Volatility Relation between Credit Default Swap and Stock market: New Empirical tests

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Abstract

This paper investigates the relation between volatility of CDS and stock prices using a sample of 109 European investment-grade companies, during the period January 2012 – January 2016. We apply two multivariate GARCH models, namely, the Dynamic Conditional Correlation (DCC) model to study the type of volatility relation and its persistence, and the BEKK-GARCH model to study the volatility spillover between CDS and stock prices, and the direction of the spillover effect. We find strong evidence in support of the hypothesis that the volatility of CDS and stock prices across European investment-grade companies can be modelled under dynamic conditional correlation assumption. When we split the volatility into two components, namely, ARCH-effect (that is, short-run persistence of shocks) and GARCH-effect (that is, long-run persistence), we find that in most cases the persistence of correlation is statistically significant, while the impact of innovations (shocks) on correlation is not. Our tests of volatility spillover hypothesis provide new evidence that the volatility spillover is bi-directional with the predominant leadership of the European CDS market over the stock market.

Keywords: Credit Default Swap, iTraxx index, volatility, multivariate GARCH

JEL classification: C58, G10, G12

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[1] In the memory of my co-author Dr. Elena Marinova, who was a grood friend and excellent researcher.

1. Introduction

Credit Default Swap (CDS) emerged in the late 1990s-early 2000s as an insurance instrument transferring risk from commercial banks' balance sheets to third parties - mainly insurance companies and investors. Basically, there are two parties involved – the protection buyer and the protection seller, where the first one "shorts" the credit and pays a premium to the second one. The two parties involved in the transaction bet on credit events such as bankruptcy, default, and debt restructuring. The protection buyer pays a premium as a percentage of the notional value each quarter (denoted as an annualized spread in basis points), and receives payoff from the seller in case a credit-related event occurs. In addition to the technical features of a CDS contract, it is worth mentioning the following characteristics of CDS:

(1) Credit Default Swap is perceived as a purer credit risk measure than corporate bonds. According to Ötker-Robe and Podpiera (2010), CDS spread is a more direct measure of credit risk than corporate bonds' credit spreads. The credit spread is derived by subtracting a risk-free interest rate from the corporate bond's yield. While selecting the risk-free rate and the term structure of the risk-free rate adds significant degree of discretion to corporate bonds spread, the CDS is a spread based on arbitrage-free pricing.

(2) There are different arguments of whether CDS reflects liquidity risk premium or not. Longstaff, Mithal and Neis (2005) find that CDS is far less sensitive to liquidity compared to corporate bonds, whereus Fabozzi, Cheng and Chen (2007) find that CDS does not contain any liquidity premium. Other authors (see e.g., Tang and Yan, 2007) emphasize on different aspects of liquidity issue related to CDS; they find that liquidity effect on CDS spreads is significant with an estimated liquidity premium similar to those of Treasury bonds and corporate bonds.

(3) Credit Default Swap is based on standardized terms, unlike corporate bonds universe where spreads reflect differences in indenture characteristics - seniority, embedded options, guarantees, and others.

(4) Credit Default Swap dominates corporate bonds in responding more quickly to changes in credit conditions (Zhu, 2004; Blanco, Brennan and Marsh at al., 2004).

The CDS market has withnessed a significant growth in the last decade. According to the International Swaps and Derivatives Association (ISDA Survey, 2009), the CDS notional amount outstanding totalled USD 30.4 trillion at year-end 2009, up from USD 2.2 trillon as of the end of 2002. The CDS market was one of the derivative market segments that suffered the most during the recent financial crisis - the CDS notional amount outstanding for the whole of 2008 was down 38 percent from $62.2 trillion at year-end 2007 (ISDA Survey, 2008). This amount was reduced in the post-crises period to $36 trillion in 2011.

In this paper, we investigate the relation between volatility of CDS and stock prices. Volatility has a key role in analysing and forecasting risk. There are two basic concepts of volatility – unconditional and conditional. Under the conditional concept, volatility is a model-based volatility and updates regularly when new information is coming to the market, while the unconditional volatility is not changing. The long-term volatility is constant, while the model-based volatility changes. Financial time series (as stock returns) are characterized by volatility clustering and changing volatility that tends to be serially correlated and cannot be modelled under the assumption of homoscedasticity (Schreiber, Klüppelberg, and Wagner, 2012). The serial correlation can be modelled via Autoregressive Conditional Heteroscedasticity (ARCH) models, developed by Engle (1982), and its generalisation process (GARCH), developed by Bollerslev (1986). Usually, serial correlation effects are captured by modelling conditional variance as a function of the squares of the previous returns and past variances, that is, these processes can be used to model the nonlinearity effects in financial data. While the univariate GARCH models are appropriate tools to address the problems of risk analysis and asset allocation, in case of hedging these models

need to be extended to multivariate ones that analyse variances and covariances of the financial time series (Wang and Yao, 2005; Minović, 2010). This is due to the fact that all models related to risk analysis and risk management require covariances as inputs (Minović, 2010). From a multivariate perspective, there are two well-known specifications, namely, the dynamic and the constant correlation GARCH (that is, DCC-GARCH and CCC-GARCH). The main advantage of multivariate GARCH models is that they are able to capture the important features of univariate GARCH models and, in the same time, to extend the analysis to more than just one asset.[2]

The existing research on the relation between Credit Default Swap (CDS) and stock prices is mainly focused on investigating the cointegration (that is, long-run relation) and the Granger causality (that is, short-term relation) between these two time series (at changes/ returns level). While the changes/returns relation reveals interesting patterns (that is, changes in one of the variables - CDS or stock prices, can cause changes in the second variable, or alternatvely, one can define the long-term relation that can be used as a proxy for price discovery), the volatility modelling captures the impact of external shocks and/or external volatility on stock market caused by changes in CDS and vice versa – from CDS to stock market. Hence, volatility modelling extends the framework of analysis of just changes/returns. Yet, the existing evidence on volatility relation between European CDS and stock market is limted.

Our paper contributes to the existing empirical literature that investigates CDS market and its volatility in two ways. First, by analysing the time-varying characteristics of CDS in conjunction with stock return volatility of the European investment-grade companies, we provide new evidence that both correlations and covariances between CDS and stock prices exhibit time-varying pattern. Second, by estimating the spillover effect between CDS and stock prices volatility, we find that volatility spillover is bi-directional, meaning that stock price returns impact on CDS volatility and vice versa – CDS changes impact on stock price volatility. To differentiate our work from previous research on CDS that investigates the spillover effect at price level (that is, cointegration analysis), we analyze volatility co-movement between CDS and stock prices. Although this topic has been widely investigated, most of the previous papers analyze volatility at broad-index level (for example, iTraxx level), and not at the individual companies level as we attempt to do. Using a sample of 109 European investment-grade companies, during the period of January 2012 to January 2016, we find strong evidence of bi-directional impact of shocks with the predominant leadership of the European CDS market over the stock market.

This paper is organised as follows. Section 2 presents literature review and hypotheses derived from the analysis of the previous empirical findings, Section 3 introduces the methodology, and Section 4 presents Data set and sample statistics. Section 5 illustrates the empirical results, and Section 6 concudes the paper.

2. Literature Review

The relation between CDS market and stock market has been extensively investigated so far, either at sovereign and stock indices level, or at individual companies level. While some of the previous research papers investigate the long-term relation between corporate CDS and

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[2] At corporate level, the relationship between credit market and stock market has been analysed from the perspective of Merton (1974) model, which postulates that the value of a credit derivative must be linked to the probability of a credit event occurring in the respective company and the efficient market hypothesis. Merton's (1974) structural model uses the current value of the company's assets (stochastic process that follows a geometric Brownian motion), the capital structure and the volatility of the company's assets as inputs.

stock prices, and explore the nature of this relation, that is, linear or non-linear (Mateev and Marinova, 2016), others analyze the link between corporate CDS and global market volatility (Figuerola-Ferretti and Paraskevopoulos, 2010). For example, Figuerola-Ferretti and Paraskevopoulos (2010) investigate the price discovery[3] between the VIX index and 47 most traded iTraxx companies (3-year, 5-year and 10-year maturity iTraxx indexes), for the period June 2004 - December 2009. They find cointegration to exist between market risk and credit risk, and a predominant price leadership in the VIX market, implying that CDS adjust to market risk when there is temporary mispricing from the long-term equilibrium.[4] The study investigates how market risk and credit risk are related, and what credit risk information can be inferred from forward volatility of equity markets. They conclude that if similar economic fundamentals affect the value of the two indices, rational long-run interdependency should exist between their price levels.

A number of empirical studies analyse the Credit Default Swap (CDS) using multivariate GARCH models, but most of them are focusing either on sovereign CDS or CDS at index level. For example, Schreiber, Klüppelberg, and Wagner (2012) analyze daily quotes of three time series, the Dow Jones Euro Stoxx 50 index, the Dow Jones VStoxx index (a volatility index based on options on the Euro Stoxx 50 index), and the CDS index iTraxx Europe, over the period June 2004 - April 2009.[5] The study provides evidence of time varying conditional variances and correlations, with dependencies increasing after the outbreak of the financial crisis of 2007-2008. Ural and Demireli (2015) investigate sovereign CDS spreads (in case of Brazil, Russia, China, South Africa and Turkey) during the period January 2003 - November 2014, and find that CDS volatility has increased during the global crisis period. They report that the source of degree of innovation (shocks) is China CDS's risk premium and the source of volatility transmission is Brazil and Turkey's CDS risk premiums.

Wang and Moore (2012) analyse the integration of CDS markets (based on weekly observation of the 5-year CDS segment) in 38 developed and emerging countries with the US market during the subprime crisis period using dynamic conditional correlation model. The study finds that the Lehman Brothers shock strengthened the integration, in particular, for developed markets. The dynamics of correlation, which is time dependent, is modelled together with the volatility of the CDS spreads. By accounting for the time varying behaviour of data series, possible changes in integration can be detected over time. Hence, the timing of shifts in the structural linkages between the US and other markets can be endogenously identified. A more recent study of Toparli and Balcilar (2016) investigates the risk spillover mechanism across oil market, stock market and oil related CDS sector (more specifically, auto, oil, chemicals, natural gas, and utilities sectors), based on daily observations during the period of 2004 to 2016. The study finds that covariances tend to respond very fast to Lehman Brothers bankruptcy shock and this response is higher in the long-run.

There are several empirical studies that use multivariate GARCH framework to analyse the relation between CDS and stock prices (Scheicher, 2009; Belke and Gokus, 2014). For example, Scheicher (2009) investigates conditional correlations between stock price returns and CDS changes for 240 companies during the period 2003-2005, using Exponentially

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[3] Price discovery as defined by Figuerola-Ferretti and Paraskevopoulos (2010) is the process of uncovering the asset's full information or permanent value. The unobservable permanent price reflects the fundamental value of the underlying asset.

[4] Figuerola-Ferretti and Paraskevopoulos (2010) argue that if the VIX index and iTraxx CDS are cointegrated, price discovery may be considered as a dynamic process in search of an equilibrium state. This requires a sudden adjustment of both indexes to new equilibrium for a given arrival of new information. If both markets do not react to new information in the same manner, one may lead the other. When such a lead-lag relationship appears, the leading market is said to provide price discovery.

[5] Schreiber, Klüppelberg, and Wagner (2012) investigate conditional variances at aggregate index level, instead of individual companies level.

Weighted Moving Average (EWMA) approach. The study shows that during periods of market turbulence, correlations between stock price returns and CDS changes increase and those correlations are highly volatile. The correlation is negative for both US and European companies. Furthermore, time-varying correlation is observed both for high-yield and investment-grade companies. Schreiber, Klüppelberg, and Wagner (2012) employ two multivariate GARCH models – BEKK and DCC (see also Section 3), to investigate the conditional covariance structure, using daily data for iTraxx Europe, Euro Stoxx 50 and VStoxx indeces, during the period June 2004 - April 2009. The study finds that the covariance and correlation are changing over time. Meng at al. (2009) analyze the volatility transmission between CDS, bond and equity markets. The authors use BEKK-GARCH model for 10 large US companies during the period 2003-2005. They find little evidence that CDS is the originator for transmission of volatility in equity and bond markets. However, the study reports there is evidence for an alternative view that as investors search for yield across different asset classes, the links between CDS, bond, and equity markets strengthen. Volatility in any of the three markets is commonly transmitted to the other two markets.

Previous studies find also that volatility increases during the recent financial crisis. For example, Coudert and Gex (2010) use volatility patterns in CDS market to identify the start of a crisis period (in this case, the GM and Ford crisis in 2005). Since CDS spreads, stock prices and bond yield spreads fundamentally represent the financial conditions of a company, events affecting the financial outlook of the firm should also be observed in the volatility of all three variables (that is, CDS spreads, stock price returns and bond yield spreads). However, the majority of the previous papers investigate volatility patterns at aggregate level of CDS and stock market, that is, at sovereign, index, and sector levels. In this paper, we analyze the volatility between CDS and stock prices at individual companies level. We test the following two hypotheses:

H1: The correlation between volatilities of CDS and stock prices follows a dynamic framework, meaning that the correlation is not constant.
H2: There is no volatility spillover between CDS and stock prices, that is, CDS and stock markets are independent.

3. Methodology

The aim of this paper is to analyse the relation between the volatility of European CDS and stock markets. Following previous research, we employ two models in our analysis. The Dynamic Conditional Correlation (DCC)-GARCH model is used to study the type of volatility correlation, that is, dynamic (changing over time) or constant. The second model, BEKK-GARCH, is used to study the presence of volatility spillover between CDS and stock prices; this model is far more computationally intensive. The first model is appropriate tool to indicate the type of correlation and its persistence, while the second one will help us identify if there is any contagion in the volatility between CDS and stock prices.[6] Therefore, the BEKK-GARCH model has not only the advantage of analyzing time-varying variances and covariances, but may also be used to capture the cross-market volatility spillover and the asymmetric responses between the analysed variables. Li and Majerowska (2006) argue that

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[6] In order to estimate the DCC-GARCH and BEKK-GARCH models, we used the *R* libraries "rmgarch" (for DCC-GARCH) and "mgarch" (for BEKK-GARCH). To estimate BEKK-GARCH model we may also use another library available - "MTS" but we decided to use "mgarch" since in the empirical literature there are many examples of using "mgarch" (see Chevallier (2012), Econometric Analysis of Carbon Markets, Springer Science+Business Media B.V.).

the cross-market effects capturing return linkage and transmission of shocks and volatility from one market to another, are often used in the literature to indicate market integration. The estimated time-varying conditional co-variances by using the BEKK model can measure the extent of market integration in terms of volatility.

The Dynamic Conditional Correlation (DCC) model that has been proposed by Engle and Sheppard (2001) and Engle (2002), basically represents a new class of multivariate model (as an alternative to the univariate models applied previously that failed to capture the co-movement of the assets), and is appropriate to examine correlation dynamics among assets. The DCC model is based on the constant conditional correlation estimator of Bollerslev (1990), and can be presented in the following format, given that R is the correlation matrix with the conditional correlations, and H is the covariance matrix:

$$H_t = D_t R D_t \ , \tag{1}$$

Where:
$$D_t = diag\{\sqrt{h_{i,t}}\} \tag{2}$$

In equation (2), h contains the univariate GARCH model parameters, that are ARCH-effect (the influence of squared past volatility shocks on current volatility, that is, short-run persistence of shocks) and GARCH-effects (influence of squared past volatility spillover, that is, long-run volatility persistence). In a further breakdown of equation (2), we can show that:

$$h_{i,t} = \alpha_{i0} + \sum_{q=1}^{Q} \alpha_{iq} \, a_{i,t-q}^2 + \sum_{p=1}^{P} \beta_{ip} \, \sigma_{i,t-p} \ , \tag{3}$$

Where:
α refers to ARCH-effect in the variance equation, and β is the GARCH-effect;
$a_{i,t-q}^2$ is the squared past volatility shock;
$\sigma_{i,t-p}$ is the past standard deviation.

The DCC model can be presented as:

$$H_t = D_t R_t D_t \ , \tag{4}$$

allowing the correlation to be time-varying unlike the constant correlation model. Basically, equation (4) shows that the conditional covariance matrix is decomposed into conditional standard deviations (D_t) and correlation matrix (R_t).

DCC model contains two parameters. The first parameter provides information about the impact of innovations (shocks) on the correlation, and the second one indicates the persistence of the correlation. During the analysis of the DCC-GARCH model, we estimate the significance of the following parameters:
1. The ARCH and GARCH parameters – based on this we will be able to conclude if GARCH model is appropriate and preferred instead of ARCH model.
2. The joint conditional correlation parameters – based on this we will be able to conclude if the dynamic correlation is appropriate and preferred instead of constant correlation.

The second multivariate model (BEKK-GARCH) originates from the work of Bollerslev, Engle, and Wooldridge (1988) and their VEC-GARCH model, an extension of the univariate GARCH model. In this study, we use Baba, Engle, Kraft, and Kroner's (1990) BEKK specification of the Multivariate GARCH (MGARCH) model to highlight the transmission of

price volatility between CDS and stock prices. The general version of BEKK model can be presented as:

$$H_{i,t} = C_0^T C_0 + \sum_{k=1}^{K} \sum_{i=1}^{Q} A_{ik}^T \varepsilon_{t-i} \varepsilon_{t-i}^T A_{ik} + \sum_{k=1}^{K} \sum_{i=1}^{Q} G_{ik}^T \sum_{t-i} G_{ik} \,, \tag{5}$$

Where:
H is the covariance matrix.

In equation (5), the matrices *A* and *G* represent, respectively, the ARCH-effect (the influence of squared past volatility shocks on current volatility, that is, short-run persistence) and the GARCH-effects (influence of squared past volatility spillover, that is, long-run volatility persistence). However, unlike the DCC-GARCH model, the BEKK-GARCH model provides also information about the spillover between the markets. This means that under the BEKK-GARCH model we can estimate: 1) the impact of the squared past volatility of the stock prices on CDS and vice versa, and 2) the impact of the squared past volatility shocks in stock prices on the current volatility of CDS and vice versa. Hence, we can distinguish between diagonal and non-diagonal elements of *A* and *G* matrices: the non-diagonal elements of matrix *A* (that is, ARCH effects) a_{ik} measure the effect of innovation (shocks) in market *i* on market *k*, while the diagonal elements measure own innovation effects (shocks) of market *i*. Similarly, the non-diagonal elements of matrix *G* (that is, GARCH effects) g_{ik} measure the persistence of conditional volatility spillover between markets (cross-volatility spillover), while the diagonal elements measure own volatility persistence.

