*0.3765*	*0.5031*	*0.9281*
Credit spread change	0.0211	-0.0224	-0.0036	0.0030	-0.0065	-0.0062	-0.0050	-0.0252	0.0067	-0.0065
	0.0549	*0.0009*	*0.2725*	*0.6369*	*0.1834*	*0.4689*	*0.6623*	*0.0082*	*0.4893*	*0.4603*
Return FTSE	1.4878	0.7418	0.4744	0.6124	0.7074	0.5739	0.7033	0.6200	0.4983	1.1486
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	-0.0497	0.1035	0.1399	0.0791	0.0706	0.0504	-0.0245	0.2147	0.0519	-0.0004
	0.1846	*0.0000*	*0.0000*	*0.0003*	*0.0000*	*0.0849*	*0.5313*	*0.0000*	*0.1168*	*0.9894*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**ConsumerGoods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.2506	-0.0148	-0.1056	0.0407	0.0181	0.1554	0.1712	0.0707	0.1803	0.1614
	0.0000	*0.7698*	*0.1693*	*0.5608*	*0.7436*	*0.0769*	*0.0489*	*0.3762*	*0.0665*	*0.0085*
Volatility index	-0.0106	0.0003	0.0060	-0.0021	0.0000	-0.0064	-0.0072	-0.0030	-0.0078	-0.0064
	0.0000	*0.9133*	*0.0926*	*0.5235*	*0.9984*	*0.1167*	*0.0768*	*0.4168*	*0.0893*	*0.0239*
Liquidity spread variation	-0.0092	0.0075	-0.0087	0.0128	0.0030	0.0051	0.0042	0.0160	0.0033	0.0028
	0.0725	*0.1905*	*0.3182*	*0.1056*	*0.6357*	*0.6054*	*0.6716*	*0.0762*	*0.7665*	*0.6839*
T-bill spread variation	-0.0003	0.0105	0.0582	0.0195	0.0196	0.0651	0.0580	0.0141	0.0606	-0.0009
	0.9843	*0.5229*	*0.0199*	*0.3949*	*0.2783*	*0.0233*	*0.0410*	*0.5892*	*0.0586*	*0.9653*
Yield spread change	0.0183	0.0090	0.0105	0.0219	0.0115	0.0296	0.0317	0.0222	0.0303	0.0076
	0.0000	*0.0023*	*0.0192*	*0.0000*	*0.0003*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0341*
Credit spread change	-0.0100	0.0079	0.0043	-0.0071	0.0049	-0.0097	-0.0072	-0.0025	-0.0102	-0.0107
	0.0131	*0.0808*	*0.5281*	*0.2567*	*0.3238*	*0.2166*	*0.3554*	*0.7296*	*0.2451*	*0.0501*
Return real estate	0.2636	0.1647	-0.0359	0.2254	0.2039	0.3068	0.3843	0.3019	0.4092	0.2094
	0.0000	*0.0000*	*0.1756*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.2261	0.6147	1.3825	0.6055	0.6361	0.4459	0.2470	0.3693	0.2477	0.4020
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 10: Quantile regression results UK over the recovery period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. The 3-month T-bill rate for UK is not available on a daily basis over the entire time period. Therefore, we used the 3-konth UK nominal sport curve as proxy for the T-bill rate. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$.

Appendix C: Quantile regression results Germany

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-1.5892	-1.4513	0.2547	-1.4383	-9.0583	-5.7429	-4.5942	-5.2827	-1.2695	-2.4401
	0.0000	*0.0000*	*0.0129*	*0.0359*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0212*
VDAX NEW	-0.0065	-0.0072	-0.0692	-0.1145	0.1085	0.0064	0.0117	-0.0027	-0.0079	-0.1136
	0.4311	*0.1032*	*0.0000*	*0.0000*	*0.0005*	*0.8475*	*0.4918*	*0.9184*	*0.1168*	*0.0005*
Liquidity spread variation	-0.0052	0.0109	-0.0037	0.0106	0.0261	0.0377	0.0143	0.0180	0.0073	0.0084
	0.3009	*0.0001*	*0.0549*	*0.4073*	*0.1674*	*0.0638*	*0.1655*	*0.2653*	*0.0172*	*0.6726*
T-bill spread variation	0.0138	0.0023	0.0175	0.1487	0.0253	0.0210	-0.0193	0.0208	-0.0066	0.0368
	0.6332	*0.8849*	*0.1151*	*0.0453*	*0.8165*	*0.8581*	*0.7467*	*0.8234*	*0.7085*	*0.7480*
Yield spread change	0.0116	0.0145	0.0091	0.1373	0.0475	0.0259	-0.0258	0.0027	0.0066	0.0257
	0.6636	*0.3084*	*0.3724*	*0.0439*	*0.6356*	*0.8107*	*0.6381*	*0.9751*	*0.6824*	*0.8068*
Credit spread change	-0.0191	-0.0014	0.0247	0.1280	-0.0532	-0.0004	-0.0609	0.0032	0.0288	-0.0622
	0.1874	*0.8539*	*0.0000*	*0.0006*	*0.3306*	*0.9943*	*0.0420*	*0.9447*	*0.0011*	*0.2784*
Return CDAX	0.2357	0.1946	0.2649	0.2134	0.5692	0.7974	1.2218	0.7434	0.1905	0.1198
	0.0000	*0.0000*	*0.0000*	*0.1186*	*0.0047*	*0.0002*	*0.0000*	*0.0000*	*0.0000*	*0.5702*
Return real estate	0.1458	0.5193	-0.1040	-1.1279	0.6818	1.6796	-0.5186	0.5459	0.5306	-0.8210
