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Media sentiment and CDS spread spillovers: Evidence from the GIIPS countries

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ABSTRACT

This study explores the role of newswire messages during the European debt crisis. It quantifies how this news metric, revealed by statements recorded by newspapers articles, affects CDS spillovers across five European countries with sovereign debt problems and strict bail-out programs, i.e. Greece, Ireland, Italy, Portugal, and Spain with daily data spanning the period 2009–2012. Using panel ARDL and asymmetric conditional volatility modeling methods, the empirical findings document that the news variable generates significant spillover effects across the underlined CDS markets. These findings cast a cloudy doubt on the effectiveness of economic modeling on which CDS spreads are based.

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1. Introduction

The European sovereign debt market was under stress over the period starting in October 2009 throughout June 2012. The beginning of this period was marked by the announcement of the Greek socialist prime minister on the fiscal problem the country was experiencing at that time, i.e. the deficit was much higher than originally predicted. Immediately afterwards, in 5 November 2009, the Greek government revealed a revised budget deficit of 12.7% of GDP. As a result, the turbulence in the Greek debt market spread to other European countries, leading to two rescue packages, as well as the installment of a crisis mechanism with funds from the EU (i.e., the European Financial Stabilization Mechanism, EFSM) and other euro-zone countries (European Financial Stability Facility, EFSF). The end of the turbulence period is marked by the ratification of the second bail-out program by the spring of 2012. While Ireland and Portugal have received rescue packages, Italy and Spain never adopted a bail-out program.

As a consequences, the impact of the European debt crisis on the interconnectedness between financial markets has attracted great attention of many scholars (e.g., Ahmad, Sehgal, & Bhanumurthy, 2013; Albulescu, Goyeau, & Tiwari, 2015; Petmezas & Santamaria, 2014). The goal of this paper is to explore spillover effects between Credit Default Swaps (CDS) spreads across the countries that suffered the most from the European sovereign debt crisis, i.e., Greece, Ireland, Italy, Portugal and Spain (GIIPS), and newswire messages in relevance to these stressful economies. There are various fields of literature to which this paper is related. First, it contributes to the literature that explores whether news has an impact on financial markets (e.g., Albuquerque & Vega, 2009; Andersen, Bollerslev, Diebold, & Vega, 2007; Fleming & Remolona, 1999). Kaminsky and Schmukler (1999) investigate the impact of news on stock markets during the period of the Asian crisis, while Aizenman, Jinjarak, Lee, and Park (2012) explore the presence of spillovers during both the recent financial crisis and the European sovereign debt crisis for the case of developing countries. They distinguish the effects of bad and good news (a procedure we also follow in our methodological part). A second strand is in relevance to contagion and co-movements in financial markets (Pericoli & Sbracia, 2003). Ahmad et al. (2013) investigate contagion effects between daily returns on developed markets of Greece, Ireland, Portugal, Spain and Italy, the USA, the UK and Japanese markets, and daily returns on emerging markets of BRIICKS (Brazil, Russia, India, Indonesia, China, South Korea and South Africa) during the European debt crisis. The empirical results show that Ireland, Italy and Spain appear to be most contagious for BRIICKS markets compared to Greece. Bekaert, Ehrmann, Fratzscher, and Mehl (2011) argue that co-movements may be caused by interdependence as a result of fundamental and financial cross-country linkages. However, in this paper we go beyond estimation of the dynamics and intensity of information transmission across markets during the crisis episodes (e.g., Yarovaya, Brzeszczynski, & Lau, 2016a). We use Diebold and Yilmaz (2012) total spillover index as the dependent variable providing the novel evidence on the impact of newswire

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messages on intensity of spillovers across CDS spreads. A third strand explores the role of trade and financial linkages across countries in the contagion of currency crises (e.g., Eichengreen, Rose, & Wyplosz, 1996; Van Rijckeghem & Weder, 2001; Albuquerque, Ramadorai, & Watugala, 2011). Finally, our work is related to the literature on spillovers across CDS markets (e.g., Alemany, Ballester, & Urteaga, 2015). Elkhaldia, Chebbiab, and Naoui (2014) investigate contagion spillovers between macroeconomic and market factors across peripheral and core countries in Europe. Their results provide supportive evidence for the presence of a positive link between CDS sovereign spreads of the peripheral countries and those spreads of the core countries. Blommestein, Eijffinger, and Qian (2016) study the determinants of sovereign CDS spreads for the case of the GIIPS economies after the collapse of Lehman Brothers. Their results document that global and/or European Monetary Union (EMU)-wide factors are the main drivers of changes in their sovereign CDS spreads, while the impact of such factors changes with market uncertainty. This type of changes affects sovereign credit risk with further impacts on domestic economic and financial indicators.