In addition to the dynamic conditional correlation and BEKK-GARCH analysis, a test of the residuals of the models for serial correlation is usually required. A good fitted model should have no serial correlation in the squared residuals (that is, no ARCH effect is present). In this study, we use the approach introduced by Tsay (2014). However, it should be mentioned that there is lack of enough clarity in the empirical literature about the procedures to be used in the residuals diagnostic. The appropriate test for serial correlation in the squared residuals used in the multivariate models should substitute the univariate ARCH-LM test. The critical values of the Ljung-Box test should also be adjusted for the fact that the test is applied for model residuals rather than the original series; however, this approach is not straightforward. For this reason, we use the approach to Tsay's (2014) statistics presented by Katzke (2017), in which we extract the covariance matrix from the DCC-GAARCH model to test the adequacy of the model.[7]

4. Data set and sample statistics

Our analysis is based on Markit iTraxx Europe series 24, which consists of 125 most liquid CDS of European investment-grade rated companies, and is published by Markit.[8] (iTraxx indexes are standardized contracts and reference a fixed number of obligors with shared characteristics. Investors can be long or short of the index, which is equivalent to being protection sellers or buyers.) The industrial sectors in the index are represented as follows: autos & industrials and financial industries have both 24% share in the index, consumers – 20%, energy and technology, media and telecommunications - 16% each. We pair daily

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[7] See Katzke (2017), Financial Econometrics Practical, Practical 7: Multi-variate Volatility Modelling, available at http://curiousquant.com/ClassNotes/FinMetrics/Practicals/Practical_7/Practical_7.pdf

[8] See Markit iTraxx Europe series 24, available at:
https://www.markit.com/NewsInformation/NewsAnnouncementsFile?CMSID=6eeeb28203e94f3f83c83d2a586 09ab3

observations of 5-year CDS (highly-liquid CDS segment) and stock prices of the companies included in the iTraxx Europe index, over the period of January 1, 2012 to January 29, 2016.[9] We apply the following selection criterion: all companies in the sample must have both frequently traded CDS and shares (that is, we exclude from the sample companies that do not have liquid CDS). This approach results in a final sample of 109 companies from 13 European countries. The source of information is Thomson Reuters and the analysis is implemented in *R* Program. We use daily logarithmic changes of CDS and stock prices.[10]

Out of 109 iTraxx Europe companies in our sample, 39 companies have all variations of A-credit ratings, and 53 BBB-credit ratings (using S&P definition). Most companies are from the UK (26 companies), followed by France (25 companies), Germany (19 companies), and the Netherlands (11 companies). Table A.1 in Appendix A presents the basic statistics (minimum, maximum, mean, median, and standard deviation) of the daily changes of CDS and stock prices. Out of the 109 companies, there are only 3 cases where the standard deviations of daily changes in stock prices are higher than the standard deviation of daily changes of CDS. The daily CDS changes also have more dips and highs (that is, changes are either very negative or very positive) compared to the stock price changes. Overall, we observe more abrupt changes in the CDS market than in the stock market.

Further, in Table A.2 we present information for Pearson correlation coefficients between stock price changes and CDS changes for all iTraxx companies included in our sample, over the period January 1, 2012 - January 29, 2016. We observe that correlation between CDS changes and stock returns varies widely among the companies but it is negative in all cases; the correlation coefficients range between -0.045 (for Bayerische Landesbank) and -0.575 (for Allianz). These coefficients are statistically significant at the usual level of 5% and 10% significance.

5. Empirical Results

For the sample of 109 European investment-grade companies, constituents of the Markit iTraxx index, we paired the daily observations of 5-year CDS spreads and stock prices during the period of January 1, 2012 to January 29, 2016. The DCC-GARCH(1,1) model (under the assumption of Student's *t* distribution) applied to CDS changes and return series of stock prices of the companies in the index,[11] reveals the following results:

(1)   It is evident that the correlation between CDS and stock prices of European iTraxx companies is dynamic. There are 36 cases where the two DCC parameters are statistically significant, showing that both new information (shocks) and persistence have impact on correlation.

(2)   Within the group of 36 pairs, the analysis of the two DCC coefficients (see equation 5 above) reveals that the impact of innovations (shocks) on correlation is rather limited (the coefficient magnitude is very small in most cases), whereus the correlation is persistent.

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[9] Our preliminary tests show that the models are not well specified. For this reason, we split the whole data set (2008 -2016) into two sub samples (periods), and test the second period (January 01, 2012 - January 29, 2016), which provides much more reliable results.

[10] We use term changes of CDS and stock returns based on the daily price changes, where both of them are calculated in the same way, that is, as logarithmic changes.

[11] We allow for some of the ARCH/GARCH effects not to be statistically significant in the DCC-GARCH(1,1) model in a way that mostly ARCH effects are not significant but not both ARCH and GARCH terms.

(3) There are 59 cases where the first DCC parameter (showing the impact of innovations/shocks) is not statistically significant, while the second DCC parameter (showing volatility persistence) is statistically significant.

The results of the DCC-GARCH model applied to CDS and stock prices of the companies included in our sample, are presented in Table 1. We aslo report *p*-values to identify the level of significance of each estimated GARCH coefficient. Based on these results, we may conclude that the correlation between CDS and stock prices (at return levels) is dynamic.

As a robustness check, we also perform a diagnostic test of the residuals from DCC-GARCH (1,1) model. We find that the residuals from DCC-GARCH(1,1) model, in general, behave properly, in a sense they do not move in patterns (that is, no serial correlation exists as tested by Tsay (2014) MCHdiag test), although some of the tests show that serial correlation is still present in few cases. The results of the four tests, namely, Q(m) of squared series (Lagrange Multiplier, LM), Rank-based, Qk(m) of epsilon_t, and Robust test, are presented in Table 2. These tests detect the presence of conditional heteroscedasticity: if the *p*-value is less than the critical value, we can reject the null hypothesis of no conditional heteroscedasticity and accept the alternative hypothesis for presence of conditional heteroscedasticity. Rank-based and Robust tests are usually considered to be stronger; if the *p*-values of Rank-based and Robust tests are higher than the critical value, we accept the null hypothesis of no conditional heteroscedasticity. Based on this we may conclude that the DCC-GARCH (1,1) models are well fitted. Our analysis shows that there are 10 cases where both Rank-based and Robust tests reject the null hypothesis of no conditional heteroscedasticity. We have additionally 30 cases where either Rank-based or Robust tests lead to rejection of no conditional heteroscedasticity hypothesis (see Table 2).

Next, we apply the BEKK-GARCH(1,1) model to CDS changes and return series of stock prices (on a daily basis). Our results reveal the following:[12]

(1) There are 76 cases in total where one or two of the non-diagonal elements are statistically significance; for these cases we can conclude that there is cross-volatility spillover between CDS and stock prices. For the rest (33 cases), the *G*-matrix's non-diagonal elements are not statistically significant; for these cases we cannot confirm there is volatility spillover, meaning that CDS and stock prices volatilities are independent of each other.

(2) Out of the 76 cases, there are 33 cases where both non-diagonal elements of the *G*-matrix, that is, g_{ik} and g_{ki}, are statistically significant, implying that CDS volatility contributes to stock prices volatility and vice versa, that is, the volatility spillover is bi-directional.

(3) Out of the 76 cases, there are 32 cases where the impact of CDS on stock price volatility is statistically significant (that is, g_{12} is statistically significant while g_{21} is not significant), meaning that the spillover is transmitted from CDS to stock prices.

(4) Out of the 76 cases, there are only 11 cases where the direction of spillover effect is from the stock prices to CDS, that is, g_{21} is statistically significant and g_{12} is insignificant.

The results of the tests using BEKK-GARCH model are presented in Table 3. The way the equiations of the model are structured, indicates that if the none-diagonal GARCH coefficient [1,2] is statistically significant, the spillover effect is transmitted from CDS market to stock market, while if the GARCH coefficient [2,1] is statistically significant, the direction of spillover is from stock prices to CDS. It should be highlighted that the BEKK-GARCH

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[12] In this case we analyse the statistical significance of non-diagonal elements of the GARCH-matrix only at the usual levels of significance of 5% and 10%, that is, we estimate the statistical significance of those coefficients that represent the cross-volatility spillover.

model as implemented raises some convergence warnings, meaning that the results need to be treated with some degree of caution.

Furthermore, the analysis of shocks transmission between CDS and stock prices (as represented by A-matrix in equation (5), namely, the none-diagonal element a_{12} that measures the transmission from CDS to stock prices, and the a_{21} that measures the transmission from stock prices to CDS) shows that the transmission is persistence as coefficient estimates are statistically significant. More specifically, there are in total 87 pairs of CDS and stock prices for which we find evidence of shocks transmission, with 34 cases where the transmission is from stock prices to CDS, and 22 cases where the transmission is from CDS to stock prices. Out of 87 cases, there are 31 cases where the transmission of shocks is bi-directional, that is, both a_{12} and a_{21} are statistically significant.

Based on these results, we may conclude that the innovations (shocks) spillover direction is mostly from stock market to CDS market, but there is also evidence that the shocks spillover is bi-directional. On the other hand, the analysis of volatility spillover shows that the direction is mostly from CDS to stock market. In conclusion, the results do not support our second hypothesis that there is no volatility spillover between CDS and stock market; as evident from the two tests, the coefficients that measure shocks and volatility spillover between CDS and stock prices are, in most cases, statistically significant. Additionally, we are able to identify the direction of the spillover between the two markets.

6. Conclusion

Using a sample of 5-year CDS and stock prices of 109 European iTraxx investment-grade companies, during the period of January 2012 to January 2016, this paper investigates the volatility patterns of CDS and stock prices. We apply multivariate GARCH models (more specifically, DCC-GARCH and BEKK-GARCH) in order to estimate time-varying nature of covariances and cross-market volatility patterns. This type of analysis is important for risk management decisions since both stock prices and CDS volatility are considered as indicator of a company risk. While the majority of previous empirical papers investigate volatility patterns at aggregate level of CDS and stock returns, our paper addresses this issue at individual companies level.

We contribute to the existing literature that associates stock prices and CDS volatility by testing two important hypotheses: 1) volatilities of CDS and stock prices are better represented via dynamic conditional correlation, and 2) there is no volatility spillover between CDS and stock prices. We find evidence that for a large number of companies included in the index, both correlations and covariances between CDS and stock prices exhibit time-varying feature. However, our analysis does not support the second hypothesis; in opposite, we provide strong evidence that there is volatility spillover between CDS and stock prices. Out of 109 companies included in the sample, there are 33 cases where the volatility spillover is bi-directional, that is, both g_{12} and g_{21} coefficients are statistically significant, meaning that stock returns impact on the CDS volatility and vice versa – CDS changes affect stock price volatility. We find also that for 32 companies, the volatility spillover effect is transmitted from CDS to stock market, and, in a limited number of cases (11 companies), the direction of spillover is opposite – from stock market to CDS.

The main limitations of our paper are related to the fact that structural breaks are not considered in the analysis of shocks and volatility transmission between CDS and stock prices. Furthermore, the serial correlation test for residuals from BEKK-GARCH model is not implemented (as mentioned above, there is a lack of an unified approach for residuals diagnostic in case of multivariate models). Therefore, our future work will explore these two issues.

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Table 1. DCC-GARCH (1,1) Parameters and *P*-values

		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Volvo AB	-0.001	0.058	Statoil ASA	0.000	0.124
CDS.ar1		0.154	0.000		0.062	0.023
CDS.omega		0.000	0.049		0.000	0.045
CDS.alpha1		0.453	0.001		0.501	0.000
CDS.beta1		0.546	0.000		0.498	0.004
CDS.shape		2.739	0.000		2.358	0.000
Stock.mu		0.000	0.971		0.000	0.826
Stock.ar1		-0.002	0.952		-0.057	0.068
Stock.omega		0.000	0.080		0.000	0.424
Stock.alpha1		0.017	0.000		0.052	0.000
Stock.beta1		0.979	0.000		0.947	0.000
Stock.shape		4.893	0.000		4.863	0.000
[Joint]dcca1		0.016	0.394		*0.018*	*0.074*
[Joint]dccb1		*0.952*	*0.000*		*0.948*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Akzo Nobel NV	-0.001	0.029	Total SA	-0.001	0.046
CDS.ar1		0.051	0.042		0.072	0.002
CDS.omega		0.000	0.605		0.000	0.021
CDS.alpha1		0.131	0.087		0.362	0.000
CDS.beta1		0.868	0.000		0.637	0.000
CDS.shape		2.563	0.000		2.281	0.000
Stock.mu		0.000	0.286		0.000	0.236
Stock.ar1		0.009	0.793		-0.032	0.323
Stock.omega		0.000	0.000		0.000	0.829
Stock.alpha1		0.131	0.016		0.065	0.523
Stock.beta1		0.000	1.000		0.921	0.000
Stock.shape		5.375	0.000		6.675	0.000
[Joint]dcca1		0.000	1.000		0.009	0.350
[Joint]dccb1		*0.893*	*0.032*		*0.921*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
				United Utilities Group		
CDS.mu	Anglo American PLC	0.000	0.694	PLC	-0.001	0.008
CDS.ar1		0.174	0.000		0.114	0.000
CDS.omega		0.000	0.318		0.000	0.185
CDS.alpha1		0.257	0.125		0.466	0.002
CDS.beta1		0.715	0.000		0.533	0.039
CDS.shape		3.226	0.000		2.433	0.000
Stock.mu		-0.001	0.013		0.000	0.124
Stock.ar1		-0.056	0.046		-0.063	0.023
Stock.omega		0.000	0.383		0.000	0.173
Stock.alpha1		0.042	0.000		0.006	0.000
Stock.beta1		0.957	0.000		0.991	0.000
Stock.shape		6.596	0.000		4.519	0.002
[Joint]dcca1		*0.017*	*0.067*		*0.028*	*0.043*
[Joint]dccb1		*0.953*	*0.000*		*0.939*	*0.000*
[Joint]mshape		4.796	0.000		4.000	0.001
		Estimate	*p*-value		Estimate	*p*-value
				Veolia Environnement		
CDS.mu	AstraZeneca PLC	0.000	0.544	VE SA	-0.001	0.050
CDS.ar1		0.023	0.284		0.093	0.000
CDS.omega		0.000	0.975		0.000	0.062
CDS.alpha1		0.152	0.012		0.199	0.000
CDS.beta1		0.847	0.738		0.800	0.000
CDS.shape		2.194	0.000		2.550	0.000

		Estimate	p-value		Estimate	p-value
Stock.mu		0.001	0.045		0.001	0.061
Stock.ar1		0.024	0.440		0.021	0.484
Stock.omega		0.000	0.000		0.000	0.133
Stock.alpha1		0.102	0.000		0.017	0.000
Stock.beta1		0.810	0.000		0.980	0.000
Stock.shape		4.004	0.000		4.447	0.000
[Joint]dcca1		0.012	0.732		0.019	0.225
[Joint]dccb1		0.494	0.209		*0.875*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Atlantia SpA	-0.001	0.010	Aegon NV	-0.002	0.016
CDS.ar1		0.087	0.001		0.159	0.000
CDS.omega		0.000	0.620		0.000	0.003
CDS.alpha1		0.097	0.001		0.236	0.000
CDS.beta1		0.902	0.000		0.519	0.000
CDS.shape		2.729	0.000		4.826	0.000
Stock.mu		0.001	0.087		0.001	0.083
Stock.ar1		-0.029	0.363		-0.004	0.881
Stock.omega		0.000	0.344		0.000	0.547
Stock.alpha1		0.078	0.072		0.039	0.011
Stock.beta1		0.832	0.000		0.956	0.000
Stock.shape		7.158	0.000		4.447	0.000
[Joint]dcca1		0.004	0.257		*0.008*	*0.034*
[Joint]dccb1		*0.988*	*0.000*		*0.986*	*0.000*
[Joint]mshape		4.131	0.000		4.500	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	BAE Systems PLC	-0.001	0.052	Allianz SE	-0.002	0.051
CDS.ar1		0.145	0.000		0.081	0.010
CDS.omega		0.000	0.160		0.000	0.097
CDS.alpha1		0.203	0.000		0.106	0.018
CDS.beta1		0.796	0.000		0.759	0.000
CDS.shape		2.484	0.000		5.399	0.000
Stock.mu		0.001	0.070		0.001	0.002
Stock.ar1		-0.034	0.301		-0.008	0.789
Stock.omega		0.000	0.000		0.000	0.477
Stock.alpha1		0.074	0.000		0.064	0.005
Stock.beta1		0.843	0.000		0.920	0.000
Stock.shape		6.004	0.000		4.698	0.000
[Joint]dcca1		0.000	1.000		*0.015*	*0.011*
[Joint]dccb1		0.905	0.393		*0.971*	*0.000*
[Joint]mshape		4.000	0.000		5.497	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	BASF SE	-0.001	0.008	Assicurazioni Generali SpA	-0.002	0.007
CDS.ar1		0.023	0.790		0.136	0.000
CDS.omega		0.000	0.990		0.000	0.020
CDS.alpha1		0.050	0.941		0.295	0.000
CDS.beta1		0.949	0.439		0.575	0.000
CDS.shape		2.587	0.278		3.404	0.000
Stock.mu		0.001	0.094		0.000	0.432
Stock.ar1		0.003	0.933		-0.084	0.005
Stock.omega		0.000	0.752		0.000	0.253
Stock.alpha1		0.050	0.314		0.051	0.000
Stock.beta1		0.937	0.000		0.935	0.000
Stock.shape		6.465	0.003		6.315	0.000
[Joint]dcca1		*0.010*	*0.095*		*0.010*	*0.040*
[Joint]dccb1		*0.986*	*0.000*		*0.981*	*0.000*
[Joint]mshape		4.000	0.000		4.643	0.000