	0.4914	*0.0000*	*0.1997*	*0.0378*	*0.3931*	*0.0510*	*0.2351*	*0.4227*	*0.0000*	*0.3270*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-3.3117	-2.9203	-2.0609	-5.3905	-3.5065	-3.6640	-2.4674	-2.3904	-3.5689	-3.8505
	0.0000	*0.0010*	*0.0256*	*0.0000*	*0.0000*	*0.0000*	*0.0002*	*0.0025*	*0.0000*	*0.0000*
VDAX NEW	0.0033	-0.0040	-0.0561	0.0716	0.0135	0.0126	-0.0215	-0.0120	0.0099	0.0173
	0.8520	*0.8821*	*0.0485*	*0.0000*	*0.2977*	*0.3360*	*0.2957*	*0.6203*	*0.6655*	*0.3982*
Liquidity spread variation	-0.0043	0.0008	0.0096	-0.0107	-0.0035	0.0015	0.0057	-0.0079	-0.0033	-0.0108
	0.6878	*0.9600*	*0.5771*	*0.0415*	*0.6615*	*0.8505*	*0.6516*	*0.5906*	*0.8106*	*0.3868*
T-bill spread variation	0.0149	0.0225	0.1044	0.0454	0.0468	0.0555	0.0026	0.0724	0.0628	0.0586
	0.7992	*0.8076*	*0.2749*	*0.1137*	*0.2804*	*0.2048*	*0.9702*	*0.3746*	*0.4118*	*0.3935*
Yield spread change	0.0337	0.0337	0.1031	0.0527	0.0513	0.0593	0.0151	0.0725	0.0688	0.0705
	0.5293	*0.6891*	*0.2388*	*0.0444*	*0.1941*	*0.1385*	*0.8139*	*0.3297*	*0.3258*	*0.2613*
Credit spread change	-0.0013	0.0401	0.0420	-0.0317	0.0195	0.0034	0.0048	0.0102	0.0139	0.0004
	0.9660	*0.4028*	*0.4015*	*0.0365*	*0.3916*	*0.8838*	*0.8940*	*0.8119*	*0.7303*	*0.9908*
Return real estate	0.8154	0.7014	0.7340	1.3505	1.1031	0.8001	1.0493	0.7289	1.2128	1.0310
	0.0676	*0.3231*	*0.3174*	*0.0000*	*0.0009*	*0.0168*	*0.0457*	*0.2430*	*0.0382*	*0.0496*
Return sector i	0.6630	1.2350	0.5409	0.1006	0.0318	0.0321	0.2109	0.0171	0.1921	0.0285
	0.0005	*0.0003*	*0.0512*	*0.0192*	*0.3022*	*0.2790*	*0.0029*	*0.8267*	*0.5238*	*0.5332*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.0559	-0.0667	-0.0016	-0.0115	-0.7235	-0.6282	-0.9694	-1.2666	0.0910	0.0372
	0.4556	*0.3832*	*0.9767*	*0.8723*	*0.0001*	*0.0256*	*0.0000*	*0.0000*	*0.1380*	*0.8779*
VDAX NEW	-0.0031	0.0010	-0.0008	0.0001	0.0109	0.0069	0.0246	0.0252	-0.0031	-0.0088
	0.1775	*0.6815*	*0.6357*	*0.9764*	*0.0498*	*0.4231*	*0.0006*	*0.0017*	*0.1063*	*0.2397*
Liquidity spread variation	-0.0010	0.0018	0.0008	-0.0005	0.0102	0.0093	0.0027	0.0017	0.0003	0.0043
	0.4818	*0.2047*	*0.4421*	*0.6938*	*0.0026*	*0.0792*	*0.5391*	*0.7337*	*0.7700*	*0.3407*
T-bill spread variation	-0.0097	0.0056	-0.0027	0.0088	0.0079	-0.0078	-0.0373	-0.0285	-0.0121	-0.0354
	0.2320	*0.5032*	*0.6516*	*0.2564*	*0.6854*	*0.7991*	*0.1395*	*0.3120*	*0.0684*	*0.1775*
Yield spread change	-0.0114	0.0030	-0.0026	0.0109	-0.0162	0.0007	-0.0329	-0.0181	-0.0079	-0.0298
	0.1273	*0.6936*	*0.6241*	*0.1281*	*0.3664*	*0.9788*	*0.1557*	*0.4831*	*0.1937*	*0.2155*
Credit spread change	-0.0035	0.0036	-0.0020	0.0055	0.0052	0.0098	-0.0064	-0.0238	-0.0034	-0.0117
	0.3855	*0.3839*	*0.4927*	*0.1599*	*0.5914*	*0.5195*	*0.6133*	*0.0914*	*0.3026*	*0.3746*
Return CDAX	0.2209	0.2580	0.3204	0.1135	0.3744	0.7284	1.4175	0.7542	0.0895	0.3315
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	0.1129	0.2847	0.3053	0.1747	0.1960	0.3172	-0.8226	0.5941	0.0384	0.0829
	0.0574	*0.0000*	*0.0000*	*0.0022*	*0.1690*	*0.1544*	*0.0000*	*0.0040*	*0.4293*	*0.6657*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.2453	-0.2949	-0.3102	-0.3744	-0.1649	-0.2867	-0.1161	-0.0995	-0.1867	-0.3440
	0.0551	*0.0070*	*0.0241*	*0.0052*	*0.1197*	*0.0134*	*0.4677*	*0.3267*	*0.1238*	*0.0020*
VDAX NEW	0.0034	0.0059	0.0051	0.0049	0.0040	0.0042	0.0002	0.0024	0.0009	0.0062
	0.3953	*0.0816*	*0.2271*	*0.2348*	*0.2249*	*0.2431*	*0.9657*	*0.4497*	*0.8026*	*0.0724*
Liquidity spread variation	0.0038	0.0003	0.0036	0.0031	-0.0025	0.0063	0.0041	0.0019	0.0011	0.0017
	0.1112	*0.8856*	*0.1672*	*0.2191*	*0.2075*	*0.0037*	*0.1735*	*0.3123*	*0.6267*	*0.4268*
T-bill spread variation	0.0548	0.0216	0.0256	0.0646	0.0373	0.0302	0.0285	0.0294	0.0599	0.0653
	0.0000	*0.0583*	*0.0721*	*0.0000*	*0.0007*	*0.0116*	*0.0890*	*0.0053*	*0.0000*	*0.0000*