The novelties of this paper are: it employs daily yield data, not only for CDS spreads, but from a novel news dataset that identifies the most important newswire messages about the role of the European sovereign debt crisis with respect to the GIIPS economies, as well as in the remaining European economies. This news variable explicitly measures the 'positive' and 'negative' news by the type of messages involved in words published in those newswire articles/statements (messages/statements mentioned on each given day) and investigate for spillover reactions in the CDS markets. To foreshadow our results, they provided supportive evidence that newswire messages have a significant impact on CDS spread spillovers across the CDS markets of fiscally stressful economies.

Section 2 presents a description of the data used along with the methodology followed, while Section 3 reports the empirical results. Concluding remarks and policy implications are given in Section 4.

2. Data and methodology

Five countries are investigated by the empirical analysis, i.e. Greece, Italy, Ireland, Portugal, and Spain (GIIPS) based on their serious and substantial sovereign debt problems.[1] Our daily data set starts on October 2, 2009, a few days before the Greek Prime Minister disclosed the country's fiscal problems in his first parliamentary speech, while the data set ends on June 29, 2012.[2] Regarding to the sources of newswire messages, we retrieved newspaper articles mainly from: (a) the presidents, prime ministers, finance ministers across euro area countries and the US; (b) the Director of the IMF; (c) the presidents of the European Council and Commission; and (d) members of the ECB Council. We extracted those articles containing contents related to the sovereign debt in the GIIPS countries, carefully avoiding double counting (i.e., this has been achieved with the sentiment measures from Thomson Reuters News Analytics, since each item is assigned a 'novelty' score).

Apart from GIIPS, we also obtained articles from newspapers in Belgium, France, Germany, the Netherlands, and the UK. The source for news articles is Factiva.com, a comprehensive online database of newspapers, which categorizes its articles by subject, and provides a code that identifies articles that discuss sovereign debt issues. This code is determined by a propriety algorithm that remains objective across all newspapers and years. We managed to download 2894 articles consisting of 1,629,305 words. We captured news through a textual analysis of these newspaper articles.[3] Textual analysis is an increasingly popular methodology used to quantify the tone and sentiment in financial documents. A number of finance and accounting studies have applied textual analysis techniques to capture the tone of earnings announcements, investor chat rooms, and newspaper articles (e.g., Hanley & Hoberg, 2010; Loughran & McDonald, 2011).

Daily counts of positive, negative and total words were manually produced. The percentage of positive words (POS_{it} = [# positive words / # total words]$_{it}$ × 100) is calculated as the number of positive words per the total number of words in that article. The percentage fraction of negative words (NEG_{it} = [# negative words / # total words]$_{it}$ × 100) is generated in the same manner. We additionally adjusted both negative and positive word counts for negation using the terms: no, not, none, neither, never, and nobody. We considered a word negated if it was preceded within five words by one of these negation terms. It was possible within an article to track both negative and positive words, though that in the case of a negative article, positive words could be hardly tracked. Based on the above mentioned rules, total negative news constituted a 73.4% of total news, while the remaining 26.6% was related to the positive news. The daily data on 5-year sovereign CDSs for GIIPS are downloaded from Bloomberg. Following Apergis (2015b), we specify the sovereign news index as $NEWS_{it} = POS_{it} - NEG_{it}$, where i and t denote the country i and day t, respectively.