		Estimate	p-value		Estimate	p-value
CDS.mu	Bayerische Motoren Werke AG	-0.001	0.040	Aviva PLC	-0.002	0.010
CDS.ar1		0.018	0.522		0.081	0.013
CDS.omega		0.000	0.699		0.000	0.303
CDS.alpha1		0.403	0.371		0.138	0.090
CDS.beta1		0.596	0.519		0.676	0.008
CDS.shape		2.335	0.000		3.814	0.000
Stock.mu		0.001	0.041		0.000	0.262
Stock.ar1		-0.114	0.000		-0.026	0.401
Stock.omega		0.000	0.746		0.000	0.000
Stock.alpha1		0.036	0.078		0.061	0.000
Stock.beta1		0.959	0.000		0.897	0.000
Stock.shape		6.010	0.050		4.323	0.000
[Joint]dcca1		0.025	0.336		0.041	0.113
[Joint]dccb1		*0.778*	*0.000*		*0.600*	*0.003*
[Joint]mshape		4.000	0.000		4.268	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Bayer AG	-0.002	0.000	AXA SA	-0.003	0.003
CDS.ar1		-0.033	0.331		0.161	0.000
CDS.omega		0.000	0.149		0.000	0.114
CDS.alpha1		0.432	0.000		0.151	0.007
CDS.beta1		0.567	0.002		0.676	0.000
CDS.shape		2.829	0.000		4.610	0.000
Stock.mu		0.001	0.266		0.001	0.021
Stock.ar1		0.028	0.377		-0.002	0.953
Stock.omega		0.000	0.581		0.000	0.000
Stock.alpha1		0.032	0.001		0.057	0.000
Stock.beta1		0.964	0.000		0.912	0.000
Stock.shape		6.489	0.000		6.674	0.000
[Joint]dcca1		*0.012*	*0.065*		*0.015*	*0.029*
[Joint]dccb1		*0.982*	*0.000*		*0.968*	*0.000*
[Joint]mshape		4.001	0.000		5.762	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Bouygues SA	-0.001	0.002	Banco Bilbao Vizcaya Argentaria SA	-0.001	0.407
CDS.ar1		0.124	0.000		0.147	0.440
CDS.omega		0.000	0.000		0.001	0.939
CDS.alpha1		0.681	0.004		0.558	0.806
CDS.beta1		0.318	0.005		0.441	0.933
CDS.shape		2.403	0.000		2.449	0.000
Stock.mu		0.000	0.997		0.000	0.444
Stock.ar1		-0.029	0.330		0.025	0.416
Stock.omega		0.000	0.685		0.000	0.081
Stock.alpha1		0.006	0.000		0.050	0.000
Stock.beta1		0.991	0.000		0.931	0.000
Stock.shape		3.841	0.121		6.345	0.000
[Joint]dcca1		0.027	0.362		0.017	0.307
[Joint]dccb1		*0.936*	*0.000*		*0.936*	*0.000*
[Joint]mshape		4.000	0.270		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Compagnie de Saint Gobain SA	-0.001	0.001	Banco Santander SA	-0.002	0.009
CDS.ar1		0.072	0.012		0.149	0.000
CDS.omega		0.000	0.416		0.000	0.231
CDS.alpha1		0.350	0.017		0.237	0.041
CDS.beta1		0.649	0.028		0.554	0.045
CDS.shape		2.496	0.000		3.724	0.000

		Estimate	p-value		Estimate	p-value
Stock.mu		0.000	0.383		0.001	0.234
Stock.ar1		-0.042	0.184		-0.013	0.673
Stock.omega		0.000	0.479		0.000	0.667
Stock.alpha1		0.033	0.025		0.062	0.113
Stock.beta1		0.952	0.000		0.920	0.000
Stock.shape		6.965	0.000		5.756	0.000
[Joint]dcca1		0.048	0.215		0.009	0.138
[Joint]dccb1		*0.422*	*0.302*		*0.968*	*0.000*
[Joint]mshape		4.000	0.000		4.793	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Continental AG	-0.001	0.029	Barclays PLC	-0.002	0.084
CDS.ar1		0.148	0.000		0.169	0.000
CDS.omega		0.000	0.002		0.000	0.295
CDS.alpha1		0.678	0.000		0.061	0.042
CDS.beta1		0.321	0.009		0.919	0.000
CDS.shape		2.626	0.000		4.026	0.000
Stock.mu		0.001	0.011		0.000	0.766
Stock.ar1		0.024	0.475		0.021	0.490
Stock.omega		0.000	0.085		0.000	0.748
Stock.alpha1		0.054	0.000		0.021	0.341
Stock.beta1		0.926	0.000		0.969	0.000
Stock.shape		10.409	0.001		4.700	0.000
[Joint]dcca1		*0.011*	*0.025*		*0.030*	*0.068*
[Joint]dccb1		*0.977*	*0.000*		*0.890*	*0.000*
[Joint]mshape		4.000	0.000		4.409	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Daimler AG	-0.002	0.000	Bayerische Landesbank	0.000	0.307
CDS.ar1		0.079	0.004		-0.010	0.280
CDS.omega		0.000	0.019		0.000	0.712
CDS.alpha1		0.340	0.000		0.878	0.000
CDS.beta1		0.659	0.000		0.121	0.000
CDS.shape		2.450	0.000		2.100	0.000
Stock.mu		0.001	0.367		0.000	0.183
Stock.ar1		0.030	0.699		-0.077	0.001
Stock.omega		0.000	0.991		0.000	1.000
Stock.alpha1		0.067	0.947		0.717	0.000
Stock.beta1		0.915	0.277		0.268	0.005
Stock.shape		7.103	0.906		2.205	0.000
[Joint]dcca1		0.004	0.562		0.305	0.259
[Joint]dccb1		*0.966*	*0.000*		*0.520*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Koninklijke DSM NV	0.000	0.265	BNP Paribas SA	-0.002	0.024
CDS.ar1		0.003	0.871		0.125	0.000
CDS.omega		0.000	0.550		0.000	0.682
CDS.alpha1		0.133	0.015		0.060	0.344
CDS.beta1		0.866	0.000		0.926	0.000
CDS.shape		2.324	0.000		3.523	0.000
Stock.mu		0.001	0.107		0.000	0.387
Stock.ar1		0.000	0.988		-0.030	0.355
Stock.omega		0.000	0.000		0.000	0.407
Stock.alpha1		0.074	0.000		0.054	0.000
Stock.beta1		0.868	0.000		0.932	0.000
Stock.shape		4.029	0.000		9.008	0.000
[Joint]dcca1		*0.076*	*0.027*		*0.027*	*0.039*
[Joint]dccb1		*0.772*	*0.000*		*0.877*	*0.000*
[Joint]mshape		4.000	0.125		5.176	0.000
		Estimate	p-value		Estimate	p-value

		Estimate	p-value		Estimate	p-value
CDS.mu	Lafargeholcim Ltd	-0.001	0.000	Commerzbank AG	-0.001	0.100
CDS.ar1		0.094	0.001		0.142	0.000
CDS.omega		0.000	0.001		0.000	0.137
CDS.alpha1		0.697	0.000		0.099	0.037
CDS.beta1		0.302	0.002		0.792	0.000
CDS.shape		2.341	0.000		3.707	0.000
Stock.mu		0.000	0.838		0.000	0.551
Stock.ar1		0.096	0.002		0.011	0.749
Stock.omega		0.000	0.000		0.000	0.008
Stock.alpha1		0.040	0.000		0.021	0.000
Stock.beta1		0.937	0.000		0.973	0.000
Stock.shape		5.079	0.000		5.731	0.000
[Joint]dcca1		0.014	0.431		*0.010*	*0.008*
[Joint]dccb1		*0.693*	*0.000*		*0.983*	*0.000*
[Joint]mshape		4.000	0.108		4.415	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Lanxess AG	-0.001	0.101	Credit Agricole SA	-0.002	0.008
CDS.ar1		0.074	0.006		0.138	0.000
CDS.omega		0.000	0.454		0.000	0.462
CDS.alpha1		0.204	0.000		0.118	0.169
CDS.beta1		0.795	0.000		0.821	0.000
CDS.shape		2.769	0.000		3.357	0.000
Stock.mu		0.000	0.910		0.001	0.219
Stock.ar1		0.059	0.040		0.008	0.811
Stock.omega		0.000	0.420		0.000	0.902
Stock.alpha1		0.045	0.014		0.030	0.576
Stock.beta1		0.946	0.000		0.966	0.000
Stock.shape		5.094	0.000		6.555	0.126
[Joint]dcca1		0.027	0.334		*0.057*	*0.002*
[Joint]dccb1		*0.864*	*0.000*		*0.769*	*0.000*
[Joint]mshape		4.000	0.000		4.605	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Linde AG	0.000	0.059	Credit Suisse Group AG	-0.001	0.077
CDS.ar1		0.031	0.031		0.108	0.000
CDS.omega		0.000	0.970		0.000	0.247
CDS.alpha1		0.042	0.015		0.085	0.068
CDS.beta1		0.957	0.000		0.882	0.000
CDS.shape		2.356	0.000		3.135	0.000
Stock.mu		0.001	0.049		0.000	0.876
Stock.ar1		-0.056	0.114		0.023	0.435
Stock.omega		0.000	0.680		0.000	0.150
Stock.alpha1		0.028	0.193		0.012	0.000
Stock.beta1		0.962	0.000		0.986	0.000
Stock.shape		5.787	0.003		4.618	0.000
[Joint]dcca1		0.007	0.441		*0.031*	*0.098*
[Joint]dccb1		*0.975*	*0.000*		*0.821*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	PostNL NV	-0.001	0.414	Danske Bank A/S	-0.001	0.107
CDS.ar1		0.071	0.195		0.055	0.022
CDS.omega		0.000	0.920		0.000	0.247
CDS.alpha1		0.049	0.634		0.023	0.000
CDS.beta1		0.950	0.000		0.976	0.000
CDS.shape		2.303	0.010		2.544	0.000
Stock.mu		0.000	0.634		0.001	0.031
Stock.ar1		-0.028	0.210		-0.069	0.032
Stock.omega		0.000	0.000		0.000	0.058

		Estimate	p-value		Estimate	p-value
Stock.alpha1		0.001	0.000		0.201	0.004
Stock.beta1		0.995	0.000		0.532	0.005
Stock.shape		3.093	0.000		4.758	0.000
[Joint]dcca1		0.006	0.377		*0.064*	*0.012*
[Joint]dccb1		*0.822*	*0.000*		*0.855*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Rentokil Initial PLC	-0.001	0.000	Deutsche Bank AG	-0.001	0.073
CDS.ar1		0.021	0.154		0.110	0.000
CDS.omega		0.000	1.000		0.000	0.102
CDS.alpha1		0.021	0.000		0.105	0.009
CDS.beta1		0.978	0.000		0.855	0.000
CDS.shape		2.356	0.000		3.673	0.000
Stock.mu		0.000	0.136		0.000	0.997
Stock.ar1		0.017	0.502		0.021	0.995
Stock.omega		0.000	0.151		0.000	1.000
Stock.alpha1		0.011	0.000		0.044	0.999
Stock.beta1		0.979	0.000		0.950	0.981
Stock.shape		3.915	0.002		7.973	0.997
[Joint]dcca1		*0.023*	*0.073*		0.040	0.404
[Joint]dccb1		*0.948*	*0.000*		0.498	0.621
[Joint]mshape		4.000	0.320		4.665	0.118
		Estimate	p-value		Estimate	p-value
CDS.mu	Rolls-Royce Holdings PLC	-0.001	0.029	Hannover Rueck SE	-0.002	0.039
CDS.ar1		0.050	0.028		0.084	0.008
CDS.omega		0.000	0.299		0.000	0.071
CDS.alpha1		0.274	0.000		0.117	0.007
CDS.beta1		0.725	0.000		0.769	0.000
CDS.shape		2.406	0.000		4.471	0.000
Stock.mu		0.000	0.834		0.001	0.003
Stock.ar1		-0.036	0.238		-0.004	0.908
Stock.omega		0.000	0.000		0.000	0.312
Stock.alpha1		0.038	0.017		0.040	0.000
Stock.beta1		0.908	0.000		0.953	0.000
Stock.shape		3.422	0.000		5.177	0.000
[Joint]dcca1		0.001	0.133		*0.085*	*0.017*
[Joint]dccb1		*0.999*	*0.000*		*0.711*	*0.000*
[Joint]mshape		4.000	0.022		4.921	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Sanofi SA	0.000	0.085	HSBC Holdings PLC	-0.002	0.007
CDS.ar1		-0.002	0.934		0.115	0.000
CDS.omega		0.000	0.623		0.000	0.259
CDS.alpha1		0.695	0.000		0.204	0.146
CDS.beta1		0.304	0.703		0.703	0.001
CDS.shape		2.177	0.000		2.868	0.000
Stock.mu		0.001	0.019		0.000	0.824
Stock.ar1		-0.144	0.000		-0.038	0.189
Stock.omega		0.000	0.808		0.000	0.791
Stock.alpha1		0.063	0.158		0.048	0.248
Stock.beta1		0.918	0.000		0.930	0.000
Stock.shape		5.353	0.000		5.384	0.000
[Joint]dcca1		0.020	0.132		*0.030*	*0.023*
[Joint]dccb1		*0.919*	*0.000*		*0.922*	*0.000*
[Joint]mshape		4.000	0.282		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Siemens AG	-0.001	0.001	ING Groep NV	0.000	0.282
CDS.ar1		0.072	0.588		0.052	0.010

		Estimate	p-value		Estimate	p-value
CDS.omega		0.000	0.939		0.001	0.259
CDS.alpha1		0.160	0.896		0.646	0.000
CDS.beta1		0.839	0.695		0.353	0.410
CDS.shape		2.429	0.274		2.108	0.000
Stock.mu		0.000	0.090		0.001	0.121
Stock.ar1		-0.004	0.900		-0.020	0.552
Stock.omega		0.000	0.961		0.000	0.156
Stock.alpha1		0.036	0.887		0.055	0.000
Stock.beta1		0.950	0.011		0.927	0.000
Stock.shape		4.708	0.589		8.990	0.004
[Joint]dcca1		0.012	0.230		0.024	0.366
[Joint]dccb1		*0.974*	*0.000*		*0.824*	*0.006*
[Joint]mshape		4.000	0.329		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Solvay SA	-0.001	0.016	Intesa Sanpaolo SpA	-0.001	0.051
CDS.ar1		0.064	0.037		0.177	0.000
CDS.omega		0.000	0.716		0.001	0.026
CDS.alpha1		0.398	0.335		0.622	0.000
CDS.beta1		0.601	0.474		0.377	0.029
CDS.shape		2.430	0.000		2.369	0.000
Stock.mu		0.000	0.601		0.001	0.072
Stock.ar1		-0.007	0.822		-0.094	0.004
Stock.omega		0.000	0.911		0.000	0.000
Stock.alpha1		0.033	0.567		0.052	0.000
Stock.beta1		0.961	0.000		0.922	0.000
Stock.shape		6.600	0.374		8.243	0.000
[Joint]dcca1		*0.020*	*0.034*		0.012	0.441
[Joint]dccb1		*0.965*	*0.000*		*0.937*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Valeo SA	-0.001	0.031	Lloyds Banking Group PLC	-0.002	0.018
CDS.ar1		0.087	0.003		0.111	0.000
CDS.omega		0.000	0.631		0.000	0.465
CDS.alpha1		0.157	0.145		0.088	0.176
CDS.beta1		0.842	0.000		0.868	0.000
CDS.shape		2.609	0.000		3.211	0.000
Stock.mu		0.001	0.017		0.000	0.331
Stock.ar1		0.014	0.663		-0.028	0.351
Stock.omega		0.000	0.134		0.000	0.142
Stock.alpha1		0.027	0.000		0.028	0.000
Stock.beta1		0.964	0.000		0.970	0.000
Stock.shape		7.455	0.000		5.981	0.000
[Joint]dcca1		0.005	0.103		*0.050*	*0.020*
[Joint]dccb1		*0.993*	*0.000*		*0.745*	*0.000*
[Joint]mshape		4.000	0.000		4.349	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Vinci SA	-0.001	0.009	Mediobanca Banca di Credito Finanziario SpA	-0.001	0.000
CDS.ar1		0.088	0.002		0.013	0.310
CDS.omega		0.000	0.393		0.000	0.386
CDS.alpha1		0.181	0.002		0.014	0.000
CDS.beta1		0.818	0.000		0.985	0.000
CDS.shape		2.535	0.000		2.215	0.000
Stock.mu		0.001	0.040		0.001	0.214
Stock.ar1		-0.061	0.053		-0.022	0.483
Stock.omega		0.000	0.881		0.000	0.000

		Estimate	p-value		Estimate	p-value
Stock.alpha1		0.061	0.169		0.054	0.000
Stock.beta1		0.919	0.000		0.920	0.000
Stock.shape		5.618	0.067		10.511	0.000
[Joint]dcca1		*0.039*	*0.088*		0.037	0.199
[Joint]dccb1		*0.730*	*0.000*		*0.859*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Volkswagen AG	-0.002	0.002	Muenchener Rueckversicherungs Gesellschaft in Muenchen AG	-0.002	0.081
CDS.ar1		0.131	0.000		0.059	0.038
CDS.omega		0.000	0.003		0.000	0.433
CDS.alpha1		0.427	0.000		0.062	0.041
CDS.beta1		0.572	0.000		0.908	0.000
CDS.shape		2.567	0.000		4.187	0.000
Stock.mu		0.000	0.448		0.001	0.003
Stock.ar1		0.080	0.029		0.001	0.977
Stock.omega		0.000	0.746		0.000	0.000
Stock.alpha1		0.069	0.390		0.070	0.000
Stock.beta1		0.922	0.000		0.875	0.000
Stock.shape		5.164	0.000		4.667	0.000
[Joint]dcca1		*0.045*	*0.003*		0.022	0.106
[Joint]dccb1		*0.930*	*0.000*		*0.890*	*0.000*
[Joint]mshape		4.000	0.000		4.581	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Wendel SA	-0.002	0.006	Societe Generale SA	-0.002	0.005
CDS.ar1		0.169	0.000		0.176	0.000
CDS.omega		0.000	0.024		0.000	0.202
CDS.alpha1		0.374	0.000		0.227	0.051
CDS.beta1		0.625	0.000		0.562	0.036
CDS.shape		2.681	0.000		3.271	0.000
Stock.mu		0.001	0.009		0.000	0.455
Stock.ar1		0.026	0.415		0.025	0.437
Stock.omega		0.000	0.470		0.000	0.330
Stock.alpha1		0.082	0.013		0.045	0.000
Stock.beta1		0.904	0.000		0.944	0.000
Stock.shape		5.873	0.000		7.997	0.000
[Joint]dcca1		*0.005*	*0.025*		*0.040*	*0.090*
[Joint]dccb1		*0.995*	*0.000*		*0.736*	*0.002*
[Joint]mshape		4.000	0.000		4.982	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Accor SA	-0.001	0.043	Standard Chartered PLC	-0.001	0.064
CDS.ar1		0.048	0.082		0.134	0.000
CDS.omega		0.000	0.320		0.000	0.011
CDS.alpha1		0.459	0.000		0.467	0.000
CDS.beta1		0.540	0.083		0.532	0.000
CDS.shape		2.381	0.000		2.588	0.000
Stock.mu		0.001	0.089		-0.001	0.132
Stock.ar1		0.007	0.817		0.031	0.314
Stock.omega		0.000	0.839		0.000	0.001
Stock.alpha1		0.072	0.007		0.084	0.000
Stock.beta1		0.910	0.000		0.890	0.000
Stock.shape		6.275	0.005		4.300	0.000
[Joint]dcca1		0.014	0.614		0.012	0.562
[Joint]dccb1		*0.966*	*0.000*		*0.752*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000