Yield spread change	0.0452	0.0165	0.0196	0.0669	0.0468	0.0233	0.0213	0.0222	0.0504	0.0547
	0.0002	*0.1129*	*0.1322*	*0.0000*	*0.0000*	*0.0331*	*0.1651*	*0.0205*	*0.0000*	*0.0000*
Credit spread change	-0.0002	-0.0065	-0.0033	-0.0053	0.0036	-0.0061	0.0039	0.0051	-0.0059	0.0008
	0.9823	*0.2718*	*0.6580*	*0.4623*	*0.5370*	*0.3290*	*0.6535*	*0.3580*	*0.3694*	*0.8931*
Return real estate	0.4170	0.0219	0.3638	0.4912	0.6213	0.3955	0.5273	0.2295	0.3549	0.3721
	0.0000	*0.8028*	*0.0009*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0044*	*0.0002*	*0.0000*
Return sector i	0.3588	0.8404	0.4548	0.0459	0.1667	0.1109	0.1614	0.1116	0.3002	0.0748
	0.0000	*0.0000*	*0.0000*	*0.0259*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 11: Quantile regression results Germany over the difficult period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. The daily real estate returns were interpolated from weekly returns of the DIMAX index. After each regression, the insignificant variables were excluded and we re-run the regressions. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$. The variables were added in a stepwise manner for those sectors with only insignificant coefficients. However, there is no significance for the ex Healthcare sector index returns at the 2.5%-quantile.

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.7560	0.4369	1.7440	-4.8115	-0.9183	0.2351	-1.4871	-0.9638	-0.7627	-2.7122
	0.1320	*0.0002*	*0.0010*	*0.0000*	*0.0001*	*0.1349*	*0.0000*	*0.1193*	*0.1380*	*0.0081*
VDAX NEW	-0.1160	-0.0861	-0.2031	0.0607	-0.0205	-0.0896	-0.0186	-0.1444	-0.0290	-0.0570
	0.0000	*0.0000*	*0.0000*	*0.2308*	*0.0758*	*0.0000*	*0.2103*	*0.0000*	*0.2408*	*0.2464*
Liquidity spread variation	0.0537	0.0068	-0.0156	-0.1013	-0.0254	0.0072	-0.0032	0.0735	-0.0555	-0.0108
	0.0220	*0.2141*	*0.5259*	*0.0396*	*0.0239*	*0.3287*	*0.8227*	*0.0110*	*0.0208*	*0.8218*
T-bill spread variation	0.0919	0.0029	0.0380	-0.1375	0.0335	0.0186	-0.0178	-0.1223	-0.1539	0.0294
	0.3056	*0.8880*	*0.6876*	*0.4656*	*0.4356*	*0.5089*	*0.7463*	*0.2686*	*0.0942*	*0.8723*
Yield spread change	0.0207	0.0251	-0.0065	-0.0430	0.0093	0.0105	0.0064	-0.0157	-0.0616	0.0783
	0.6282	*0.0116*	*0.8843*	*0.6318*	*0.6494*	*0.4329*	*0.8088*	*0.7648*	*0.1590*	*0.3683*
Credit spread change	0.0061	0.0097	0.0087	0.0473	-0.0056	-0.0075	-0.0081	-0.0218	-0.0219	-0.0185
	0.7951	*0.0763*	*0.7259*	*0.3378*	*0.6190*	*0.3110*	*0.5753*	*0.4512*	*0.3636*	*0.6985*
Return S&P 500	0.2254	0.5352	0.3916	0.5257	0.5048	0.6534	0.8550	0.5091	0.3514	0.7823
	0.1033	*0.0000*	*0.0073*	*0.0706*	*0.0000*	*0.0000*	*0.0000*	*0.0029*	*0.0133*	*0.0056*
Return real estate	0.3162	0.2996	0.4879	1.1472	0.3913	0.2590	-0.2275	1.1683	0.1104	0.6178
	0.4044	*0.0007*	*0.2220*	*0.1500*	*0.0316*	*0.0295*	*0.3290*	*0.0126*	*0.7764*	*0.4246*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-1.0061	-1.7027	-1.5974	0.3006	-0.9168	-1.4105	-0.9315	-1.2354	-0.5138	-0.9827
	0.0027	*0.0075*	*0.0007*	*0.0424*	*0.0036*	*0.0383*	*0.2430*	*0.0047*	*0.2357*	*0.1937*
VDAX NEW	-0.0333	-0.0217	-0.0264	-0.0671	-0.0401	-0.0226	-0.0291	-0.0224	-0.0490	-0.0293
	0.0391	*0.4786*	*0.2466*	*0.0000*	*0.0080*	*0.4896*	*0.4487*	*0.2859*	*0.0189*	*0.4206*
Liquidity spread variation	-0.0197	-0.0042	0.0206	-0.0148	0.0043	0.0115	-0.0310	-0.0136	-0.0497	-0.0215
	0.2092	*0.8884*	*0.3510*	*0.0335*	*0.7685*	*0.7169*	*0.4062*	*0.5069*	*0.0143*	*0.5438*
T-bill spread variation	0.0377	-0.0799	0.0216	-0.0500	-0.0160	-0.0250	-0.0307	0.0191	-0.1269	-0.0127
	0.5287	*0.4822*	*0.7979*	*0.0591*	*0.7756*	*0.8371*	*0.8299*	*0.8067*	*0.1018*	*0.9254*
Yield spread change	0.0640	0.0408	0.0423	0.0314	0.0330	0.0428	0.0579	0.0540	0.0363	0.0542
	0.0213	*0.4437*	*0.2810*	*0.0109*	*0.2085*	*0.4506*	*0.3846*	*0.1374*	*0.3125*	*0.3883*