Table 1 provides summary statistics for variables used in this study. We can see from panel A of Table 1 that Greece exhibits the highest average CDS of 990 basis points (b.p.) as the country had the highest default probability among the GIIPS counties, implying that investors must pay the bank $990,000 for a $10 million worth of protection from the bank. By contrast, Spain shows the lowest average CDS of 282 basis points. Moreover, Greece also illustrates the highest volatility on its CDSs, virtually 7 times higher vis-à-vis that of Spain. In terms of the sovereign news index, both Greece and Portugal display the lowest values (i.e. −19), which implies that negative wording dominates over positive wording, while Greece has the largest variation for its sovereign news index. A similar pattern on the percentage fraction of negative words has been observed for both Greece and Portugal (i.e. 29%) as well, while the highest fraction of positive words comes from the case of Italy. It is also noteworthy that Greece shows the highest variation for the variables of NEWS, POS, and NEG.

3. Empirical analysis

3.1. Unit root tests

First, Table 2 reports the results for stationarity tests; the findings document that all variables contain a unit root through the ADF and the Phillips-Perron (PP) tests. However, the univariate ADF test under structural break suggests that the CDS for major countries is stationary across all countries in our sample, except the cases of Greece and Italy.

Given that the evidence regarding stationarity of the CDS variable is relatively mixed, the analysis implements a robustness stationarity test, recommended by Hadri and Rao (2008), which is more powerful by incorporating the possibility of cross-sectional dependence across countries and structural breaks. Let the CDS for the country i at time t be $CDS_{i,t}$ such that under the null hypothesis of stationarity we get:

$$CDS_{i,t} = r_{i,t} + Z_{i,t}\beta + \varepsilon_{i,t} \quad (1)$$

$$r_{i,t} = r_{i,t-1} + \mu_{i,t} \quad (2)$$

[1] In particular, Greece, Ireland and Portugal have been under austerity programs during the time span under study.

[2] It has been noted that CSDs increased substantially as a result of the worsened euro area crisis.

[3] Apergis (2015a) examined how this news metric affects credit ratings of three European countries with sovereign debt problems (i.e. Greece, Ireland, and Portugal). The found evidence that news comes from market sources is more influential on credit ratings than news that is from politicians Similar data has been used in Apergis (2015b) analysed the forecasting performance of newswire messages, revealed by newspaper articles for CDS.

Table 1
Descriptive statistics.

Panel A: CDS spread and sovereign news index statistics										
	PORTUGAL	IRELAND	ITALY	GREECE	SPAIN	NEWSPO	NEWSIR	NEWSIT	NEWSGR	NEWSSP
Mean	611.42	491.628	259.574	990.629	281.745	−19.854	−15.763	−13.346	−19.69	−16.19
Median	495.988	576.711	192.089	851.893	255.755	−19.608	−15.693	−13.158	−19.304	−16.131
Maximum	1526.948	1191.501	591.536	7586.135	623.325	−0.68	0	5.714	−0.719	4.167
Minimum	50.181	110.528	67.573	121.725	65.888	−40.152	−30.667	−28.859	−171.429	−33.571
Std. Dev.	400.167	243.248	151.209	844.362	131.228	5.02	4.385	4.463	8.027	4.816
Skewness	0.233	−0.198	0.667	2.732	0.357	−0.165	−0.068	0.03	−9.736	0.03
Kurtosis	1.617	1.905	1.993	14.781	2.532	3.708	3.136	3.701	180.349	3.898
Jarque-Bera probability	0	0	0	0	0	0	0.575	0.001	0	0

Panel B: percentage fraction of positive and negative words										
	NPO	NIR	NIT	NGR	NSP	PPO	PIR	PIT	PGR	PSP
Mean	29.621	26.431	24.714	29.411	26.689	9.766	10.668	11.368	9.721	10.499
Median	29.894	26.726	24.848	28.488	26.984	9.931	10.968	11.476	9.677	10.625
Maximum	38.346	35.443	34.932	307.143	35.417	19.853	18.792	18.391	135.714	19.424
Minimum	14.286	14.286	11.429	12.95	11.806	−2.273	1.333	2.013	0	0.714
Std. Dev.	3.565	3.214	3.377	11.723	3.388	3.428	2.876	2.848	5.664	3.116
Skewness	−0.283	−0.289	−0.249	18.738	−0.307	−0.228	−0.265	−0.224	15.41	−0.157
Kurtosis	3.165	3.152	3.165	441.59	3.386	2.954	2.898	2.958	343.293	3.094
Jarque-Bera probability	0.006	0.005	0.016	0	0	0.043	0.013	0.048	0	0.202
Observations	716	716	716	716	716	716	716	716	716	716