		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Electrolux AB	0.000	0.239	Royal Bank of Scotland Group PLC	-0.001	0.067
CDS.ar1		0.043	0.075		0.158	0.000
CDS.omega		0.000	0.000		0.000	0.078
CDS.alpha1		0.999	0.000		0.217	0.007
CDS.beta1		0.000	1.000		0.615	0.000
CDS.shape		2.193	0.000		3.023	0.000
Stock.mu		0.000	0.267		0.000	0.555
Stock.ar1		-0.017	0.559		-0.001	0.980
Stock.omega		0.000	0.261		0.000	0.000
Stock.alpha1		0.010	0.000		0.064	0.000
Stock.beta1		0.987	0.000		0.913	0.000
Stock.shape		3.938	0.000		5.598	0.000
[Joint]dcca1		0.007	0.449		0.032	0.179
[Joint]dccb1		*0.944*	*0.000*		*0.761*	*0.000*
[Joint]mshape		4.000	0.000		4.003	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	British American Tobacco PLC	0.000	0.422	UBS Group AG	-0.002	0.008
CDS.ar1		-0.018	0.508		0.091	0.001
CDS.omega		0.000	0.827		0.000	0.067
CDS.alpha1		0.369	0.176		0.133	0.033
CDS.beta1		0.630	0.486		0.799	0.000
CDS.shape		2.370	0.000		2.788	0.000
Stock.mu		0.000	0.238		0.000	0.391
Stock.ar1		-0.037	0.236		0.032	0.293
Stock.omega		0.000	0.690		0.000	0.843
Stock.alpha1		0.044	0.118		0.010	0.261
Stock.beta1		0.928	0.000		0.988	0.000
Stock.shape		9.571	0.001		4.195	0.000
[Joint]dcca1		*0.016*	*0.034*		0.053	0.257
[Joint]dccb1		*0.964*	*0.000*		*0.754*	*0.019*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Carlsberg A/S	-0.001	0.040	BT Group PLC	0.000	0.208
CDS.ar1		0.120	0.000		0.133	0.000
CDS.omega		0.000	0.674		0.000	0.187
CDS.alpha1		0.286	0.195		0.538	0.174
CDS.beta1		0.713	0.100		0.461	0.008
CDS.shape		2.559	0.000		2.361	0.000
Stock.mu		0.000	0.585		0.001	0.035
Stock.ar1		-0.054	0.083		-0.075	0.007
Stock.omega		0.000	0.306		0.000	0.002
Stock.alpha1		0.102	0.094		0.035	0.000
Stock.beta1		0.712	0.002		0.950	0.000
Stock.shape		4.285	0.000		5.267	0.000
[Joint]dcca1		0.015	0.231		0.064	0.119
[Joint]dccb1		*0.852*	*0.000*		0.098	0.786
[Joint]mshape		4.000	0.000		4.000	0.143
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	LVMH Moet Hennessy Louis Vuitton SE	-0.001	0.025	Deutsche Telekom AG	-0.001	0.004
CDS.ar1		0.066	0.040		0.173	0.000
CDS.omega		0.000	0.377		0.000	0.173
CDS.alpha1		0.371	0.000		0.241	0.081
CDS.beta1		0.628	0.000		0.727	0.000
CDS.shape		2.599	0.000		3.024	0.000

		Estimate	p-value		Estimate	p-value
Stock.mu		0.000	0.297		0.001	0.102
Stock.ar1		-0.046	0.136		-0.041	0.160
Stock.omega		0.000	0.616		0.000	0.736
Stock.alpha1		0.032	0.000		0.046	0.250
Stock.beta1		0.967	0.000		0.941	0.000
Stock.shape		5.646	0.000		4.572	0.000
[Joint]dcca1		0.036	0.342		0.035	0.316
[Joint]dccb1		*0.754*	*0.067*		0.198	0.664
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Marks and Spencer Group PLC	-0.002	0.000	ITV PLC	-0.001	0.000
CDS.ar1		0.112	0.000		0.154	0.000
CDS.omega		0.000	0.609		0.001	0.000
CDS.alpha1		0.149	0.194		0.916	0.000
CDS.beta1		0.850	0.000		0.083	0.207
CDS.shape		2.627	0.000		2.211	0.000
Stock.mu		0.000	0.897		0.001	0.036
Stock.ar1		0.028	0.363		-0.013	0.708
Stock.omega		0.000	0.327		0.000	0.002
Stock.alpha1		0.000	0.978		0.134	0.001
Stock.beta1		0.999	0.000		0.563	0.000
Stock.shape		5.632	0.000		7.443	0.017
[Joint]dcca1		0.004	0.192		0.000	1.000
[Joint]dccb1		*0.990*	*0.000*		*0.951*	*0.005*
[Joint]mshape		4.000	0.000		4.000	0.206
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Nestle SA	0.000	0.912	Koninklijke KPN NV	-0.001	0.012
CDS.ar1		0.010	0.577		0.098	0.026
CDS.omega		0.000	0.824		0.000	0.608
CDS.alpha1		0.256	0.000		0.332	0.433
CDS.beta1		0.743	0.000		0.667	0.211
CDS.shape		2.436	0.000		2.315	0.000
Stock.mu		0.000	0.064		0.000	0.694
Stock.ar1		0.044	0.164		0.059	0.061
Stock.omega		0.000	0.000		0.000	0.068
Stock.alpha1		0.149	0.000		0.143	0.010
Stock.beta1		0.714	0.000		0.766	0.000
Stock.shape		4.481	0.000		3.663	0.000
[Joint]dcca1		0.005	0.619		0.003	0.887
[Joint]dccb1		*0.873*	*0.000*		*0.902*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Next PLC	-0.001	0.000	Orange SA	-0.001	0.055
CDS.ar1		0.071	0.019		0.208	0.000
CDS.omega		0.000	0.163		0.000	0.157
CDS.alpha1		0.371	0.000		0.404	0.029
CDS.beta1		0.628	0.000		0.595	0.006
CDS.shape		2.526	0.000		2.607	0.000
Stock.mu		0.001	0.001		0.000	0.721
Stock.ar1		-0.060	0.039		-0.005	0.851
Stock.omega		0.000	0.000		0.000	0.122
Stock.alpha1		0.016	0.000		0.004	0.000
Stock.beta1		0.958	0.000		0.994	0.000
Stock.shape		3.933	0.000		5.383	0.000
[Joint]dcca1		0.016	0.124		0.006	0.636
[Joint]dccb1		*0.954*	*0.000*		*0.923*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000

		Estimate	p-value		Estimate	p-value
CDS.mu	Pernod Ricard SA	-0.001	0.006	Pearson PLC	-0.001	0.001
CDS.ar1		0.115	0.000		0.074	0.013
CDS.omega		0.000	0.025		0.000	0.053
CDS.alpha1		0.208	0.000		0.413	0.000
CDS.beta1		0.791	0.000		0.586	0.000
CDS.shape		2.771	0.000		2.518	0.000
Stock.mu		0.000	0.117		0.000	0.693
Stock.ar1		-0.059	0.037		0.021	0.524
Stock.omega		0.000	0.448		0.000	0.019
Stock.alpha1		0.038	0.006		0.017	0.000
Stock.beta1		0.949	0.000		0.977	0.000
Stock.shape		4.730	0.000		3.976	0.000
[Joint]dcca1		0.007	0.330		0.000	1.000
[Joint]dccb1		*0.965*	*0.000*		*0.912*	*0.009*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	SABMiller PLC	-0.001	0.333	Publicis Groupe SA	-0.001	0.000
CDS.ar1		0.105	0.000		0.135	0.000
CDS.omega		0.000	0.613		0.000	0.555
CDS.alpha1		0.179	0.004		0.552	0.124
CDS.beta1		0.820	0.000		0.447	0.633
CDS.shape		2.815	0.000		2.254	0.000
Stock.mu		0.000	0.375		0.001	0.013
Stock.ar1		-0.054	0.072		-0.005	0.882
Stock.omega		0.000	0.000		0.000	0.104
Stock.alpha1		0.106	0.000		0.027	0.005
Stock.beta1		0.822	0.000		0.963	0.000
Stock.shape		3.548	0.000		6.481	0.033
[Joint]dcca1		0.065	0.225		0.000	0.962
[Joint]dccb1		*0.033*	*0.958*		*0.860*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.051
		Estimate	p-value		Estimate	p-value
CDS.mu	Tate & Lyle PLC	0.000	0.706	TDC A/S	0.000	0.747
CDS.ar1		0.126	0.000		0.016	0.392
CDS.omega		0.000	0.338		0.000	0.993
CDS.alpha1		0.252	0.000		0.595	0.001
CDS.beta1		0.747	0.000		0.404	0.000
CDS.shape		2.435	0.000		2.254	0.000
Stock.mu		0.000	0.611		0.000	0.130
Stock.ar1		-0.011	0.701		0.060	0.076
Stock.omega		0.000	0.000		0.000	0.544
Stock.alpha1		0.003	0.001		0.035	0.172
Stock.beta1		0.976	0.000		0.955	0.000
Stock.shape		3.782	0.000		3.342	0.053
[Joint]dcca1		*0.091*	*0.067*		0.010	0.444
[Joint]dccb1		0.000	1.000		*0.970*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.155
		Estimate	p-value		Estimate	p-value
CDS.mu	Unilever NV	0.000	0.872	Telefonaktiebolaget L M Ericsson	-0.001	0.000
CDS.ar1		-0.044	0.013		0.133	0.000
CDS.omega		0.000	0.936		0.000	0.059
CDS.alpha1		0.260	0.000		0.579	0.000
CDS.beta1		0.739	0.000		0.420	0.013
CDS.shape		2.367	0.000		2.435	0.000
Stock.mu		0.000	0.171		0.000	0.250
Stock.ar1		-0.035	0.226		-0.049	0.100

		Estimate	p-value		Estimate	p-value
Stock.omega		0.000	0.184		0.000	0.742
Stock.alpha1		0.024	0.000		0.011	0.000
Stock.beta1		0.975	0.000		0.987	0.000
Stock.shape		5.777	0.000		3.825	0.069
[Joint]dcca1		0.030	0.444		0.015	0.382
[Joint]dccb1		*0.880*	*0.000*		0.407	0.257
[Joint]mshape		4.000	0.000		4.000	0.129
		Estimate	p-value		Estimate	p-value
CDS.mu	BP PLC	-0.001	0.016	Telefonica SA	-0.002	0.020
CDS.ar1		0.162	0.000		0.218	0.000
CDS.omega		0.000	0.018		0.000	0.003
CDS.alpha1		0.447	0.000		0.423	0.000
CDS.beta1		0.552	0.000		0.576	0.000
CDS.shape		2.458	0.000		2.774	0.000
Stock.mu		0.000	0.755		0.000	0.751
Stock.ar1		0.021	0.511		0.047	0.134
Stock.omega		0.000	0.438		0.000	0.300
Stock.alpha1		0.043	0.002		0.087	0.000
Stock.beta1		0.956	0.000		0.898	0.000
Stock.shape		4.322	0.000		6.292	0.000
[Joint]dcca1		0.000	1.000		*0.122*	*0.001*
[Joint]dccb1		0.926	0.360		*0.391*	*0.022*
[Joint]mshape		4.000	0.032		4.157	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Centrica PLC	-0.001	0.040	Telekom Austria AG	-0.001	0.001
CDS.ar1		0.093	0.000		0.082	0.017
CDS.omega		0.000	0.528		0.000	0.004
CDS.alpha1		0.292	0.174		0.844	0.000
CDS.beta1		0.707	0.084		0.155	0.296
CDS.shape		2.363	0.000		2.411	0.000
Stock.mu		0.000	0.164		0.000	0.666
Stock.ar1		-0.021	0.453		-0.002	0.949
Stock.omega		0.000	0.128		0.000	0.826
Stock.alpha1		0.022	0.000		0.152	0.000
Stock.beta1		0.973	0.000		0.847	0.000
Stock.shape		4.280	0.030		3.843	0.000
[Joint]dcca1		0.002	0.795		*0.026*	*0.074*
[Joint]dccb1		*0.948*	*0.000*		*0.885*	*0.000*
[Joint]mshape		4.000	0.534		4.000	0.001
		Estimate	p-value		Estimate	p-value
CDS.mu	E.ON SE	-0.001	0.107	Telenor ASA	-0.001	0.004
CDS.ar1		0.127	0.000		0.051	0.096
CDS.omega		0.000	0.364		0.000	0.004
CDS.alpha1		0.206	0.000		0.609	0.000
CDS.beta1		0.793	0.000		0.390	0.002
CDS.shape		2.639	0.000		2.420	0.000
Stock.mu		0.000	0.666		0.001	0.080
Stock.ar1		0.019	0.546		-0.054	0.055
Stock.omega		0.000	0.145		0.000	0.000
Stock.alpha1		0.110	0.038		0.039	0.000
Stock.beta1		0.821	0.000		0.913	0.000
Stock.shape		4.519	0.000		4.263	0.000
[Joint]dcca1		*0.018*	*0.028*		0.023	0.228
[Joint]dccb1		*0.955*	*0.000*		*0.804*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.001
		Estimate	p-value		Estimate	p-value
CDS.mu	Electricite de France SA	-0.001	0.008	TeliaSonera AB	-0.001	0.004
CDS.ar1		0.121	0.000		0.027	0.306

		Estimate	p-value		Estimate	p-value
CDS.omega		0.000	0.097		0.000	0.000
CDS.alpha1		0.234	0.002		0.256	0.001
CDS.beta1		0.765	0.000		0.743	0.000
CDS.shape		2.576	0.000		2.390	0.000
Stock.mu		0.000	0.401		0.000	0.345
Stock.ar1		0.028	0.373		-0.017	0.617
Stock.omega		0.000	0.457		0.000	0.000
Stock.alpha1		0.047	0.000		0.077	0.001
Stock.beta1		0.939	0.000		0.872	0.000
Stock.shape		3.956	0.000		3.761	0.007
[Joint]dcca1		0.011	0.171		0.065	0.176
[Joint]dccb1		*0.971*	*0.000*		*0.842*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.531
		Estimate	p-value		Estimate	p-value
CDS.mu	Enbw Energie Baden Wuerttemberg AG	0.000	0.087	Vivendi SA	-0.001	0.011
CDS.ar1		0.094	0.001		0.142	0.000
CDS.omega		0.000	0.150		0.000	0.004
CDS.alpha1		0.363	0.000		0.701	0.010
CDS.beta1		0.636	0.000		0.298	0.012
CDS.shape		2.377	0.000		2.319	0.000
Stock.mu		-0.001	0.056		0.000	0.267
Stock.ar1		-0.193	0.000		-0.053	0.093
Stock.omega		0.000	0.389		0.000	0.434
Stock.alpha1		0.093	0.191		0.030	0.000
Stock.beta1		0.875	0.000		0.969	0.000
Stock.shape		2.893	0.000		4.534	0.000
[Joint]dcca1		0.000	1.000		0.007	0.363
[Joint]dccb1		0.928	0.539		*0.987*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.192
		Estimate	p-value		Estimate	p-value
CDS.mu	Enel SpA	-0.001	0.039	Vodafone Group PLC	-0.001	0.021
CDS.ar1		0.171	0.000		0.135	0.000
CDS.omega		0.000	0.021		0.000	0.370
CDS.alpha1		0.358	0.000		0.202	0.189
CDS.beta1		0.641	0.000		0.797	0.000
CDS.shape		2.687	0.000		2.454	0.000
Stock.mu		0.000	0.305		0.000	0.848
Stock.ar1		-0.106	0.001		-0.025	0.408
Stock.omega		0.000	0.107		0.000	0.000
Stock.alpha1		0.087	0.046		0.065	0.000
Stock.beta1		0.632	0.002		0.880	0.000
Stock.shape		7.213	0.000		4.234	0.000
[Joint]dcca1		*0.059*	*0.023*		0.021	0.226
[Joint]dccb1		*0.745*	*0.000*		*0.855*	*0.000*
[Joint]mshape		4.046	0.000		4.000	0.019
		Estimate	p-value		Estimate	p-value
CDS.mu	Engie SA	-0.001	0.006	Wolters Kluwer NV	-0.001	0.000
CDS.ar1		0.050	0.074		0.123	0.005
CDS.omega		0.000	0.290		0.000	0.659
CDS.alpha1		0.417	0.000		0.276	0.256
CDS.beta1		0.582	0.007		0.723	0.138
CDS.shape		2.536	0.000		2.500	0.000
Stock.mu		0.000	0.778		0.001	0.002
Stock.ar1		0.010	0.740		0.025	0.441
Stock.omega		0.000	0.002		0.000	0.223
Stock.alpha1		0.013	0.000		0.042	0.000
Stock.beta1		0.977	0.000		0.947	0.000