Credit spread change	0.0233	0.0210	0.0252	0.0063	0.0142	0.0187	0.0160	0.0207	0.0168	0.0162
	0.1378	*0.4805*	*0.2549*	*0.3663*	*0.3334*	*0.5574*	*0.6689*	*0.3117*	*0.4075*	*0.6482*
Return real estate	0.6483	0.8747	0.7788	0.3891	0.4944	0.6483	0.6545	0.4557	0.4272	0.6113
	0.0104	*0.0707*	*0.0295*	*0.0005*	*0.0384*	*0.2077*	*0.2754*	*0.1670*	*0.1901*	*0.2821*
Return sector i	0.2339	0.4240	0.2173	0.0792	0.3086	0.1554	0.0126	0.1659	0.2385	0.0114
	0.0015	*0.0448*	*0.0296*	*0.0001*	*0.0003*	*0.3206*	*0.9021*	*0.0056*	*0.0639*	*0.7832*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.0915	-0.0405	0.0480	0.1303	-0.0333	0.1156	-0.1228	-0.1436	0.0497	0.4034
	0.3280	*0.5134*	*0.3885*	*0.0397*	*0.7262*	*0.2374*	*0.2777*	*0.3129*	*0.3099*	*0.0764*
VDAX NEW	-0.0043	0.0014	-0.0039	-0.0027	0.0045	-0.0110	-0.0009	-0.0051	-0.0019	-0.0181
	0.3443	*0.6497*	*0.1500*	*0.3700*	*0.3300*	*0.0192*	*0.8668*	*0.4595*	*0.4214*	*0.0990*
Liquidity spread variation	0.0031	0.0100	0.0042	-0.0103	-0.0011	0.0058	0.0074	0.0097	0.0003	-0.0087
	0.4722	*0.0006*	*0.1087*	*0.0005*	*0.8107*	*0.2039*	*0.1636*	*0.1455*	*0.8867*	*0.4105*
T-bill spread variation	-0.0071	-0.0014	0.0033	-0.0238	-0.0216	0.0079	0.0181	-0.0726	-0.0146	-0.0486
	0.6726	*0.8972*	*0.7428*	*0.0353*	*0.2045*	*0.6524*	*0.3703*	*0.0044*	*0.0955*	*0.2323*
Yield spread change	-0.0153	0.0014	-0.0035	0.0007	0.0014	-0.0024	0.0101	0.0004	-0.0082	0.0055
	0.0546	*0.7914*	*0.4550*	*0.8970*	*0.8585*	*0.7778*	*0.2966*	*0.9716*	*0.0498*	*0.7765*
Credit spread change	-0.0063	-0.0028	-0.0024	0.0025	-0.0042	-0.0087	-0.0018	0.0048	-0.0035	-0.0137
	0.1503	*0.3379*	*0.3649*	*0.3917*	*0.3505*	*0.0583*	*0.7353*	*0.4733*	*0.1266*	*0.1985*
Return S&P 500	0.3645	0.3333	0.4395	0.1919	0.3909	0.5758	0.6434	0.6057	0.1214	0.6202
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	0.0873	0.1712	0.1429	0.1263	0.2541	0.1572	-0.0687	0.2065	0.0097	0.3250
	0.2169	*0.0003*	*0.0007*	*0.0084*	*0.0004*	*0.0337*	*0.4220*	*0.0551*	*0.7921*	*0.0590*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.2703	0.2022	0.1103	0.2676	0.2689	0.2084	0.2772	0.3622	0.3170	0.2750
	0.0055	*0.0102*	*0.2038*	*0.0003*	*0.0015*	*0.0142*	*0.0022*	*0.0000*	*0.0007*	*0.0041*
VDAX NEW	-0.0117	-0.0076	-0.0029	-0.0152	-0.0121	-0.0097	-0.0118	-0.0160	-0.0145	-0.0114
	0.0123	*0.0435*	*0.4959*	*0.0000*	*0.0031*	*0.0183*	*0.0067*	*0.0000*	*0.0014*	*0.0135*
Liquidity spread variation	-0.0012	-0.0031	-0.0016	0.0101	-0.0025	-0.0011	-0.0004	-0.0010	-0.0005	-0.0022
	0.7947	*0.4022*	*0.7000*	*0.0036*	*0.5267*	*0.7778*	*0.9203*	*0.7751*	*0.9014*	*0.6244*
T-bill spread variation	-0.0043	-0.0125	0.0007	-0.0097	-0.0075	-0.0066	-0.0021	-0.0034	-0.0064	-0.0120
	0.8051	*0.3736*	*0.9627*	*0.4616*	*0.6211*	*0.6624*	*0.8967*	*0.8030*	*0.7018*	*0.4827*
Yield spread change	0.0184	0.0170	0.0262	0.0196	0.0173	0.0138	0.0146	0.0146	0.0203	0.0205
	0.0222	*0.0097*	*0.0003*	*0.0014*	*0.0142*	*0.0512*	*0.0525*	*0.0217*	*0.0092*	*0.0097*
Credit spread change	0.0052	0.0062	0.0040	0.0011	0.0040	0.0023	0.0021	0.0011	0.0002	0.0042
	0.2577	*0.0926*	*0.3296*	*0.7527*	*0.3107*	*0.5650*	*0.6171*	*0.7533*	*0.9596*	*0.3449*
Return real estate	0.2638	0.2788	0.2336	0.3127	0.2208	0.2200	0.2803	0.2220	0.4262	0.2797
	0.0003	*0.0000*	*0.0004*	*0.0000*	*0.0006*	*0.0006*	*0.0000*	*0.0001*	*0.0000*	*0.0001*
Return sector i	0.0974	0.2799	0.1508	0.0138	0.1806	0.2262	0.1014	0.0542	0.1248	0.0330
	0.0000	*0.0000*	*0.0000*	*0.1711*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*

Table 12: Quantile regression results Germany over the calm period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. The daily real estate returns were interpolated from weekly returns of the DIMAX index. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$. The variables were added in a stepwise manner for those sectors with only insignificant coefficients.