Notes: The variables PORTUGAL, IRELAND, ITALY, GREECE, and SPAIN represent the CDS spreads for these countries. NEWSPO, NEWSIR, NEWSIT, NEWSGR, and NEWSSP represent the sovereign news index for Portugal, Ireland, Italy, Greece, and Spain, respectively. NPO, NIR, NIT, NGR, and NSP denote the percentage fraction of negative words for Portugal, Ireland, Italy, Greece, and Spain, respectively. PPO, PIR, PIT, PGR, and PSP denote the percentage fraction of positive words for Portugal, Ireland, Italy, Greece, and Spain, respectively.

Table 2
Unit root tests with structural breaks (p-values).

Panel A: univariate unit root test			Innovational Outlier Test	
Variables	ADF	PP	Model A	Break date
PORTUGAL	0.914	0.5119	0.0342	04/07/2011
IRELAND	0.962	0.7445	0.0345	03/06/2011
ITALY	0.344	0.3893	0.1248	04/07/2011
GREECE	1.000	0.9972	0.1176	24/04/2012
SPAIN	0.145	0.0332	0.000	10/01/2011
NEWSPO	0.000	0.000	0.000	01/06/2011
NEWSIR	0.000	0.000	0.000	09/09/2011
NEWSIT	0.000	0.000	0.000	01/06/2011
NEWSGR	0.004	0.000	0.000	10/12/2009
NEWSSP	0.000	0.000	0.000	28/03/2011
NPO	0.000	0.000	0.000	24/06/2011
NIR	0.000	0.000	0.000	24/06/2011
NIT	0.009	0.000	0.000	24/06/2011
NGR	0.000	0.000	0.000	10/12/2009
NSP	0.000	0.000	0.000	02/05/2011
PPO	0.000	0.000	0.000	02/03/2011
PIR	0.000	0.000	0.000	14/03/2011
PIT	0.000	0.000	0.000	16/03/2010
PGR	0.000	0.000	0.000	12/03/2009
PSP	0.000	0.000	0.000	19/03/2012
PORTUGALR	0.000	0.000	0.000	10/05/2010
IRELANDR	0.000	0.000	0.000	10/05/2010
ITALYR	0.000	0.000	0.000	10/05/2010
GREECER	0.000	0.000	0.000	06/08/2010
SPAINR	0.000	0.000	0.000	06/05/2010
Panel B: panel unit root test				
Test			CDS spreads	
Im, Pesaran, and Shin (2003)			0.8721	
Hadri (2000)	Homogenous variance		0.000	
	Heterogeneous variance		0.000	

Notes: For PP test, the selected truncation for the Bartlett Kernel is based on the suggestion by Newey and West (1994). The optimum lag order is selected based on the BIC criterion. The 'innovational outlier test' follows Perron (1989). It assumes that the break occurs gradually, with the breaks following the same dynamic path as the innovations. The variables PORTUGAL, IRELAND, ITALY, GREECE, and SPAIN represent the CDS spreads for these countries. NEWSPO, NEWSIR, NEWSIT, NEWSGR, and NEWSSP represent the sovereign news index for Portugal, Ireland, Italy, Greece, and Spain, respectively. NPO, NIR, NIT, NGR, and NSP denote the percentage fraction of negative words for Portugal, Ireland, Italy, Greece, and Spain, respectively. PPO, PIR, PIT, PGR, and PSP denote the percentage fraction of positive words for Portugal, Ireland, Italy, Greece, and Spain, respectively. PORTUGALR, IRELANDR, ITALYR, and SPAINR represent percentage changes of CDS spreads for these countries. The results for the univariate unit root tests with structural break are based on Perron and Vogelsang (1993) asymptotic one-sided p-values.