		Estimate	p-value		Estimate	p-value
Stock.shape		5.326	0.000		5.258	0.000
[Joint]dcca1		0.013	0.134		0.011	0.349
[Joint]dccb1		*0.932*	*0.000*		*0.836*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Eni SpA	-0.001	0.019	Carrefour SA	-0.002	0.000
CDS.ar1		0.123	0.000		0.142	0.000
CDS.omega		0.000	0.016		0.000	0.157
CDS.alpha1		0.549	0.000		0.308	0.013
CDS.beta1		0.450	0.001		0.691	0.000
CDS.shape		2.438	0.000		2.705	0.000
Stock.mu		0.000	0.601		0.000	0.546
Stock.ar1		-0.068	0.029		-0.039	0.177
Stock.omega		0.000	0.502		0.000	0.980
Stock.alpha1		0.058	0.008		0.048	0.929
Stock.beta1		0.927	0.000		0.945	0.136
Stock.shape		5.646	0.000		5.363	0.680
[Joint]dcca1		0.000	0.999		*0.032*	*0.037*
[Joint]dccb1		*0.944*	*0.000*		*0.881*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Fortum Oyj	-0.001	0.012	Casino Guichard Perrachon SA	-0.001	0.334
CDS.ar1		0.114	0.001		0.186	0.000
CDS.omega		0.000	0.334		0.000	0.399
CDS.alpha1		0.352	0.019		0.473	0.070
CDS.beta1		0.647	0.026		0.526	0.183
CDS.shape		2.345	0.000		2.661	0.000
Stock.mu		0.000	0.584		0.000	0.652
Stock.ar1		0.032	0.222		0.021	0.484
Stock.omega		0.000	0.541		0.000	0.631
Stock.alpha1		0.013	0.000		0.049	0.058
Stock.beta1		0.983	0.000		0.946	0.000
Stock.shape		3.985	0.040		3.799	0.000
[Joint]dcca1		0.019	0.482		*0.035*	*0.006*
[Joint]dccb1		0.519	0.127		*0.908*	*0.000*
[Joint]mshape		4.000	0.139		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Gas Natural SDG SA	-0.002	0.001	Compass Group PLC	-0.001	0.000
CDS.ar1		0.114	0.000		-0.037	0.105
CDS.omega		0.000	0.033		0.000	0.020
CDS.alpha1		0.232	0.000		0.645	0.000
CDS.beta1		0.767	0.000		0.354	0.007
CDS.shape		2.638	0.000		2.242	0.000
Stock.mu		0.001	0.117		0.001	0.011
Stock.ar1		0.031	0.325		-0.040	0.178
Stock.omega		0.000	0.000		0.000	0.088
Stock.alpha1		0.085	0.000		0.019	0.000
Stock.beta1		0.871	0.000		0.977	0.000
Stock.shape		6.717	0.000		8.131	0.000
[Joint]dcca1		0.014	0.208		0.008	0.252
[Joint]dccb1		*0.955*	*0.000*		*0.955*	*0.000*
[Joint]mshape		4.057	0.000		4.000	0.000
		Estimate	*p*-value		Estimate	*p*-value
CDS.mu	Iberdrola SA	-0.002	0.009	Danone SA	-0.001	0.036
CDS.ar1		0.146	0.000		0.052	0.600
CDS.omega		0.000	0.714		0.000	0.880
CDS.alpha1		0.186	0.257		0.511	0.721

		Estimate	p-value		Estimate	p-value
CDS.beta1		0.813	0.013		0.488	0.854
CDS.shape		2.591	0.000		2.581	0.001
Stock.mu		0.001	0.009		0.000	0.375
Stock.ar1		0.055	0.092		-0.098	0.002
Stock.omega		0.000	0.644		0.000	0.112
Stock.alpha1		0.070	0.024		0.035	0.000
Stock.beta1		0.924	0.000		0.941	0.000
Stock.shape		6.315	0.000		6.748	0.000
[Joint]dcca1		*0.016*	*0.042*		0.008	0.245
[Joint]dccb1		*0.955*	*0.000*		*0.960*	*0.000*
[Joint]mshape		4.000	0.000		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	National Grid PLC	0.000	0.101	Diageo PLC	-0.001	0.017
CDS.ar1		0.038	0.103		0.030	0.338
CDS.omega		0.000	0.581		0.000	0.341
CDS.alpha1		0.328	0.001		0.742	0.000
CDS.beta1		0.671	0.067		0.257	0.611
CDS.shape		2.263	0.000		2.405	0.000
Stock.mu		0.001	0.001		0.000	0.263
Stock.ar1		-0.010	0.701		-0.088	0.002
Stock.omega		0.000	0.614		0.000	0.019
Stock.alpha1		0.006	0.000		0.025	0.000
Stock.beta1		0.991	0.000		0.954	0.000
Stock.shape		4.185	0.034		7.669	0.000
[Joint]dcca1		0.008	0.127		*0.091*	*0.011*
[Joint]dccb1		*0.973*	*0.000*		*0.430*	*0.012*
[Joint]mshape		4.000	0.081		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Repsol SA	-0.001	0.027	Kering SA	-0.001	0.018
CDS.ar1		0.177	0.000		0.067	0.033
CDS.omega		0.000	0.432		0.000	0.040
CDS.alpha1		0.258	0.054		0.577	0.000
CDS.beta1		0.741	0.006		0.422	0.028
CDS.shape		2.397	0.000		2.492	0.000
Stock.mu		0.000	0.743		0.000	0.909
Stock.ar1		0.028	0.335		-0.010	0.743
Stock.omega		0.000	0.909		0.000	0.000
Stock.alpha1		0.068	0.630		0.072	0.000
Stock.beta1		0.931	0.000		0.873	0.000
Stock.shape		4.573	0.000		4.279	0.000
[Joint]dcca1		*0.020*	*0.091*		*0.062*	*0.091*
[Joint]dccb1		*0.896*	*0.000*		0.543	0.171
[Joint]mshape		4.000	0.015		4.000	0.000
		Estimate	p-value		Estimate	p-value
CDS.mu	Royal Dutch Shell PLC	-0.001	0.040	Koninklijke Ahold NV	-0.001	0.001
CDS.ar1		0.088	0.002		0.122	0.000
CDS.omega		0.000	0.290		0.000	0.031
CDS.alpha1		0.402	0.002		0.210	0.000
CDS.beta1		0.597	0.049		0.789	0.000
CDS.shape		2.364	0.000		2.840	0.000
Stock.mu		0.000	0.717		0.001	0.033
Stock.ar1		0.067	0.038		0.041	0.177
Stock.omega		0.000	0.413		0.000	0.893
Stock.alpha1		0.056	0.000		0.027	0.619
Stock.beta1		0.942	0.000		0.965	0.000
Stock.shape		4.730	0.000		3.947	0.221
[Joint]dcca1		0.012	0.562		0.024	0.124
[Joint]dccb1		*0.514*	*0.019*		*0.920*	*0.000*

		Estimate	p-value		4.000	0.000
[Joint]mshape		4.000	0.001			
		Estimate	p-value			
CDS.mu	RWE AG	-0.001	0.224			
CDS.ar1		0.119	0.000			
CDS.omega		0.000	0.031			
CDS.alpha1		0.258	0.000			
CDS.beta1		0.741	0.000			
CDS.shape		2.431	0.000			
Stock.mu		0.000	0.546			
Stock.ar1		0.040	0.202			
Stock.omega		0.000	0.044			
Stock.alpha1		0.111	0.001			
Stock.beta1		0.858	0.000			
Stock.shape		4.674	0.001			
[Joint]dcca1		0.005	0.396			
[Joint]dccb1		*0.980*	*0.000*			
[Joint]mshape		4.000	0.147			

Note: Some models cannot converge, for these models CDS-stock prices pairs ae excluded

Table 2. Diagnosis of DCC-GARCH models

Test	Company	Test stat	*P*-value	Company	Test stat	*P*-value
Q(m)	Volvo AB	5.470	0.858	Statoil ASA	6.728	0.751
Rank-based		*25.079*	*0.005*		*25.233*	*0.005*
Qk(m) of epsilon_t		30.355	0.865		43.869	0.311
Robust test		*61.379*	*0.016*		51.259	0.109
Q(m)	Akzo Nobel NV	4.146	0.941	Total SA	2.136	0.995
Rank-based		16.551	0.085		18.067	0.054
Qk(m) of epsilon_t		30.036	0.874		20.416	0.996
Robust test		48.689	0.163		35.445	0.675
Q(m)	Anglo American PLC	11.639	0.310	United Utilities Group PLC	6.147	0.803
Rank-based		6.981	0.727		*18.636*	*0.045*
Qk(m) of epsilon_t		30.938	0.847		36.354	0.635
Robust test		46.485	0.223		47.408	0.196
Q(m)	AstraZeneca PLC	11.905	0.291	Veolia Environnement VE SA	10.897	0.366
Rank-based		12.819	0.234		11.135	0.347
Qk(m) of epsilon_t		68.114	0.004		21.040	0.994
Robust test		33.619	0.752		37.622	0.578
Q(m)	Atlantia SpA	9.275	0.506	Aegon NV	5.972	0.818
Rank-based		15.137	0.127		8.321	0.598
Qk(m) of epsilon_t		23.877	0.980		30.261	0.868
Robust test		38.014	0.560		33.093	0.772
Q(m)	BAE Systems PLC	5.635	0.845	Allianz SE	12.423	0.258
Rank-based		*22.617*	*0.012*		12.523	0.252
Qk(m) of epsilon_t		17.750	0.999		42.453	0.366
Robust test		34.294	0.724		31.336	0.835
Q(m)	BASF SE	5.573	0.850	Assicurazioni Generali SpA	5.301	0.870
Rank-based		8.821	0.549		10.542	0.394
Qk(m) of epsilon_t		45.542	0.252		21.388	0.993
Robust test		36.794	0.615		34.150	0.730
Q(m)	Bayerische Motoren Werke AG	5.975	0.817	Aviva PLC	12.066	0.281
Rank-based		8.272	0.602		15.769	0.106
Qk(m) of epsilon_t		24.997	0.969		63.340	0.011
Robust test		41.063	0.424		43.957	0.308
Q(m)	Bayer AG	6.322	0.787	AXA SA	9.914	0.448
Rank-based		*21.190*	*0.020*		8.015	0.627
Qk(m) of epsilon_t		25.053	0.969		47.405	0.196
Robust test		*68.589*	*0.003*		41.072	0.423
Q(m)	Bouygues SA	13.393	0.203	Banco Bilbao Vizcaya Argentaria SA	18.873	0.042
Rank-based		*25.693*	*0.004*		*22.690*	*0.012*
Qk(m) of epsilon_t		86.237	0.000		49.172	0.152
Robust test		37.473	0.585		40.178	0.462
Q(m)	Compagnie de Saint	3.494	0.967	Banco Santander	5.108	0.884

Test	Company	Stat	p	Company	Stat	p
	Gobain SA			SA		
Rank-based		15.056	0.130		8.545	0.576
Qk(m) of epsilon_t		36.911	0.610		22.727	0.987
Robust test		34.552	0.714		46.252	0.230
Q(m)	Continental AG	8.030	0.626	Barclays PLC	7.732	0.655
Rank-based		13.602	0.192		13.975	0.174
Qk(m) of epsilon_t		33.696	0.749		36.094	0.647
Robust test		46.581	0.220		33.034	0.774
Q(m)	Daimler AG	21.750	0.016	Bayerische Landesbank	0.671	1.000
Rank-based		6.187	0.799		*18.314*	*0.050*
Qk(m) of epsilon_t		93.335	0.000		1.662	1.000
Robust test		35.525	0.672		39.917	0.474
Q(m)	Koninklijke DSM NV	4.327	0.931	BNP Paribas SA	3.404	0.970
Rank-based		15.426	0.117		12.082	0.280
Qk(m) of epsilon_t		10.783	1.000		30.912	0.848
Robust test		35.983	0.652		37.237	0.595
Q(m)	Lafargeholcim Ltd	10.664	0.384	Commerzbank AG	10.098	0.432
Rank-based		9.346	0.500		20.581	0.024
Qk(m) of epsilon_t		20.520	0.995		38.059	0.558
Robust test		40.033	0.469		*54.237*	*0.066*
Q(m)	Lanxess AG	8.901	0.541	Credit Agricole SA	12.544	0.250
Rank-based		13.666	0.189		*17.171*	*0.071*
Qk(m) of epsilon_t		44.197	0.299		47.736	0.187
Robust test		49.359	0.147		33.263	0.766
Q(m)	Linde AG	19.073	0.039	Credit Suisse Group AG	25.994	0.004
Rank-based		*17.369*	*0.067*		8.834	0.548
Qk(m) of epsilon_t		41.107	0.422		64.811	0.008
Robust test		50.448	0.125		31.986	0.813
Q(m)	PostNL NV	1.447	0.999	Danske Bank A/S	8.359	0.594
Rank-based		*76.539*	*0.000*		*42.653*	*0.000*
Qk(m) of epsilon_t		6.756	1.000		47.353	0.198
Robust test		*66.789*	*0.005*		42.955	0.346
Q(m)	Rentokil Initial PLC	7.925	0.636	Deutsche Bank AG	2.037	0.996
Rank-based		*26.040*	*0.004*		10.747	0.378
Qk(m) of epsilon_t		19.496	0.997		27.408	0.935
Robust test		*70.752*	*0.002*		33.817	0.744
Q(m)	Rolls-Royce Holdings PLC	2.399	0.992	Hannover Rueck SE	2.897	0.984
Rank-based		*21.457*	*0.018*		*20.435*	*0.025*
Qk(m) of epsilon_t		8.674	1.000		35.688	0.665
Robust test		37.746	0.572		*56.312*	*0.045*
Q(m)	Sanofi SA	11.717	0.304	HSBC Holdings PLC	7.207	0.706
Rank-based		10.067	0.435		6.761	0.748
Qk(m) of epsilon_t		48.816	0.160		28.359	0.916
Robust test		48.446	0.169		33.626	0.751

Q(m)	Siemens AG	7.613	0.667	ING Groep NV	5.218	0.876
Rank-based		*26.756*	*0.003*		9.032	0.529
Qk(m) of epsilon_t		29.291	0.894		32.065	0.810
Robust test		68.998	0.003		45.844	0.243
Q(m)	Solvay SA	1.044	1.000	Intesa Sanpaolo SpA	18.339	0.050
Rank-based		12.065	0.281		9.329	0.501
Qk(m) of epsilon_t		23.215	0.984		44.880	0.275
Robust test		27.062	0.941		36.918	0.610
Q(m)	Valeo SA	1.787	0.998	Lloyds Banking Group PLC	13.009	0.223
Rank-based		*27.744*	*0.002*		*16.083*	*0.097*
Qk(m) of epsilon_t		19.734	0.997		57.226	0.038
Robust test		*54.718*	*0.060*		*58.168*	*0.032*
Q(m)	Vinci SA	6.970	0.728	Mediobanca Banca di Credito Finanziario SpA	7.602	0.668
Rank-based		9.599	0.476		14.481	0.152
Qk(m) of epsilon_t		36.954	0.608		19.051	0.998
Robust test		43.703	0.317		*53.869*	*0.070*
Q(m)	Volkswagen AG	3.118	0.979	Muenchener Rueckversicherungs Gesellschaft in Muenchen AG	9.138	0.519
Rank-based		13.298	0.208		*21.506*	*0.018*
Qk(m) of epsilon_t		846.163	0.000		33.133	0.771
Robust test		46.487	0.223		37.088	0.602
Q(m)	Wendel SA	12.348	0.262	Societe Generale SA	3.598	0.964
Rank-based		7.136	0.713		10.905	0.365
Qk(m) of epsilon_t		39.116	0.510		18.926	0.998
Robust test		44.298	0.295		36.360	0.635
Q(m)	Accor SA	7.952	0.633	Standard Chartered PLC	2.923	0.983
Rank-based		*21.788*	*0.016*		*16.031*	*0.099*
Qk(m) of epsilon_t		17.253	0.999		18.814	0.998
Robust test		38.946	0.518		43.642	0.319
Q(m)	Electrolux AB	9.454	0.490	Royal Bank of Scotland Group PLC	8.650	0.566
Rank-based		*32.055*	*0.000*		*16.014*	*0.099*
Qk(m) of epsilon_t		58.855	0.028		34.651	0.709
Robust test		*67.602*	*0.004*		*59.586*	*0.024*
Q(m)	British American Tobacco PLC	3.917	0.951	UBS Group AG	13.668	0.189
Rank-based		7.370	0.690		14.744	0.142
Qk(m) of epsilon_t		16.271	1.000		38.020	0.560
Robust test		33.803	0.744		39.309	0.501
Q(m)	Carlsberg A/S	2.566	0.990	BT Group PLC	3.412	0.970
Rank-based		15.664	0.110		9.447	0.490
Qk(m) of epsilon_t		17.570	0.999		18.195	0.999
Robust test		41.305	0.413		28.813	0.906

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Q(m)	LVMH Moet Hennessy Louis Vuitton SE	9.280	0.506	Deutsche Telekom AG	3.055	0.980
Rank-based		12.197	0.272		4.398	0.928
Qk(m) of epsilon_t		26.036	0.957		31.226	0.838
Robust test		36.642	0.622		*53.855*	*0.070*
Q(m)	Marks and Spencer Group PLC	24.035	0.008	ITV PLC	18.078	0.054
Rank-based		*16.657*	*0.082*		*17.505*	*0.064*
Qk(m) of epsilon_t		42.363	0.369		53.419	0.076
Robust test		35.284	0.682		25.006	0.969
Q(m)	Nestle SA	2.430	0.992	Koninklijke KPN NV	3.257	0.975
Rank-based		6.635	0.759		6.460	0.775
Qk(m) of epsilon_t		55.709	0.050		30.784	0.852
Robust test		31.892	0.816		40.431	0.451
Q(m)	Next PLC	7.195	0.707	Orange SA	4.303	0.933
Rank-based		13.843	0.180		11.576	0.314
Qk(m) of epsilon_t		27.020	0.942		26.584	0.949
Robust test		34.319	0.723		40.028	0.469
Q(m)	Pernod Ricard SA	9.445	0.490	Pearson PLC	0.723	1.000
Rank-based		14.114	0.168		*18.569*	*0.046*
Qk(m) of epsilon_t		30.352	0.865		16.707	1.000
Robust test		44.289	0.295		49.125	0.153
Q(m)	SABMiller PLC	1.933	0.997	Publicis Groupe SA	7.529	0.675
Rank-based		6.431	0.778		8.207	0.609
Qk(m) of epsilon_t		12.375	1.000		34.000	0.736
Robust test		28.271	0.918		35.063	0.692
Q(m)	Tate & Lyle PLC	8.960	0.536	TDC A/S	0.534	1.000
Rank-based		8.178	0.611		14.058	0.170
Qk(m) of epsilon_t		149.527	0.000		10.825	1.000
Robust test		37.113	0.601		47.866	0.184
Q(m)	Unilever NV	1.958	0.997	Telefonaktiebolaget L M Ericsson	0.913	1.000
Rank-based		2.771	0.986		5.429	0.861
Qk(m) of epsilon_t		15.757	1.000		16.121	1.000
Robust test		43.825	0.312		51.531	0.105
Q(m)	BP PLC	22.036	0.015	Telefonica SA	7.622	0.666
Rank-based		*37.104*	*0.000*		5.710	0.839
Qk(m) of epsilon_t		124.094	0.000		26.352	0.952
Robust test		40.974	0.428		34.201	0.728
Q(m)	Centrica PLC	5.231	0.875	Telekom Austria AG	8.024	0.626
Rank-based		*17.076*	*0.073*		*17.358*	*0.067*
Qk(m) of epsilon_t		18.275	0.999		29.650	0.885
Robust test		35.731	0.663		44.795	0.278
Q(m)	E.ON SE	6.245	0.794	Telenor ASA	13.343	0.205
Rank-based		9.266	0.507		13.578	0.193
Qk(m) of epsilon_t		28.231	0.919		84.563	0.000