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.9072	-0.2863	0.1610	-2.7828	-0.9631	-0.9147	-1.6519	-0.1783	-0.9466	-3.0097
	0.0000	*0.2065*	*0.4992*	*0.0029*	*0.0003*	*0.0494*	*0.0035*	*0.6220*	*0.0694*	*0.0092*
VDAX NEW	-0.0279	-0.0424	-0.0630	-0.1678	-0.0270	-0.0201	-0.0514	-0.0654	-0.0895	-0.0574
	0.0004	*0.0000*	*0.0000*	*0.0000*	*0.0085*	*0.2698*	*0.0199*	*0.0000*	*0.0000*	*0.2027*
Liquidity spread variation	-0.0006	0.0013	-0.0023	0.0164	-0.0028	-0.0017	0.0003	0.0040	0.0026	0.0003
	0.7007	*0.4496*	*0.2162*	*0.0244*	*0.1795*	*0.6421*	*0.9406*	*0.1593*	*0.5165*	*0.9720*
T-bill spread variation	0.0489	0.0374	0.0205	0.2585	0.0087	0.0181	0.0357	-0.0194	0.0192	-0.1255
	0.0136	*0.0968*	*0.3866*	*0.0053*	*0.7369*	*0.6951*	*0.5237*	*0.5889*	*0.7108*	*0.2728*
Yield spread change	0.0222	0.0197	0.0131	0.1581	-0.0302	0.0094	0.0222	-0.0273	0.0027	-0.1165
	0.1833	*0.2985*	*0.5128*	*0.0425*	*0.1678*	*0.8087*	*0.6383*	*0.3673*	*0.9511*	*0.2270*
Credit spread change	0.0194	0.0026	0.0154	-0.0554	-0.0283	-0.0213	-0.0312	-0.0097	-0.0450	0.0065
	0.0343	*0.8067*	*0.1610*	*0.1951*	*0.0186*	*0.3180*	*0.2273*	*0.5613*	*0.0602*	*0.9029*
Return CDAX	0.7409	0.4408	0.7133	-0.3816	0.4242	0.4836	0.6970	0.5249	-0.1166	1.5252
	0.0000	*0.0000*	*0.0000*	*0.0919*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.3575*	*0.0000*
Return real estate	0.1692	0.3938	0.0041	0.4016	0.1688	0.1445	-0.0373	0.4963	-0.2026	0.6605
	0.0494	*0.0001*	*0.9685*	*0.3173*	*0.1356*	*0.4717*	*0.8780*	*0.0016*	*0.3677*	*0.1844*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.5644	-1.2119	-1.2131	0.1207	-1.2403	-1.7263	-1.4306	-1.0969	-2.1373	-1.2401
	0.1973	*0.1267*	*0.0692*	*0.7922*	*0.0157*	*0.0000*	*0.0000*	*0.0601*	*0.0517*	*0.0076*
VDAX NEW	-0.0550	-0.0659	-0.0684	-0.0645	-0.0461	-0.0174	-0.0263	-0.0475	-0.0320	-0.0435
	0.0014	*0.0339*	*0.0089*	*0.0003*	*0.0215*	*0.0338*	*0.0000*	*0.0373*	*0.4552*	*0.0165*
Liquidity spread variation	-0.0042	-0.0031	0.0041	-0.0035	-0.0034	-0.0060	-0.0059	-0.0038	-0.0053	-0.0021
	0.2204	*0.6216*	*0.4367*	*0.3301*	*0.3936*	*0.0003*	*0.0000*	*0.4099*	*0.5399*	*0.5590*
T-bill spread variation	0.0656	0.1663	0.1260	0.1302	0.1548	0.2009	0.1495	0.1057	0.1703	0.1745
	0.1259	*0.0312*	*0.0450*	*0.0023*	*0.0016*	*0.0000*	*0.0000*	*0.0591*	*0.0944*	*0.0001*
Yield spread change	0.0865	0.2057	0.0894	0.1498	0.1532	0.1735	0.1908	0.1224	0.2332	0.1555
	0.0145	*0.0011*	*0.0830*	*0.0000*	*0.0001*	*0.0000*	*0.0000*	*0.0072*	*0.0046*	*0.0000*
Credit spread change	0.0259	0.0254	-0.0214	0.0276	0.0166	0.0314	0.0280	0.0078	0.0373	0.0255
	0.1977	*0.4867*	*0.4851*	*0.1903*	*0.4822*	*0.0011*	*0.0002*	*0.7712*	*0.4605*	*0.2315*
Return real estate	0.0520	-0.1274	-0.0800	0.2837	-0.1069	-0.2417	-0.1997	-0.2319	0.5167	0.0425
	0.7804	*0.7110*	*0.7730*	*0.1263*	*0.6253*	*0.0090*	*0.0037*	*0.3574*	*0.2438*	*0.8271*
Return sector i	0.4393	-0.0884	0.2264	0.0537	0.0786	0.3017	0.2072	0.1825	0.1531	0.0367
	0.0004	*0.7182*	*0.1002*	*0.2968*	*0.5906*	*0.0000*	*0.0000*	*0.2830*	*0.5058*	*0.4687*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.1720	-0.0816	0.0594	-0.1342	0.0588	0.2622	-0.1943	-0.0901	0.0839	-0.0837