where Z_{it} is a deterministic component, ε_{it} are stationary errors, μ_{it} is the independent identically distributed errors, and r_{it} is a random walk process. Z_{it} is the control variable for the dynamics of $CDS_{i,t}$. If $Z_{it}=[1]$,then Eq. (1) turns to a simple level stationary process without trend and structural breaks. Following the notations from the study by Ranjbar, Li, Chang, and Lee (2014) we get five possibilities:

$$Model\ 0: Z_{i,t} = [1, t]' \tag{3}$$

$$Model\ 1: Z_{i,t} = [1, D_{i,t}]' \tag{4}$$

$$Model\ 2: Z_{i,t} = [1, t, D_{i,t}]' \tag{5}$$

$$Model\ 3: Z_{i,t} = [1, t, DT_{i,t}]' \tag{6}$$

$$Model\ 4: Z_{i,t} = \left[1, t, D_{i,t}, DT_{i,t}\right]' \tag{7}$$

The dummy variables D_{it} and DT_{it} are, respectively, defined as:

$$D_{i,t} = \begin{cases} 1, & if\ t > T_{B,i}, \\ 0, & \text{otherwise} \end{cases} \tag{8}$$

$$DT_{i,t} = \begin{cases} t - T_{B,i}, & if\ t > T_{B,i}, \\ 0, & \text{otherwise} \end{cases} \tag{9}$$

where $T_{B,i}$ is the break date in intercept and/or time trend function of the CDS for country i. Model 0 is a trend-stationary process without breaks. Model 1 specifies a break in the level and no trend. Model 2 to model 4 are trend-stationary process. In particular, Model 2 allows for a break in the level only, while model 3 allows a break in the slope. Model 4 admits a break in both the level and the slope. In this study, the finite sample critical values for the individual univariate test statistics are calculated through Monte Carlo simulations based on 20,000 replications.

The results of the Hadri and Rao (2008) stationarity test on the GIIPS countries are presented in Table 3, and they allow various types of breaks to be different across countries. The finite sample critical values for test statistics are calculated by Monte Carlo simulation, running 20,000 replications. The results at the 10%, 5% and 1% significant levels are presented in the third, the fourth and fifth columns. The null

Table 3
Hadri and Rao (2008) stationarity tests.

Individual test statistics for models allows for serial correlation							
Countries	Test statistics	10%	5%	1%	Optimum lag(s) based on BIC	Selected model	Break dates
GREECE	0.147**	0.112	0.139	0.207	2	2	21/05/2012
IRELAND	0.072**	0.058	0.069	0.097	2	3	05/07/2011
ITALY	0.042	0.089	0.107	0.152	3	1	29/07/2011
PORTUGAL	0.017	0.059	0.07	0.097	4	3	05/07/2011
SPAIN	0.032	0.053	0.062	0.082	2	3	28/01/2011
HR panel	0.062	0.028	0.035	0.051			

Notes: Models 0, 1, and 4 examine the trend-stationary process without breaks, shifts in the level and no trend, trend functions with a shift in the intercept and slope process, respectively. We use the Schwarz Bayesian Information Criterion (BIC) to find the appropriate break-type model for the series. The optimum lag(s) are used as in the Sul et al. (2005) procedure to estimate the consistent long-run variance. We compute the empirical distribution of the panel test statistics using bootstrap techniques as in Maddala and Wu (1999) and using 20,000 replications. ** denotes significant at 5%.

hypothesis of stationarity is rejected in the case of Greece and Ireland at the 5% significance level. Moreover, the estimated break dates of the selected models are presented in the last column of Table 3. The results indicate the break dates for the cases of: Greek (21/05/2012); Ireland (05/07/2011), Italy (29/07/2011), Portugal (05/07/2011), and Spain (28/01/2011).

3.2. ARDL model estimates

We employ the Autoregressive Distributed Lag (ARDL) cointegration model proposed by Pesaran, Shin, and Smith (2001) to examine the non-linear relationship between CDS and newswire variables for Greece due to the possibility of I(1) property for CDS while newswire variables are clearly I(0). The general ARDL representation of the effects of both the POS_{it} and NEG_{it} news on CDSs yields the following spcification:

$$CDS_t = \alpha_{0+}\sum_{i=1}^{p}\lambda_i\, CDS_{t-i} + \sum_{i=1}^{q}\alpha_{1i}\, POS_{t-i} + \sum_{i=1}^{m}\alpha_{2i}\, NEG_{t-i} + \upsilon_t \quad (10)$$

where p, q, and m denotes the lag order, and v_t is assumed to be an independent and identically distributed (IID) process with a finite second moment. Eq. (10) can be transformed into an Error Correction modeling process as follows:

$$\begin{aligned}\Delta CDS_t = {} & \sigma_{0+}\sum_{i=1}^{p}\sigma_{1i}\,\Delta CDS_{t-i} + \sum_{i=1}^{q}\sigma_{2i}\,\Delta POS_{t-i} \\ & + \sum_{i=1}^{m}\sigma_{3i}\,\Delta NEG_{t-i} + \xi(CDS_{t-1} - \beta_1 POS_{t-1} - \beta_2 NEG_{t-1}) \\ & + \mu_t \end{aligned} \quad (11)$$

where ξ is the speed of adjustment parameter. β_1 and β_2 are the long-run coefficients for the percentage of positive words and the percentage of negative words, respectively. The short-run parameters are represented by σ_2, and σ_3. The final ARDL (p, q, m) model can be simplified (e.g. news variables contain shorter memory) and is given by:

$$\begin{aligned}\Delta CDS_t = {} & \sigma_0 + \sum_{i=1}^{p}\sigma_{1i}\Delta CDS_{t-i} + \sigma_2\Delta POS_t + \sigma_3\Delta NEG_t \\ & + \xi(CDS_{t-1} - \beta_1 POS_{t-1} - \beta_2 NEG_{t-1}) + \mu_t \end{aligned} \quad (12)$$

Table 4 presents the results of ARDL model, i.e. Eq. 10, obtained for Greece. The findings demonstrate that a 1% increase in POS causes a decrease in 1.52 b.p. of the CDS spreads, while a 1% increase in NEG leads to only 0.7 b.p. increase of the CDS spreads. Therefore the impact of newswire messages on CDS spreads is asymmetric: an increase in number of positive words in news releases on the CDS spreads is more pronounced than increase in number of negative words. Furthermore, the results reported by Table 5 illustrate that the error-correction coefficient, i.e. Eq. (12), is negative and statistically significant at 1%.[4] More importantly, the long-run coefficients from the cointegrating equation display that a 1% increase in POS results in a decrease of the CDS spreads by 43 b.p. in the long-run, while a 1% increase in NEG results in an increase of 20 b.p. in the CDS spreads in the long run, which is consistent with findings presented in Table 4 The error correction (EC) coefficient turns out to be −0.037, which implies that the adjustment speed is about 3.7%.

Table 4
ARDL estimations for Greece.

Dependent variable: GREECE				
Variable	Coefficient	Std. error	t-Statistic	Prob.*
GREECE(−1)	0.652	0.059	11.049	0.000
GREECE(−2)	0.242	0.036	6.666	0.000
GREECE(−3)	0.105	0.056	1.871	0.062
GREECE(−4)	0.016	0.043	0.364	0.716
GREECE(−5)	−0.158	0.008	−19.726	0.000
GREECE(−6)	0.427	0.279	1.530	0.126
GREECE(−7)	−0.569	0.385	−1.479	0.140
GREECE(−8)	0.250	0.127	1.966	0.050
PGR	−1.520	0.642	−2.367	0.018
NGR	0.717	0.330	2.171	0.030
DUMMYGREECE	205.944	42.514	4.844	0.000
C	−7.301	7.300	−1.000	0.318
@TREND	0.105	0.040	2.613	0.009
R-squared	0.977	Mean dependent var		1000.405
Adjusted R-squared	0.977	S.D. dependent var		844.068
S.E. of regression	129.389	Akaike info criterion		12.582
Sum squared resid	11,635,396.000	Schwarz criterion		12.665
Log likelihood	−4440.928	Hannan-Quinn criter.		12.614
F-statistic	2449.325	Durbin-Watson stat		2.028
Prob(F-statistic)	0.000			

Notes: The maximum dependent lags allowed: 8 (Automatic selection). Model selection method: Akaike information criterion (AIC). Number of models evaluated: 648.