Robust test		29.176	0.897		45.901	0.241
Q(m)	Electricite de France SA	14.520	0.151	TeliaSonera AB	0.577	1.000
Rank-based		11.307	0.334		*22.029*	*0.015*
Qk(m) of epsilon_t		84.435	0.000		7.423	1.000
Robust test		35.177	0.687		31.632	0.825
Q(m)	Enbw Energie Baden Wuerttemberg AG	2.686	0.988	Vivendi SA	1.224	1.000
Rank-based		5.310	0.870		15.619	0.111
Qk(m) of epsilon_t		23.552	0.982		6.576	1.000
Robust test		28.990	0.901		39.807	0.479
Q(m)	Enel SpA	9.124	0.520	Vodafone Group PLC	4.731	0.908
Rank-based		13.260	0.209		13.411	0.202
Qk(m) of epsilon_t		36.841	0.613		26.297	0.953
Robust test		36.184	0.643		37.675	0.575
Q(m)	Engie SA	3.002	0.981	Wolters Kluwer NV	6.361	0.784
Rank-based		15.316	0.121		15.627	0.111
Qk(m) of epsilon_t		10.842	1.000		36.572	0.625
Robust test		35.069	0.692		*56.707*	*0.042*
Q(m)	Eni SpA	9.196	0.514	Carrefour SA	8.145	0.615
Rank-based		*16.933*	*0.076*		9.663	0.471
Qk(m) of epsilon_t		40.955	0.428		20.910	0.994
Robust test		31.765	0.820		*53.410*	*0.076*
Q(m)	Fortum Oyj	2.671	0.988	Casino Guichard Perrachon SA	3.537	0.966
Rank-based		*26.795*	*0.003*		*18.433*	*0.048*
Qk(m) of epsilon_t		18.248	0.999		28.853	0.905
Robust test		42.839	0.350		43.588	0.321
Q(m)	Gas Natural SDG SA	6.820	0.742	Compass Group PLC	14.109	0.168
Rank-based		9.804	0.458		10.632	0.387
Qk(m) of epsilon_t		40.185	0.462		56.705	0.042
Robust test		51.574	0.104		33.955	0.738
Q(m)	Iberdrola SA	12.773	0.237	Danone SA	4.825	0.903
Rank-based		6.692	0.754		15.619	0.111
Qk(m) of epsilon_t		34.453	0.718		26.265	0.954
Robust test		42.311	0.372		*52.923*	*0.083*
Q(m)	National Grid PLC	10.846	0.370	Diageo PLC	2.183	0.995
Rank-based		14.312	0.159		12.856	0.232
Qk(m) of epsilon_t		63.870	0.010		35.726	0.663
Robust test		23.296	0.984		*54.998*	*0.057*
Q(m)	Repsol SA	7.742	0.654	Kering SA	10.562	0.393
Rank-based		12.830	0.233		10.655	0.385
Qk(m) of epsilon_t		28.005	0.923		34.056	0.734
Robust test		35.444	0.675		31.357	0.834
Q(m)	Royal Dutch Shell PLC	4.833	0.902	Koninklijke Ahold NV	4.451	0.925
Rank-based		*21.146*	*0.020*		9.230	0.510

Qk(m) of epsilon_t		25.046	0.969	65.874	0.006
Robust test		*67.104*	*0.005*	47.130	0.204
Q(m)	RWE AG	2.554	0.990		
Rank-based		8.389	0.591		
Qk(m) of epsilon_t		12.029	1.000		
Robust test		50.989	0.114		

Note: some models can not converge, so CDS-stock prices pairs ae excluded

Table 3. BEKK-GARCH of CDS and Stock Prices

	Dependent Variable		*t*-value	*t*-value
	ARCH estimates:			
Airbus Group SE	[,1]	[,2]	[,1]	[,2]
	[1,] -0.582	-0.087	-16.475*	-2.432*
	[2,] -0.446	0.056	-9.752*	0.953
	GARCH	estimates:		
	[,1]	[,2]		
	[1,] 0.801	-0.042	41.856*	-1.146
	[2,] -0.156	0.007	-2.617*	0.322
Volvo AB	aic : -5459.465			
	ARCH estimates:			
	[,1]	[,2]		
	[1,] -0.570	0.086	-11.720*	2.527*
	[2,] 0.291	0.034	3.961*	0.433
	GARCH estimates:			
	[,1]	[,2]		
	[1,] 0.572	-0.262	8.174*	-4.697*
	[2,] -0.002	0.003	-0.011	0.032
Akzo Nobel NV	aic : -5694.375			
	ARCH estimates:			
	[,1]	[,2]		
	[1,] 0.410	-0.048	8.360*	-0.913
	[2,] -0.193	-0.148	-2.238*	-1.623
	GARCH estimates:			
	[,1]	[,2]		
	[1,] 0.685	-0.138	11.195*	-2.211*
	[2,] -0.125	0.024	-0.373	0.333
Anglo American PLC	aic : -4692.81			
	ARCH estimates:			
	[,1]	[,2]		
	[1,] 0.394	-0.137	8.708*	-3.253*
	[2,] -0.075	-0.327	-1.136	-7.247*
	GARCH estimates:			
	[,1]	[,2]		
	[1,] -0.967	0.539	-8.492*	14.742*
	[2,] -0.888	-0.203	-5.683*	-1.518
AstraZeneca PLC	aic : -6058.101			
	ARCH estimates:			
	[,1]	[,2]		
	[1,] 0.209	-0.008	3.971*	-0.210
	[2,] -0.046	-0.486	-0.449	-8.070*
	GARCH estimates:			
	[,1]	[,2]		
	[1,] 0.072	-0.383	0.923*	-18.427*
	[2,] 0.480	-0.720	4.244*	-23.896*
Atlantia SpA	aic : -5458.747			
	ARCH estimates:			
	[,1]	[,2]		
	[1,] -0.444	0.002	-10.578*	0.040
	[2,] 0.181	-0.152	3.382*	-1.452
	GARCH estimates:			
	[,1]	[,2]		

		[,1]	[,2]		
	[1,]	-0.777	0.169	-15.356*	3.191*
	[2,]	0.025	-0.006	0.112	-0.121

BAE Systems PLC — aic : -5831.671

ARCH estimates:

	[,1]	[,2]		
	[,1]	[,2]		
[1,]	0.552	0.043	8.145*	1.167
[2,]	0.120	-0.221	1.143	-4.403*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.729	-0.200	7.240*	-1.891**
[2,]	0.204	-0.046	0.463	-0.320

BASF SE — aic : -5845.83

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.533	0.055		
[2,]	0.101	-0.028	-9.702*	1.151
			1.797**	-0.241

GARCH estimates:

	[,1]	[,2]		
[1,]	0.651	-0.115	9.880*	-2.287*
[2,]	0.007	-0.001	0.031	-0.027

Bayerische Motoren Werke AG — aic : -5707.82

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.477	0.056	-9.609*	0.567
[2,]	0.079	-0.137	1.058	-0.670

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.659	-0.094	-9.869*	-1.466
[2,]	0.196	0.029	3.040*	6.757*

Bayer AG — aic : -5057.048

ARCH estimates:

	[,1]	[,2]		
[1,]	0.418	0.057	15.652*	4.123*
[2,]	-0.135	0.211	-1.981*	3.317*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.938	0.092	-79.900*	5.237*
[2,]	-0.721	0.363	-9.385*	2.891*

Bouygues SA — aic : -5360.432

ARCH estimates:

	[,1]	[,2]		
[1,]	0.516	-0.102	9.923*	-2.363*
[2,]	0.245	0.244	5.406*	5.512*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.301	0.125	7.217*	2.473*
[2,]	-0.654	-0.296	-8.134*	-6.985*

Compagnie de Saint Gobain SA — aic : -5311.52

ARCH estimates:

	[,1]	[,2]		
[1,]	0.450	0.056	8.431*	1.492
[2,]	-0.358	0.240	-5.033*	3.757*

GARCH

		[,1]	[,2]		
	estimates:				
		[,1]	[,2]		
	[1,]	0.021	0.017	0.320	0.320
	[2,]	0.012	0.010	0.117	0.118
Continental AG	aic	: -5350.123			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.731	0.149	-11.397*	3.283*
	[2,]	-0.101	0.157	-1.413	1.661**
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.239	0.046	0.917	0.334
	[2,]	0.026	0.006	0.138	0.166
Daimler AG	aic	: -5250.15			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.351	0.122	-8.899*	3.661*
	[2,]	0.564	0.115	8.985*	2.576*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.747	0.119	-18.095*	3.411*
	[2,]	0.202	-0.032	1.088	-0.674
Koninklijke DSM NV	aic	: -5851.066			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.386	0.077	-11.269*	2.692*
	[2,]	0.205	0.150	2.337*	2.834*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.806	0.173	-6.608*	4.998*
	[2,]	0.106	-0.021	0.133	-0.123
Lafargeholcim Ltd	aic	: -5425.949			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.456	0.004	11.259*	0.159
	[2,]	-0.274	0.149	-3.589*	0.834
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.760	-0.137	14.811*	-5.111*
	[2,]	-0.152	0.028	-0.433	0.428
Lanxess AG	aic	: -5332.781			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.584	0.220	-8.448*	4.084*
	[2,]	-0.528	-0.074	-7.843*	-1.258
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.695	0.029	6.749*	0.309
	[2,]	-0.345	0.519	-0.725	2.242*
Linde AG	aic	: -5913.737			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.050	0.367	-0.989	9.399*
	[2,]	-0.230	0.028	-3.571*	0.462

		[,1]	[,2]		
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.000	0.003	0.002	0.107
	[2,]	0.031	-0.013	0.354	-0.425
PostNL NV	aic	: -4600.705			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.231	0.734	-1.730**	8.533*
	[2,]	0.488	-0.305	5.814*	-3.356*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.725	0.038	-10.166*	0.617
	[2,]	-0.700	0.021	-11.098*	0.315
Rentokil Initial PLC	aic	: -5768.987			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.583	-0.001	12.216*	-0.041
	[2,]	-0.128	0.100	-1.386	1.500
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.006	0.007	-0.098	0.066
	[2,]	-0.001	0.004	-0.013	0.019
Rolls-Royce Holdings PLC	aic	: -5576.678			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.601	0.176	12.520*	4.094*
	[2,]	-0.081	0.327	-1.704**	6.080*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.802	-0.172	27.547*	-3.411*
	[2,]	0.660	-0.441	9.424*	-6.145*
Sanofi SA	aic	: -5836.259			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.344	-0.026	-5.784*	-0.566
	[2,]	0.056	-0.383	0.969	-5.727*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.037	0.014	-0.765	0.112
	[2,]	-0.062	0.047	-1.100	0.268
Siemens AG	aic	: -5948.957			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.529	0.023	-3.981*	0.585
	[2,]	-0.558	-0.023	-10.520*	-0.602
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.197	0.107	-0.202	0.442
	[2,]	-0.242	0.141	-0.207	0.470
Solvay SA	aic	: -5515.293			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.305	-0.140	7.045*	-2.972*

	[,1]	[,2]	[,1]	[,2]
[2,]	-0.707	-0.040	-15.478*	-0.975

GARCH estimates:

	[,1]	[,2]		
[1,]	0.108	0.399	0.983	5.073*
[2,]	-0.005	0.035	-0.093	0.203

Valeo SA — aic : -5188.141

ARCH estimates:

	[,1]	[,2]		
[1,]	0.491	-0.264	8.470*	-4.632*
[2,]	0.143	-0.155	1.753**	-1.554

GARCH estimates:

	[,1]	[,2]		
[1,]	0.752	-0.171	8.952*	-3.722*
[2,]	-0.219	0.050	-0.717	0.621

Vinci SA — aic : -5755.619

ARCH estimates:

	[,1]	[,2]		
[1,]	0.389	0.006	11.742*	0.139
[2,]	-0.002	-0.221	-0.032	-2.746*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.966	0.273	-63.548*	7.017*
[2,]	-0.450	0.134	-9.310*	3.911*

Volkswagen AG — aic : -5160.883

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.426	-0.003	-11.017*	-0.093
[2,]	0.690	-0.143	15.256	-9.436*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.658	0.149	-12.645*	5.344*
[2,]	0.007	-0.005	0.032	-0.084

Wendel SA — aic : -5365.082

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.532	0.071	-12.873*	3.081*
[2,]	-0.162	-0.307	-1.549	-5.010*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.742	0.014	23.999*	0.443
[2,]	-0.348	0.194	-3.210*	2.057*

Accor SA — aic : -5457.054

ARCH estimates:

	[,1]	[,2]		
[1,]	0.507	-0.099	10.325*	-3.064*
[2,]	-0.074	0.136	-0.980	1.937**

GARCH estimates:

	[,1]	[,2]		
[1,]	0.240	0.053	4.288*	1.204
[2,]	-0.784	-0.254	-6.397*	-4.184*

Electrolux AB — aic : -5549.777

ARCH estimates:

	[,1]	[,2]

	[1,]	0.561	-0.120	6.325*	-2.333*
	[2,]	-0.125	-0.036	-1.574	-0.492
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.280	0.365	-2.142*	1.242
	[2,]	0.030	-0.035	0.114	-0.108
British American Tobacco PLC	aic	: -5872.692			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.512	-0.047	13.968*	-2.253*
	[2,]	-0.044	0.215	-0.431	3.085*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.751	0.006	28.511*	0.307
	[2,]	-0.039	0.001	-0.172	0.046
Carlsberg A/S	aic	: -5794.434			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.572	0.061	-12.300*	1.256
	[2,]	0.218	0.010	3.304*	0.137
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.570	0.044	-9.307*	0.615
	[2,]	0.020	-0.002	0.095	-0.083
LVMH Moet Hennessy Louis Vuitton SE	aic	: -5732.413			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.644	0.092	-13.368*	1.964*
	[2,]	-0.129	-0.094	-2.774*	-1.289
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.678	-0.121	11.538*	-1.871*
	[2,]	0.030	-0.003	0.125	-0.072
Marks and Spencer Group PLC	aic	: -5694.405			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.563	0.043	10.595*	0.926
	[2,]	0.315	0.069	3.481*	0.836
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.727	0.099	-14.028*	2.452*
	[2,]	-0.069	-0.012	-0.303	-0.313
Nestle SA	aic	: -6233.617			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.250	-0.034	-4.863*	-1.552
	[2,]	-0.059	0.370	-0.724	8.204*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.193	-0.259	2.063*	-4.180*
	[2,]	0.162	-0.207	1.272	-2.354*
Next PLC	aic	: -5879.298			
	ARCH estimates:				

	[,1]	[,2]		
[1,]	0.580	-0.018	11.191*	-0.805
[2,]	0.275	0.158	2.337*	1.616

GARCH estimates:

	[,1]	[,2]		
[1,]	0.608	-0.098	10.796*	-3.020*
[2,]	-0.842	0.032	-6.593*	0.361

Pernod Ricard SA   aic   : -5996.543

ARCH estimates:

	[,1]	[,2]		
[1,]	0.524	-0.017	16.857*	-0.578
[2,]	0.057	-0.237	0.967	-4.380*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.277	-0.369	-7.072*	-3.741*
[2,]	0.205	0.261	2.019*	6.362*

SABMiller PLC   aic   : -5885.762

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.292	-0.279	-7.870*	-8.563*
[2,]	0.347	-0.496	7.157*	-12.150*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.638	0.433	-11.964*	15.507*
[2,]	-1.008	-0.128	-14.674*	-2.074*

Tate & Lyle PLC   aic   : -5815.77

ARCH estimates:

	[,1]	[,2]		
[1,]	0.324	-0.082	8.216*	-2.369*
[2,]	-0.491	-0.068	-9.274*	-1.223

GARCH estimates:

	[,1]	[,2]		
[1,]	0.190	0.600	2.793*	10.257*
[2,]	-0.245	0.792	-3.365*	12.398*

Unilever NV   aic   : -6069.942

ARCH estimates:

	[,1]	[,2]		
[1,]	0.642	-0.018	12.327*	-0.594
[2,]	-0.082	0.337	-1.345	6.421*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.155	-0.038	-1.210	-1.946**
[2,]	-0.075	-0.041	-0.798	-0.640

BP PLC   aic   : -5726.498

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.428	0.097	-10.238*	3.098*
[2,]	0.378	-0.461	3.695*	-7.939*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.651	0.043	12.235*	0.734
[2,]	-0.420	-0.028	-2.169*	-0.727

Centrica PLC   aic   : -5832.535

ARCH estimates:

	[,1]	[,2]		
[1,]	0.524	-0.047	13.793*	-1.871*
[2,]	0.081	0.267	1.235	4.643*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.803	-0.050	31.456*	-1.544
[2,]	0.105	-0.008	0.542	-0.399

E.ON SE	aic	: -5459.759		

ARCH estimates:

	[,1]	[,2]		
[1,]	0.499	-0.128	9.740*	-3.042*
[2,]	-0.030	0.355	-0.366	7.718*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.481	-0.143	4.056*	-3.281*
[2,]	-0.555	0.134	-2.274*	1.755**