	0.2103	*0.3188*	*0.5408*	*0.1665*	*0.6260*	*0.0238*	*0.4595*	*0.3208*	*0.4495*	*0.7655*
VDAX NEW	0.0050	0.0008	-0.0025	0.0019	-0.0039	-0.0131	0.0030	0.0039	-0.0075	0.0015
	0.3475	*0.7960*	*0.5103*	*0.6175*	*0.4087*	*0.0040*	*0.7672*	*0.2710*	*0.0844*	*0.8908*
Liquidity spread variation	0.0006	0.0014	0.0001	0.0006	-0.0003	0.0014	0.0009	-0.0004	0.0020	0.0002
	0.5874	*0.0355*	*0.8582*	*0.4653*	*0.7928*	*0.1129*	*0.6532*	*0.6085*	*0.0228*	*0.9140*
T-bill spread variation	0.0155	0.0265	0.0162	0.0020	0.0130	0.0117	-0.0076	0.0254	-0.0077	0.0791
	0.2556	*0.0012*	*0.0930*	*0.8389*	*0.2788*	*0.3088*	*0.7696*	*0.0049*	*0.4844*	*0.0047*
Yield spread change	0.0057	0.0156	0.0158	0.0042	0.0083	0.0067	-0.0127	0.0033	-0.0134	0.0336
	0.6220	*0.0234*	*0.0531*	*0.6081*	*0.4103*	*0.4874*	*0.5646*	*0.6684*	*0.1488*	*0.1526*
Credit spread change	-0.0020	0.0070	0.0059	-0.0022	-0.0013	0.0011	-0.0103	-0.0003	-0.0041	-0.0114
	0.7532	*0.0640*	*0.1868*	*0.6294*	*0.8217*	*0.8386*	*0.3947*	*0.9402*	*0.4173*	*0.3747*
Return CDAX	0.6026	0.4871	0.4341	0.2748	0.3822	0.4486	0.7464	0.4332	0.0711	1.1820
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0086*	*0.0000*
Return real estate	0.0748	0.1392	0.1242	0.0680	0.1827	0.1402	0.1010	0.2062	0.0297	0.2080
	0.2068	*0.0001*	*0.0032*	*0.1046*	*0.0005*	*0.0052*	*0.3733*	*0.0000*	*0.5352*	*0.0864*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.1925	0.0842	0.1163	0.1415	-0.0453	-0.0493	0.0820	0.0519	0.1518	-0.0664
	0.1134	*0.4595*	*0.4581*	*0.1810*	*0.7385*	*0.6376*	*0.5676*	*0.7028*	*0.4059*	*0.6155*
VDAX NEW	-0.0061	-0.0030	-0.0059	-0.0066	-0.0013	-0.0013	-0.0010	-0.0016	-0.0030	-0.0040
	0.2020	*0.5002*	*0.3399*	*0.1117*	*0.8095*	*0.7589*	*0.8595*	*0.7701*	*0.6712*	*0.4380*
Liquidity spread variation	0.0002	0.0010	0.0012	0.0009	0.0014	0.0006	-0.0001	0.0002	0.0007	0.0018
	0.8656	*0.2797*	*0.3239*	*0.2801*	*0.1815*	*0.4349*	*0.9060*	*0.8694*	*0.6219*	*0.0785*
T-bill spread variation	0.0153	0.0248	0.0500	0.0760	0.0505	0.0368	0.0677	0.0310	0.1243	0.0455
	0.1987	*0.0254*	*0.0008*	*0.0000*	*0.0001*	*0.0003*	*0.0000*	*0.0179*	*0.0000*	*0.0004*
Yield spread change	0.0164	0.0289	0.0417	0.0729	0.0433	0.0393	0.0581	0.0371	0.1192	0.0458
	0.0951	*0.0014*	*0.0006*	*0.0000*	*0.0001*	*0.0000*	*0.0000*	*0.0005*	*0.0000*	*0.0000*
Credit spread change	-0.0009	0.0010	-0.0045	-0.0013	-0.0004	-0.0031	0.0047	0.0045	0.0081	0.0020
	0.8691	*0.8548*	*0.5367*	*0.7864*	*0.9498*	*0.5207*	*0.4823*	*0.4752*	*0.3354*	*0.7488*
Return real estate	0.1543	0.1914	0.2453	0.4668	0.2344	0.1535	0.3452	0.2519	0.6602	0.2707
	0.0030	*0.0001*	*0.0002*	*0.0000*	*0.0001*	*0.0010*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return sector i	0.4320	0.4640	0.2793	0.0194	0.4128	0.4966	0.2042	0.4713	-0.0067	0.1284
	0.0000	*0.0000*	*0.0000*	*0.1029*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.8615*	*0.0000*

Table 13: Quantile regression results Germany over the crisis period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. The daily real estate returns were interpolated from weekly returns of the DIMAX index. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$. The variables were added in a stepwise manner for those sectors with only insignificant coefficients.

2.5%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-0.7954	-0.2030	-0.6233	-4.5911	-0.5219	-0.7123	-1.6031	-0.5897	-2.1178	-2.2934
	0.0001	*0.3620*	*0.0002*	*0.0002*	*0.2014*	*0.0050*	*0.0001*	*0.0004*	*0.0018*	*0.0005*
VDAX NEW	-0.0485	-0.0517	-0.0204	0.1203	-0.0347	-0.0437	-0.0581	-0.0340	0.0509	-0.0009
	0.0000	*0.0000*	*0.0166*	*0.0570*	*0.1014*	*0.0009*	*0.0043*	*0.0001*	*0.1467*	*0.9794*
Liquidity spread variation	0.0036	0.0036	0.0004	-0.0516	0.0030	0.0047	0.0122	0.0015	-0.0198	-0.0182
	0.2244	*0.2624*	*0.8686*	*0.0034*	*0.6094*	*0.1947*	*0.0315*	*0.5184*	*0.0418*	*0.0546*
T-bill spread variation	-0.0011	-0.0161	0.0108	0.1492	-0.0161	-0.0638	0.0138	-0.0659	0.0787	0.0398
	0.9525	*0.4138*	*0.4599*	*0.1675*	*0.6561*	*0.0046*	*0.6913*	*0.0000*	*0.1894*	*0.4945*
Yield spread change	-0.0158	0.0012	-0.0005	0.1211	-0.0165	-0.0331	0.0052	-0.0572	0.0460	0.0459
	0.2506	*0.9376*	*0.9656*	*0.1368*	*0.5445*	*0.0509*	*0.8437*	*0.0000*	*0.3087*	*0.2956*
Credit spread change	0.0150	0.0027	-0.0058	0.0569	0.0034	-0.0020	-0.0022	-0.0147	0.0044	-0.0226
	0.0024	*0.6164*	*0.1391*	*0.0518*	*0.7302*	*0.7442*	*0.8155*	*0.0002*	*0.7866*	*0.1524*
Return CDAX	0.6531	0.4677	0.4847	-0.1482	0.5170	0.6529	0.4930	0.6489	0.0960	1.0768
	0.0000	*0.0000*	*0.0000*	*0.6430*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.5884*	*0.0000*
Return real estate	0.4849	0.3667	-0.0129	0.9483	0.4028	0.2590	0.0130	0.3785	-0.0963	-0.3986
	0.0011	*0.0225*	*0.9133*	*0.2806*	*0.1714*	*0.1565*	*0.9633*	*0.0016*	*0.8434*	*0.4004*
2.5%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	-1.5724	-2.2535	-2.1925	-0.0609	-1.8386	-2.0903	-1.4572	-1.7362	-1.5067	-1.5468
	0.0000	*0.0000*	*0.0010*	*0.7618*	*0.0008*	*0.0000*	*0.0109*	*0.0020*	*0.0130*	*0.0012*
VDAX NEW	0.0243	0.0488	0.0447	-0.0649	0.0354	0.0321	0.0381	0.0511	0.0263	0.0349
	0.0350	*0.0447*	*0.1943*	*0.0000*	*0.2119*	*0.1919*	*0.1963*	*0.0774*	*0.4011*	*0.1561*
Liquidity spread variation	-0.0186	-0.0235	-0.0179	0.0046	-0.0183	-0.0153	-0.0223	-0.0235	-0.0212	-0.0211
	0.0000	*0.0005*	*0.0610*	*0.1092*	*0.0204*	*0.0249*	*0.0068*	*0.0036*	*0.0152*	*0.0021*
T-bill spread variation	-0.0027	0.0850	0.0016	0.0240	0.0099	0.0362	0.0369	0.0241	0.0528	0.0328
	0.8835	*0.0269*	*0.9769*	*0.1358*	*0.8240*	*0.3466*	*0.4322*	*0.5978*	*0.2757*	*0.3990*
Yield spread change	0.0037	0.0642	0.0120	0.0289	0.0124	0.0412	0.0202	0.0228	0.0444	0.0217
	0.7874	*0.0199*	*0.7687*	*0.0106*	*0.6984*	*0.1366*	*0.5487*	*0.4916*	*0.1923*	*0.4357*
Credit spread change	0.0131	0.0333	-0.0126	-0.0042	0.0133	0.0168	-0.0126	0.0140	-0.0109	-0.0006
	0.0150	*0.0031*	*0.4268*	*0.3829*	*0.3119*	*0.1407*	*0.3585*	*0.2979*	*0.4519*	*0.9567*
Return real estate	0.5663	0.2301	0.6616	0.6440	0.5108	0.6279	0.8682	0.5915	0.9922	0.9005
	0.0004	*0.4932*	*0.1625*	*0.0000*	*0.1957*	*0.0639*	*0.0318*	*0.1429*	*0.0195*	*0.0073*
Return sector i	0.3000	0.2755	0.2450	0.0364	0.4788	0.1836	0.1156	0.4136	-0.0085	0.0559
	0.0000	*0.0964*	*0.2867*	*0.1111*	*0.0119*	*0.2056*	*0.3622*	*0.0286*	*0.9503*	*0.4001*
50%-quantile sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.0023	0.0519	0.0686	0.1546	0.1373	0.2029	-0.0306	0.0730	-0.0398	0.0588
	0.9778	*0.4719*	*0.2693*	*0.0027*	*0.0318*	*0.0289*	*0.7909*	*0.2998*	*0.6187*	*0.7762*
VDAX NEW	0.0033	-0.0056	-0.0111	-0.0070	-0.0054	-0.0057	-0.0003	-0.0030	-0.0045	-0.0150
	0.4385	*0.1336*	*0.0006*	*0.0083*	*0.1039*	*0.2325*	*0.9602*	*0.4155*	*0.2756*	*0.1620*