Electricite de France SA	aic	: -5528.785		

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.552	0.150	-12.508*	3.234*
[2,]	0.041	-0.246	0.800	-5.177*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.620	-0.118	12.876*	-4.111*
[2,]	-0.553	0.048	-5.627*	1.012

Enbw Energie Baden Wuerttemberg AG	aic	: -5422.989		

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.465	0.084	-10.915*	1.530
[2,]	0.068	0.209	1.239	3.345*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.035	0.808	0.803	34.856*
[2,]	-0.209	0.046	-0.893	0.792

Enel SpA	aic	: -5103.165		

ARCH estimates:

	[,1]	[,2]		
[1,]	0.592	-0.053	9.494*	-1.516
[2,]	0.174	0.232	2.096*	4.277*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.503	0.208	-7.109*	3.019*
[2,]	-1.199	0.481	-4.941*	6.661*

Engie SA	aic	: -5403.288		

ARCH estimates:

	[,1]	[,2]		
[1,]	0.626	-0.004	13.530*	-0.164
[2,]	0.094	0.198	1.158	2.839*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.641	0.100	-13.719*	2.790*
[2,]	0.037	-0.017	0.183	-0.451

		[,1]	[,2]		
Eni SpA	aic	: -5413.357			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.458	-0.009	12.450*	-0.253
	[2,]	-0.270	0.232	-3.343*	2.873*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.777	0.052	-26.445*	1.024
	[2,]	-0.232	0.017	-0.750	0.613
Fortum Oyj	aic	: -5720.734			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.576	-0.106	12.281*	-1.510
	[2,]	0.187	0.080	1.852*	1.024
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.779	0.126	-10.461*	2.807*
	[2,]	0.155	-0.043	0.347	-0.541
Gas Natural SDG SA	aic	: -5301.528			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.474	0.004	9.318*	0.096
	[2,]	-0.384	0.339	-4.085*	5.484*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.831	0.065	-16.172*	1.319
	[2,]	-0.745	0.075	-1.923**	1.091
Iberdrola SA	aic	: -5376.832			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.421	-0.112	7.605*	-4.751*
	[2,]	1.575	-0.318	15.986*	-4.416*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.489	0.230	11.865*	13.117*
	[2,]	-0.331	0.966	-4.440*	26.318*
National Grid PLC	aic	: -6244.565			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.496	0.030	-9.896*	0.322
	[2,]	0.180	0.300	1.031	6.192*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.643	0.009	-5.228*	0.040
	[2,]	-1.197	0.343	-1.171	0.551
Repsol SA	aic	: -4939.321			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.060	0.127	-1.568	5.443*
	[2,]	-1.031	0.158	-16.784*	2.516*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.302	0.468	5.934*	17.829*

		[,1]	[,2]		
	[2,]	-0.734	0.716	-11.054*	10.734*
Royal Dutch Shell PLC	aic	: -5722.983			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.390	0.256	-5.867*	6.925*
	[2,]	0.129	-0.352	1.304	-6.598*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.723	0.080	20.866*	3.069*
	[2,]	-0.830	0.309	-5.579*	3.095*
RWE AG	aic	: -5215.522			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.497	-0.142	8.347*	-4.094*
	[2,]	-0.019	-0.459	-0.398	-13.341*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.542	0.186	-9.384*	4.171*
	[2,]	-0.464	0.896	-6.783*	78.514*
Statoil ASA	aic	: -5589.843			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.378	0.130	-7.778*	3.529*
	[2,]	0.209	-0.483	2.703*	-11.634*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.162	0.021	1.593	0.674
	[2,]	-1.147	-0.155	-6.594*	-1.577
Total SA	aic	: -5525.68		0.000	0.000
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.353	-0.021	-10.457*	-0.776
	[2,]	0.391	-0.354	3.841*	-5.283*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.570	-0.116	-10.074*	-0.928
	[2,]	0.070	0.040	0.317	0.463
United Utilities Group PLC	aic	: -6044.34			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.657	0.053	12.752*	2.257*
	[2,]	0.515	-0.109	6.721*	-1.980**
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.432	-0.019	-7.829*	-0.571
	[2,]	-0.082	-0.018	-0.394	-0.698
Veolia Environnement VE SA	aic	: -5199.666			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.470	0.035	13.509*	1.032
	[2,]	-0.138	-0.093	-2.918*	-1.727**
	GARCH estimates:				
		[,1]	[,2]		

	[,1]	[,2]		
[1,]	0.760	-0.201	34.303*	-9.018*
[2,]	-0.375	0.142	-11.531*	4.636*

Aegon NV	aic	: -5195.14		

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.547	0.049	-9.782*	1.304
[2,]	-0.133	-0.036	-1.750**	-0.447

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.532	0.228	-10.814*	6.793*
[2,]	-1.355	0.572	-27.365*	14.721*

Allianz SE	aic	: -5374.14		

ARCH estimates:

	[,1]	[,2]		
[1,]	0.296	0.010	16.764*	0.514
[2,]	-0.278	0.315	-2.627*	5.572*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.615	-0.210	5.453*	-4.540*
[2,]	-0.346	0.135	-1.485	2.029*

Assicurazioni Generali SpA	aic	: -5088.222		

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.396	0.066	-6.022*	2.345*
[2,]	-0.115	0.216	-1.107	2.477*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.988	0.389	-16.016*	2.619*
[2,]	-1.220	0.489	-2.109*	3.588*

Aviva PLC	aic	: -5203.372		

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.439	0.090	-6.348*	2.402*
[2,]	-0.377	-0.157	-2.613*	-2.060*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.264	-0.056	2.639*	-1.339
[2,]	-0.044	0.010	-0.154	0.150

AXA SA	aic	: -5241.238		

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.369	0.018	-6.018*	0.441
[2,]	0.139	-0.232	1.411	-2.554*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.036	-0.056	-0.432	-0.482
[2,]	-0.159	0.507	-3.913*	9.695*

Banco Bilbao Vizcaya Argentaria SA	aic	: -4999.559		

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.454	0.129	-8.412*	4.119*
[2,]	0.119	0.206	1.114	2.427*

GARCH estimates:

		[,1]	[,2]		
	[1,]	0.080	-0.098	0.597	-0.853
	[2,]	0.202	-0.254	0.974	-1.834**
Banco Santander SA	aic	: -5025.483			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.334	0.006	5.545*	0.207
	[2,]	0.481	-0.433	5.169*	-8.696*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.095	0.195	-1.471	3.386*
	[2,]	0.318	-0.623	3.869*	-9.785*
Barclays PLC	aic	: -4962.067			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.361	-0.075	5.321*	-1.828**
	[2,]	0.039	0.290	0.426	3.872*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.236	0.053	-2.961*	0.808
	[2,]	-0.062	0.011	-0.266	0.179
Bayerische Landesbank	aic	: -5844.815			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.446	0.144	-5.037*	4.511*
	[2,]	0.263	0.437	2.720*	8.437*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.559	-0.197	9.004*	-3.074*
	[2,]	-0.767	-0.716	-1.823**	-6.934*
BNP Paribas SA	aic	: -5000.5			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.073	0.051	0.538	4.939*
	[2,]	-0.221	0.461	-4.469*	25.278*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.235	0.285	0.771	2.193*
	[2,]	0.942	-0.515	4.806*	-3.081*
Commerzbank AG	aic	: -4872.525			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.023	0.157	0.229	3.106*
	[2,]	0.056	0.577	0.848	10.428*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.004	0.027	0.132	0.223
	[2,]	-0.232	0.303	-2.205*	3.153*
Credit Agricole SA	aic	: -4819.91			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.327	0.026	-5.138*	0.585
	[2,]	0.019	-0.365	0.219	-5.824*
	GARCH				

estimates:

	[,1]	[,2]		
[1,]	-0.253	0.136	-1.539	1.601
[2,]	0.106	-0.078	0.415	-0.489

Credit Suisse Group AG aic : -5243.496

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.370	0.011	-5.976*	0.295
[2,]	0.000	-0.280	-0.003	-5.043*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.307	0.149	-0.566	0.709
[2,]	-0.419	0.194	-0.203	0.217

Danske Bank A/S aic : -5561.606

ARCH estimates:

	[,1]	[,2]		
[1,]	0.413	0.012	6.951*	0.330
[2,]	0.365	-0.393	5.064*	-7.686*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.051	0.016	0.259	1.688**
[2,]	-0.931	0.011	-3.860*	0.059

Deutsche Bank AG aic : -5030.031

ARCH estimates:

	[,1]	[,2]		
[1,]	0.206	0.001	3.143*	0.029
[2,]	-0.084	0.271	-1.739**	4.222*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.304	0.660	-0.270	1.716**
[2,]	-0.038	0.228	-0.039	0.200

Hannover Rueck SE aic : -5463.264

ARCH estimates:

	[,1]	[,2]		
[1,]	0.300	0.044	5.141*	2.008*
[2,]	-0.191	0.464	-1.365	7.723*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.325	-0.142	1.618	-0.482
[2,]	0.423	-0.248	0.947	-0.837

HSBC Holdings PLC aic : -5374.735

ARCH estimates:

	[,1]	[,2]		
[1,]	0.478	-0.066	8.048*	-3.325*
[2,]	0.768	0.077	4.495*	1.037

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.553	0.063	-7.864*	2.623*
[2,]	0.138	-0.017	0.466	-0.430

ING Groep NV aic : -4885.017

ARCH estimates:

	[,1]	[,2]		
[1,]	0.311	0.094	5.641*	3.510*
[2,]	-0.058	0.420	-0.660	9.420*

	GARCH estimates:			
	[,1]	[,2]		
[1,]	-0.369	0.096	-9.141*	4.888*
[2,]	-1.522	0.358	-30.063*	9.883*

Intesa Sanpaolo SpA   aic : -4578.382

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.428	0.042	-8.605*	1.527
[2,]	0.035	-0.244	0.382	-5.757*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.010	-0.011	0.101	-0.087
[2,]	-0.232	0.335	-0.910	0.824

Lloyds Banking Group PLC   aic : -5050.145

ARCH estimates:

	[,1]	[,2]		
[1,]	0.223	0.036	3.087*	1.088
[2,]	-0.098	0.415	-0.999	6.954*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.001	-0.001	0.036	-0.022
[2,]	0.001	0.000	0.015	0.014

Mediobanca Banca di Credito Finanziario SpA   aic : -4761.101

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.310	-0.001	-6.314*	-0.032
[2,]	-0.171	-0.348	-1.875**	-7.518*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.001	-0.219	0.022	-1.846**
[2,]	0.008	-0.779	0.061	-18.453*

Muenchener Rueckversicherungs Gesellschaft in Muenchen AG   aic : -5338.763

ARCH estimates:

	[,1]	[,2]		
[1,]	0.316	-0.011	6.294*	-0.681
[2,]	0.123	0.413	0.709	6.681*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.586	-0.328	5.275*	-23.241*
[2,]	-0.297	-0.475	-0.864	-3.703*

Societe Generale SA   aic : -4884.663

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.314	0.152	-4.440*	3.729*
[2,]	-0.002	0.343	-0.022	6.896*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.114	0.255	-1.948**	2.292*
[2,]	-0.416	0.934	-3.927*	18.055*

Standard Chartered PLC   aic : -5019.157

ARCH estimates:

	[,1]	[,2]		

	[,1]	[,2]		
[1,]	0.368	-0.113	6.294*	-4.537*
[2,]	0.391	-0.555	4.687*	-12.655*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.303	0.174	-2.712*	1.992*
[2,]	-0.335	0.765	-1.683**	14.524*

Royal Bank of Scotland Group PLC   aic : -4903.266

ARCH estimates:

	[,1]	[,2]		
[1,]	0.234	0.046	3.298*	1.263
[2,]	-0.068	0.495	-0.865	8.410*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.000	0.000	0.006	0.013
[2,]	0.000	0.001	0.001	0.026

UBS Group AG   aic : -5263.047

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.351	0.151	-4.572*	3.308*
[2,]	-0.191	0.377	-1.747**	3.672*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.148	0.064	0.305	0.105
[2,]	-0.234	-0.136	-0.516	-0.206

BT Group PLC   aic : -5823.513

ARCH estimates:

	[,1]	[,2]		
[1,]	0.570	0.009	11.499*	0.244
[2,]	-0.034	0.309	-0.460	4.620*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.498	0.104	-8.968*	2.182*
[2,]	-0.057	0.012	-0.263	0.235

Deutsche Telekom AG   aic : -5804.514

ARCH estimates:

	[,1]	[,2]		
[1,]	0.506	-0.156	10.504*	-3.125*
[2,]	-0.054	-0.182	-0.884	-4.471*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.502	0.091	8.777*	0.845
[2,]	-0.260	-0.025	-1.530	-0.442

ITV PLC   aic : -5387.519

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.603	-0.002	-12.961*	-0.084
[2,]	0.598	0.091	15.396*	2.899*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.301	0.291	6.986*	11.081*
[2,]	-0.904	0.642	-24.116*	16.136*

Koninklijke KPN NV   aic : -5115.664

ARCH estimates:

	[,1]	[,2]		
[1,]	0.485	0.108	9.573*	2.440*
[2,]	0.524	-0.179	10.160*	-3.232*
GARCH estimates:				
	[,1]	[,2]		
[1,]	-0.260	0.084	-6.294*	0.688
[2,]	-0.795	0.239	-0.856	3.562*

Orange SA	aic	: -5588.11		
	ARCH estimates:			
	[,1]	[,2]		
[1,]	0.690	-0.089	12.059*	-1.810**
[2,]	-0.009	0.040	-0.180	0.831
GARCH estimates:				
	[,1]	[,2]		
[1,]	0.172	0.076	2.144*	1.373
[2,]	-0.225	-0.110	-0.898	-1.647**

Pearson PLC	aic	: -5736.731		
	ARCH estimates:			
	[,1]	[,2]		
[1,]	0.421	0.005	9.253*	0.145
[2,]	0.205	0.430	3.576*	9.561*
GARCH estimates:				
	[,1]	[,2]		
[1,]	0.126	-0.063	1.021	-0.829
[2,]	-0.077	0.041	-0.826	0.550

Publicis Groupe SA	aic	: -5753.76		
	ARCH estimates:			
	[,1]	[,2]		
[1,]	0.559	-0.007	9.278*	-0.215
[2,]	-0.336	-0.028	-4.523*	-0.301
GARCH estimates:				
	[,1]	[,2]		
[1,]	0.090	-0.239	0.778	-3.552*
[2,]	0.030	-0.079	0.346	-0.572

TDC A/S	aic	: -6151.077		
	ARCH estimates:			
	[,1]	[,2]		
[1,]	0.988	-0.269	14.034*	-4.146*
[2,]	-0.188	-0.086	-7.060*	-2.396*
GARCH estimates:				
	[,1]	[,2]		
[1,]	0.057	0.229	3.357*	4.726*
[2,]	-0.036	-0.082	-0.708	-3.460*

Telefonaktiebolaget L M Ericsson	aic	: -5785.924		
	ARCH estimates:			
	[,1]	[,2]		
[1,]	0.506	0.043	10.188*	1.138
[2,]	-0.204	-0.066	-5.683*	-1.215
GARCH estimates:				
	[,1]	[,2]		
[1,]	0.613	-0.280	9.188*	-5.054*
[2,]	-0.299	0.460	-3.142*	4.852*

Telefonica SA	aic	: -5301.278		

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.387	-0.029	-7.245*	-1.087
[2,]	0.495	-0.360	4.450*	-5.579*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.714	0.284	-13.800*	7.412*
[2,]	-1.657	0.240	-7.427*	4.153*

Telekom Austria AG   aic : -5606.004

ARCH estimates:

	[,1]	[,2]		
[1,]	0.539	-0.004	10.543*	-0.085
[2,]	0.059	-0.303	0.948	-4.143*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.364	-0.252	4.948*	-3.469*
[2,]	0.366	-0.278	2.446*	-3.832*

Telenor ASA   aic : -6003.073

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.499	-0.013	-8.969*	-0.352
[2,]	-0.122	-0.067	-1.918**	-1.113

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.189	0.527	-1.838**	4.378*
[2,]	-0.056	0.160	-0.819	1.418

TeliaSonera AB   aic : -5898.386

ARCH estimates:

	[,1]	[,2]		
[1,]	0.295	-0.041	3.850*	-1.364
[2,]	1.330	0.034	21.246*	0.887

GARCH estimates:

	[,1]	[,2]		
[1,]	0.092	-0.320	0.994	-5.490*
[2,]	0.026	-0.089	0.467	-0.886

Vivendi SA   aic : -5596.943

ARCH estimates:

	[,1]	[,2]		
[1,]	0.557	0.028	12.568*	1.090
[2,]	0.324	-0.275	3.672*	-4.526*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.414	0.035	5.514*	0.542
[2,]	-0.065	-0.022	-0.346	-0.778

Vodafone Group PLC   aic : -5874.153

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.906	0.070	-14.993*	1.820**
[2,]	0.105	-0.228	1.597	-4.855*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.324	-0.017	-5.603*	-0.371

	[,1]	[,2]		
[2,]	-0.055	-0.003	-0.321	-0.143

Wolters Kluwer NV   aic : -5935.396

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.449	0.025	-9.991*	0.873
[2,]	0.159	-0.240	1.961*	-3.884*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.247	-0.240	-16.505*	-7.247*
[2,]	0.251	0.268	1.682**	11.293*

Carrefour SA   aic : -5447.009

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.447	0.018	-8.168*	0.286
[2,]	0.094	0.084	1.669**	1.394

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.820	0.444	-8.883*	6.347*
[2,]	-0.151	0.111	-0.666	0.894

Casino Guichard Perrachon SA   aic : -5494.874

ARCH estimates:

	[,1]	[,2]		
[1,]	0.436	-0.078	6.786*	-2.268*
[2,]	-0.352	0.104	-3.613*	1.635

GARCH estimates:

	[,1]	[,2]		
[1,]	0.573	-0.359	6.330*	-5.581*
[2,]	-0.356	0.227	-2.437*	2.290*

Compass Group PLC   aic : -6080.086

ARCH estimates:

	[,1]	[,2]		
[1,]	0.515	0.082	9.017*	2.481*
[2,]	0.270	0.146	3.199*	2.140*

GARCH estimates:

	[,1]	[,2]		
[1,]	0.479	0.224	6.857*	5.294*
[2,]	-0.420	-0.383	-1.605	-5.402*

Danone SA   aic : -6000.198

ARCH estimates:

	[,1]	[,2]		
[1,]	-0.629	0.106	-10.907*	2.805*
[2,]	-0.254	0.188	-3.203*	3.403*

GARCH estimates:

	[,1]	[,2]		
[1,]	-0.322	-0.037	-2.754*	-0.820
[2,]	0.846	0.173	8.803*	1.464

Diageo PLC   aic : -5810.081

ARCH estimates:

	[,1]	[,2]		
[1,]	0.785	0.049	11.406*	1.678**
[2,]	0.052	-0.098	0.538	-1.693**

GARCH estimates:

	[,1]	[,2]		

		[,1]	[,2]		
	[1,]	0.550	-0.049	8.408*	-1.933**
	[2,]	-0.037	0.001	-0.167	0.027
Kering SA	aic	: -5690.786			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.621	0.086	-11.496*	2.223*
	[2,]	-0.190	-0.326	-3.631*	-5.704*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.580	0.091	-7.648*	1.368
	[2,]	0.094	-0.034	0.530	-1.132
Koninklijke Ahold NV	aic	: -5791.952			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	0.558	-0.029	8.925*	-1.116
	[2,]	0.116	0.371	1.327	5.803*
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.006	0.008	-0.349	0.649
	[2,]	0.002	-0.001	0.016	-0.011
Koninklijke Philips NV	aic	: -5713.976			
	ARCH estimates:				
		[,1]	[,2]		
	[1,]	-0.572	0.107	-12.024*	3.026*
	[2,]	0.402	-0.040	7.082*	-0.760
	GARCH estimates:				
		[,1]	[,2]		
	[1,]	0.130	0.271	1.374	4.638*
	[2,]	0.162	0.348	1.839**	3.611*

*We look at the absolute value of the z-stat at 0.05 level of significance to be higher or equal to 1.96.