Liquidity spread variation	-0.0012	0.0009	0.0019	0.0003	0.0000	-0.0004	0.0008	0.0001	0.0018	0.0014
	0.3297	*0.3766*	*0.0322*	*0.6446*	*0.9734*	*0.7490*	*0.6364*	*0.9459*	*0.1271*	*0.6332*
T-bill spread variation	-0.0057	-0.0025	0.0193	-0.0076	-0.0053	-0.0168	0.0129	-0.0062	-0.0029	0.0171
	0.4340	*0.6964*	*0.0005*	*0.0963*	*0.3540*	*0.0410*	*0.2091*	*0.3210*	*0.6806*	*0.3502*
Yield spread change	0.0021	-0.0073	0.0128	-0.0071	-0.0062	-0.0124	-0.0033	-0.0021	0.0020	0.0131
	0.7030	*0.1317*	*0.0020*	*0.0399*	*0.1443*	*0.0453*	*0.6669*	*0.6532*	*0.7149*	*0.3448*
Credit spread change	0.0055	0.0012	0.0022	0.0002	-0.0010	-0.0009	-0.0055	0.0005	0.0005	-0.0069
	0.0055	*0.4741*	*0.1446*	*0.8520*	*0.5264*	*0.7032*	*0.0468*	*0.7694*	*0.7977*	*0.1624*
Return CDAX	0.6230	0.4266	0.4182	0.2397	0.4321	0.4666	0.5694	0.4360	0.1195	0.7623
	0.0000	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Return real estate	0.0641	0.1314	0.1587	-0.0167	0.1766	0.0542	0.0770	0.1767	-0.0371	-0.0001
	0.2799	*0.0117*	*0.0004*	*0.6530*	*0.0001*	*0.4172*	*0.3549*	*0.0005*	*0.5199*	*0.9995*
50%-quantile ex sector index returns										
	Basic Materials	**Industrials**	**Financials**	**Consumer Goods**	**Consumer Services**	**Healthcare**	**Telecommunication**	**Technology**	**Utilities**	**Energy**
Intercept	0.1642	0.1744	0.2338	0.2159	0.1728	0.1468	0.2653	0.0894	0.3649	0.1855
	0.0069	*0.0124*	*0.0006*	*0.0234*	*0.0044*	*0.0478*	*0.0004*	*0.2661*	*0.0001*	*0.0369*
VDAX NEW	-0.0132	-0.0078	-0.0110	-0.0153	-0.0086	-0.0094	-0.0113	-0.0067	-0.0246	-0.0082
	0.0000	*0.0311*	*0.0019*	*0.0019*	*0.0063*	*0.0145*	*0.0032*	*0.1070*	*0.0000*	*0.0739*
Liquidity spread variation	0.0019	0.0001	0.0007	0.0022	0.0003	0.0010	0.0002	0.0008	0.0026	0.0009
	0.0332	*0.9463*	*0.4581*	*0.1053*	*0.7069*	*0.3300*	*0.8630*	*0.5062*	*0.0533*	*0.4708*
T-bill spread variation	0.0166	0.0184	0.0110	0.0502	0.0176	0.0244	0.0256	0.0131	0.0471	0.0280
	0.0010	*0.0013*	*0.0572*	*0.0000*	*0.0004*	*0.0001*	*0.0000*	*0.0457*	*0.0000*	*0.0001*
Yield spread change	0.0115	0.0179	0.0094	0.0490	0.0179	0.0175	0.0259	0.0113	0.0444	0.0300
	0.0018	*0.0000*	*0.0244*	*0.0000*	*0.0000*	*0.0001*	*0.0000*	*0.0172*	*0.0000*	*0.0000*
Credit spread change	-0.0024	-0.0009	-0.0001	0.0022	0.0000	0.0011	0.0008	0.0011	-0.0006	0.0016
	0.1032	*0.6018*	*0.9695*	*0.3461*	*0.9790*	*0.5318*	*0.6646*	*0.5669*	*0.7982*	*0.4568*
Return real estate	0.0703	0.0449	0.0609	0.3858	0.0751	0.1051	0.1470	0.0327	0.1871	0.1364
	0.1036	*0.3671*	*0.2082*	*0.0000*	*0.0850*	*0.0462*	*0.0051*	*0.5728*	*0.0036*	*0.0289*
Return sector i	0.3427	0.4365	0.3692	0.0243	0.4580	0.4217	0.2320	0.4832	0.0608	0.1304
	0.0000	*0.0000*	*0.0000*	*0.0250*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0033*	*0.0000*

Table 14: Quantile regression results Germany over the recovery period. The quantile regressions were run at the 2.5% and 50%-quantile where the 50%-quantile represents the median state. The p-values are shown in italics in the second line of each state variable. The daily real estate returns were interpolated from weekly returns of the DIMAX index. After each regression, the insignificant variables at the 10% level were excluded and the regressions were run again until the regression results only returned significant coefficients. These coefficients were then used to estimate $\widehat{\Delta CoVaR}$. The variables were added in a stepwise manner for those sectors with only insignificant coefficients.