** For level of significance of 0.10 critical value of 1.64

Note: Some models cannot converge, so CDS-stock prices pairs are excluded

Appendix A

Table A.1 Statistical Characteristics of Daily Changes of CDS and Stock Prices (January 01, 2012 - January 29, 2016)

Company	CDS				Stocks			
	min	max	average	stdev	min	max	average	stdev
Airbus Group SE	-0.167	0.281	-0.001	0.025	-0.110	0.102	0.001	0.019
Volvo AB	-0.128	0.184	-0.001	0.024	-0.069	0.140	0.000	0.017
Akzo Nobel NV	-0.086	0.126	-0.001	0.019	-0.084	0.069	0.000	0.016
Anglo American PLC	-0.284	0.193	0.002	0.034	-0.131	0.128	-0.002	0.026
AstraZeneca PLC	-0.128	0.137	0.000	0.016	-0.118	0.134	0.000	0.013
Atlantia SpA	-0.143	0.116	-0.001	0.023	-0.052	0.081	0.001	0.016
BAE Systems PLC	-0.120	0.131	-0.001	0.020	-0.087	0.101	0.001	0.013
BASF SE	-0.097	0.109	0.000	0.018	-0.050	0.053	0.000	0.015
Bayerische Motoren Werke AG	-0.096	0.122	-0.001	0.019	-0.051	0.060	0.001	0.016
Bayer AG	-0.253	0.382	0.000	0.055	-0.062	0.070	0.000	0.017
Bouygues SA	-0.119	0.134	-0.001	0.021	-0.097	0.124	0.000	0.019
Compagnie de Saint Gobain SA	-0.161	0.117	-0.001	0.024	-0.113	0.065	0.000	0.018
Continental AG	-0.130	0.209	-0.002	0.024	-0.054	0.065	0.001	0.018
Daimler AG	-0.151	0.405	-0.001	0.031	-0.073	0.060	0.001	0.017
Koninklijke DSM NV	-0.125	0.138	0.000	0.019	-0.108	0.062	0.000	0.014
Lafargeholcim Ltd	-0.367	0.334	0.000	0.030	-0.116	0.066	0.000	0.015
Lanxess AG	-0.186	0.336	-0.001	0.025	-0.073	0.081	0.000	0.019
Linde AG	-0.096	0.141	0.000	0.019	-0.155	0.054	0.000	0.013
PostNL NV	-0.321	0.235	-0.001	0.030	-0.445	0.404	0.000	0.032
Rentokil Initial PLC	-0.099	0.119	-0.001	0.021	-0.071	0.090	0.001	0.013
Rolls-Royce Holdings PLC	-0.097	0.178	0.000	0.021	-0.218	0.078	0.000	0.017
Sanofi SA	-0.085	0.107	-0.001	0.017	-0.112	0.052	0.000	0.015
Siemens AG	-0.162	0.132	-0.001	0.018	-0.062	0.083	0.000	0.013
Solvay SA	-0.108	0.275	0.000	0.023	-0.065	0.089	0.000	0.017
Valeo SA	-0.111	0.182	-0.001	0.026	-0.056	0.119	0.001	0.020
Vinci SA	-0.120	0.130	-0.001	0.019	-0.065	0.058	0.001	0.015
Volkswagen AG	-0.287	1.070	0.000	0.044	-0.221	0.084	0.000	0.020
Wendel SA	-0.141	0.398	-0.001	0.030	-0.071	0.061	0.001	0.016
Accor SA	-0.118	0.136	0.000	0.023	-0.078	0.057	0.001	0.017
Electrolux AB	-0.109	0.136	0.000	0.018	-0.144	0.115	0.000	0.019
British American Tobacco PLC	-0.119	0.144	0.000	0.025	-0.042	0.036	0.000	0.011
Carlsberg A/S	-0.106	0.182	0.000	0.019	-0.097	0.069	0.000	0.015
LVMH Moet Hennessy Louis Vuitton SE	-0.098	0.133	0.000	0.019	-0.070	0.078	0.000	0.016
Marks and Spencer Group PLC	-0.090	0.140	-0.001	0.021	-0.043	0.093	0.000	0.014
Nestle SA	-0.090	0.128	0.000	0.019	-0.071	0.035	0.000	0.009
Next PLC	-0.091	0.138	-0.001	0.022	-0.075	0.096	0.001	0.011
Pernod Ricard SA	-0.106	0.130	-0.001	0.018	-0.079	0.051	0.000	0.012
SABMiller PLC	-0.154	0.101	-0.001	0.019	-0.051	0.181	0.001	0.014
Tate & Lyle PLC	-0.097	0.116	0.000	0.017	-0.183	0.069	0.000	0.015
Unilever NV	-0.142	0.114	0.000	0.018	-0.065	0.054	0.000	0.012

BP PLC	-0.155	0.131	0.000	0.023	-0.076	0.059	0.000	0.013
Centrica PLC	-0.119	0.149	0.000	0.022	-0.089	0.078	0.000	0.012
E.ON SE	-0.104	0.174	0.000	0.022	-0.122	0.077	-0.001	0.018
Electricite de France SA	-0.146	0.149	0.000	0.022	-0.082	0.089	0.000	0.017
Enbw Energie Baden Wuerttemberg AG	-0.133	0.181	-0.001	0.021	-0.117	0.077	-0.001	0.017
Enel SpA	-0.168	0.157	-0.001	0.029	-0.099	0.060	0.000	0.019
Engie SA	-0.214	0.191	0.000	0.027	-0.120	0.059	0.000	0.015
Eni SpA	-0.156	0.160	0.000	0.026	-0.087	0.067	0.000	0.016
Fortum Oyj	-0.105	0.206	0.000	0.020	-0.083	0.066	0.000	0.015
Gas Natural SDG SA	-0.135	0.176	-0.001	0.030	-0.084	0.078	0.000	0.015
Iberdrola SA	-0.221	0.134	-0.001	0.031	-0.082	0.077	0.000	0.015
National Grid PLC	-0.113	0.166	0.000	0.018	-0.066	0.040	0.000	0.010
Repsol SA	-0.224	0.294	0.001	0.033	-0.092	0.108	-0.001	0.020
Royal Dutch Shell PLC	-0.163	0.212	0.000	0.024	-0.080	0.062	0.000	0.013
RWE AG	-0.140	0.178	0.000	0.023	-0.101	0.153	-0.001	0.021
Statoil ASA	-0.140	0.144	0.000	0.022	-0.076	0.080	0.000	0.015
Total SA	-0.117	0.250	0.000	0.025	-0.082	0.064	0.000	0.015
United Utilities Group PLC	-0.101	0.167	0.000	0.020	-0.049	0.050	0.000	0.011
Veolia Environnement VE SA	-0.147	0.126	-0.001	0.026	-0.124	0.139	0.001	0.019
Aegon NV	-0.113	0.151	-0.001	0.027	-0.118	0.096	0.000	0.019
Allianz SE	-0.171	0.188	-0.001	0.034	-0.064	0.057	0.001	0.014
Assicurazioni Generali SpA	-0.132	0.165	-0.001	0.032	-0.092	0.089	0.000	0.017
Aviva PLC	-0.119	0.168	-0.001	0.030	-0.134	0.078	0.000	0.017
AXA SA	-0.142	0.206	-0.001	0.029	-0.087	0.073	0.001	0.018
Banco Bilbao Vizcaya Argentaria SA	-0.161	0.171	-0.001	0.033	-0.081	0.101	0.000	0.019
Banco Santander SA	-0.108	0.150	-0.001	0.033	-0.152	0.101	0.000	0.019
Barclays PLC	-0.131	0.225	-0.001	0.031	-0.169	0.096	0.000	0.020
Bayerische Landesbank	-0.220	0.157	-0.001	0.028	-0.135	0.089	0.000	0.012
BNP Paribas SA	-0.119	0.151	-0.001	0.032	-0.074	0.093	0.000	0.019
Commerzbank AG	-0.124	0.136	-0.001	0.028	-0.102	0.145	0.000	0.025
Credit Agricole SA	-0.152	0.160	-0.001	0.032	-0.107	0.088	0.001	0.023
Credit Suisse Group AG	-0.113	0.126	0.000	0.027	-0.116	0.087	0.000	0.018
Danske Bank A/S	-0.141	0.128	-0.001	0.021	-0.098	0.089	0.001	0.016
Deutsche Bank AG	-0.102	0.226	0.000	0.031	-0.072	0.083	-0.001	0.020
Hannover Rueck SE	-0.129	0.171	-0.001	0.032	-0.066	0.046	0.001	0.012
HSBC Holdings PLC	-0.148	0.300	0.000	0.034	-0.066	0.046	0.000	0.012
ING Groep NV	-0.260	0.145	-0.001	0.032	-0.077	0.089	0.001	0.021
Intesa Sanpaolo SpA	-0.182	0.227	-0.001	0.037	-0.101	0.118	0.001	0.024
Lloyds Banking Group PLC	-0.143	0.185	-0.001	0.032	-0.063	0.087	0.001	0.018
Mediobanca Banca di Credito Finanziario SpA	-0.208	0.181	-0.001	0.030	-0.099	0.090	0.000	0.024
Muenchener Rueckversicherungs Gesellschaft in Muenchen AG	-0.159	0.168	-0.001	0.036	-0.063	0.045	0.001	0.012
Societe Generale SA	-0.120	0.135	-0.001	0.031	-0.081	0.124	0.001	0.023
Standard Chartered PLC	-0.137	0.244	0.000	0.033	-0.179	0.078	-0.001	0.018
Royal Bank of Scotland Group PLC	-0.238	0.169	-0.001	0.031	-0.122	0.102	0.000	0.021
UBS Group AG	-0.134	0.178	-0.001	0.029	-0.125	0.078	0.000	0.016

BT Group PLC	-0.106	0.153	0.000	0.019	-0.051	0.116	0.001	0.014
Deutsche Telekom AG	-0.103	0.089	-0.001	0.017	-0.087	0.074	0.001	0.015
ITV PLC	-0.284	0.328	-0.001	0.026	-0.064	0.086	0.001	0.016
Koninklijke KPN NV	-0.163	0.122	0.000	0.023	-0.173	0.157	0.000	0.022
Orange SA	-0.090	0.092	-0.001	0.019	-0.062	0.100	0.000	0.018
Pearson PLC	-0.085	0.184	0.000	0.019	-0.174	0.161	0.000	0.015
Publicis Groupe SA	-0.142	0.136	0.000	0.020	-0.073	0.062	0.000	0.014
TDC A/S	-0.068	0.190	0.000	0.014	-0.111	0.059	0.000	0.014
Telefonaktiebolaget L M Ericsson	-0.070	0.164	0.000	0.018	-0.152	0.079	0.000	0.016
Telefonica SA	-0.137	0.159	-0.001	0.030	-0.077	0.069	0.000	0.015
Telekom Austria AG	-0.089	0.125	-0.001	0.020	-0.079	0.083	0.000	0.016
Telenor ASA	-0.079	0.111	-0.001	0.017	-0.087	0.060	0.000	0.013
TeliaSonera AB	-0.147	0.518	0.000	0.024	-0.095	0.064	0.000	0.012
Vivendi SA	-0.194	0.191	-0.001	0.023	-0.106	0.054	0.000	0.015
Vodafone Group PLC	-0.144	0.145	0.000	0.019	-0.059	0.078	0.000	0.013
Wolters Kluwer NV	-0.079	0.153	-0.001	0.019	-0.048	0.076	0.001	0.012
Carrefour SA	-0.119	0.114	-0.001	0.022	-0.062	0.072	0.000	0.018
Casino Guichard Perrachon SA	-0.166	0.238	0.001	0.027	-0.122	0.082	0.000	0.016
Compass Group PLC	-0.097	0.129	-0.001	0.019	-0.055	0.044	0.001	0.011
Danone SA	-0.083	0.142	0.000	0.018	-0.062	0.057	0.000	0.013
Diageo PLC	-0.131	0.237	0.000	0.024	-0.048	0.066	0.000	0.011
Kering SA	-0.149	0.126	-0.001	0.020	-0.086	0.101	0.000	0.016
Koninklijke Ahold NV	-0.093	0.125	-0.001	0.021	-0.063	0.057	0.001	0.013
Koninklijke Philips NV	-0.100	0.177	-0.001	0.020	-0.060	0.059	0.000	0.015

Table A.2 Pearson Correlation between CDS and Stock Prices Changes

Company	Correlation	Company	Correlation	Company	Correlation
Airbus Group SE	-0.115	SABMiller PLC	-0.224	Hannover Rueck SE	-0.486
Volvo AB	-0.393	Tate & Lyle PLC	-0.140	HSBC Holdings PLC	-0.435
Akzo Nobel NV	-0.339	Unilever NV	-0.280	ING Groep NV	-0.343
Anglo American PLC	-0.421	BP PLC	-0.249	Intesa Sanpaolo SpA	-0.413
AstraZeneca PLC	-0.262	Centrica PLC	-0.202	Lloyds Banking Group PLC	-0.400
Atlantia SpA	-0.255	E.ON SE	-0.279	Mediobanca Banca di Credito Finanziario SpA	-0.265
BAE Systems PLC	-0.275	Electricite de France SA	-0.268	Muenchener Rueckversicherungs Gesellschaft in Muenchen AG	-0.461
BASF SE	-0.356	Enbw Energie Baden Wuerttemberg AG	-0.069	Societe Generale SA	-0.528
Bayerische Motoren Werke AG	-0.291	Enel SpA	-0.377	Standard Chartered PLC	-0.373
Bayer AG	-0.230	Engie SA	-0.273	Royal Bank of Scotland Group PLC	-0.415
Bouygues SA	-0.210	Eni SpA	-0.288	UBS Group AG	-0.456
Compagnie de Saint Gobain SA	-0.315	Fortum Oyj	-0.286	BT Group PLC	-0.239
Continental AG	-0.353	Gas Natural SDG SA	-0.372	Deutsche Telekom AG	-0.287
Daimler AG	-0.345	Iberdrola SA	-0.418	ITV PLC	-0.068
Koninklijke DSM NV	-0.258	National Grid PLC	-0.183	Koninklijke KPN NV	-0.222
Lafargeholcim Ltd	-0.349	Repsol SA	-0.311	Orange SA	-0.310
Lanxess AG	-0.323	Royal Dutch Shell PLC	-0.229	Pearson PLC	-0.230
Linde AG	-0.283	RWE AG	-0.296	Publicis Groupe SA	-0.249
PostNL NV	-0.455	Statoil ASA	-0.194	TDC A/S	-0.176
Rentokil Initial PLC	-0.177	Total SA	-0.306	Telefonaktiebolaget L M Ericsson	-0.282
Rolls-Royce Holdings	-0.247	United Utilities Group	-0.046	Telefonica SA	-0.440
Sanofi SA	-0.313	Veolia Environnement VE SA	-0.257	Telekom Austria AG	-0.192
Siemens AG	-0.273	Aegon NV	-0.480	Telenor ASA	-0.225
Solvay SA	-0.306	Allianz SE	-0.575	TeliaSonera AB	-0.157
Valeo SA	-0.452	Assicurazioni Generali SpA	-0.450	Vivendi SA	-0.179
Vinci SA	-0.318	Aviva PLC	-0.471	Vodafone Group PLC	-0.170
Volkswagen AG	-0.462	AXA SA	-0.554	Wolters Kluwer NV	-0.294
Wendel SA	-0.379	Banco Bilbao Vizcaya Argentaria SA	-0.455	Carrefour SA	-0.409
Accor SA	-0.350	Banco Santander SA	-0.529	Casino Guichard Perrachon SA	-0.486
Electrolux AB	-0.266	Barclays PLC	-0.451	Compass Group PLC	-0.147
British American Tobacco PLC	-0.093	Bayerische Landesbank	-0.045	Danone SA	-0.274
Carlsberg A/S	-0.291	BNP Paribas SA	-0.504	Diageo PLC	-0.124
LVMH Moet Hennessy Louis Vuitton SE	-0.281	Commerzbank AG	-0.448	Kering SA	-0.266
Marks and Spencer Group PLC	-0.265	Credit Agricole SA	-0.522	Koninklijke Ahold NV	-0.241
Nestle SA	-0.207	Credit Suisse Group	-0.470	Koninklijke Philips NV	-0.148
Next PLC	-0.177	Danske Bank A/S	-0.242		
Pernod Ricard SA	-0.243	Deutsche Bank AG	-0.527		