3.3. E-GARCH estimates

In this sub-section, an E-GARCH model is estimated for the CDS spreads of the GIIPS countries. This modeling approach has the comparative advantage over other GARCH methodological approaches in a sense that it ensures the conditional variance is strictly positive and the non-negative constraints of GARCH model are, therefore, unnecessary. Moreover, it allows the presence of asymmetric shocks in news entering the variance equation in a manner that the likelihood of bad news generates higher volatility spillover is higher than good news.[5] The mean equation for each country is specified as:

$$CDS_t = \delta_0 + \sum_{i=1}^{p}\lambda_i\, CDS_{t-i} + \delta_1\, POS_t + \delta_2\, NEG_t + \upsilon_t \quad (13)$$

The variance equation is also included to capture the conditional heteroscedasticity for the CDS spreads. Thus, an E-GARCH (1, 1) specification can be written, in terms of the conditional variance of returns, as:

$$\ln(\mathrm{h}_t) = \omega + \sum_{i=1}^{p}\alpha_i\left|\frac{\upsilon_{t-i}}{h^2_{t-i}}\right| + \sum_{k=1}^{r}\gamma_k\frac{\upsilon_{t-k}}{h^2_{t-k}} + \sum_{j=1}^{q}\beta_j \mathrm{h}_{t-j} \quad (14)$$

where h_t is the conditional volatility, ω is the constant term, υ_{t-i} is the innovation in period $t-i$, and γ_k captures the asymmetric impact of positive and negative news. Eq. (14) takes the log of the variance and it differs from the simple GARCH variance structure. The presence of the asymmetric leverage effect is denoted by $\gamma_k \neq 0$.

[4] The estimations also include a dummy variable for the relevant break date at 15/03/2011.

[5] Other GARCH models, i.e. Glosten-Jagannathan-Runkle GARCH (GJR-GARCH) and the asymmetric power autoregressive conditional heteroscedastic (APARCH) model, have been also estimated; however, these models did not fit our data well.

Table 5
ARDL Cointegration and long run forms.

Dependent variable: GREECE				
Variable	Coefficient	Std. error	*t*-Statistic	Prob.
D(GREECE(−1))	−0.312429	0.03767	−8.294	0
D(GREECE(−2))	−0.071006	0.0405	−1.753	0.08
D(GREECE(−3))	0.033128	0.04141	0.8	0.424
D(GREECE(−4))	0.049333	0.04258	1.1585	0.247
D(GREECE(−5))	−0.11076	0.04691	−2.361	0.0185
D(GREECE(−6))	0.316602	0.09813	3.2263	0.0013
D(GREECE(−7))	−0.254087	0.09522	−2.669	0.0078
D(PGR)	−1.052294	1.36972	−0.768	0.4426
D(NGR)	0.536701	0.6554	0.8189	0.4131
C	−7.867673	5.55595	−1.416	0.1572
EC(−1)	−0.037493	0.00588	−6.376	0
Long-run coefficients				
PGR	−42.871987	22.3118	−1.921	0.0551
NGR	20.220122	11.0186	1.8351	0.0669
DUMMYGREECE	5807.845223	1796.6	3.2327	0.0013
@TREND	2.965773	0.5402	5.4901	0

Notes: The maximum dependent lags allowed: 8 (Automatic selection). Model selection method: Akaike information criterion (AIC). Number of models evaluated: 648.

The advantage of the E-GARCH model is that the conditional value is positive, while the restriction of non-negative coefficients could be relaxed. All parameters in the conditional mean and variance equations are estimated simultaneously through maximum likelihood estimation (MLE). Tables 6 to 10 report the E-GARCH results for the influence of the GIIPS countries' newswire on the CDS spreads.

The overall findings provide the supportive evidence of asymmetry in spillover effect between media sentiment and CDS spread. First, we note that the effect of the Greece's "newswire message" on its own CDS spead is that 1% changes in the daily percentage of positive words leads to decrease of 0.8754 CDS b.p. (Column 2, Table 6) as compared to a 42.8720 b.p. decrease in the long run (i.e. long run coefficient for PGR in Table 5). However, the response of Greece's CDS spread to a 1% increase in negative news is 0.6516 b.p. (Column 2, Table 6), compared to the 20.2201 b.p. in the long run (i.e. long run coefficient for NGR in Table 5). These results are consistent with the theoretical predictions discussed earlier. Second, we can observe that the impact of positive news on CDS spread for all countries is negative (i.e. negative coefficient for POS), indicating that CDS spreads have a direct link with the risk associated with the market. Moreover, the markets react to unfavorable news (i.e., NEG) by increasing the spreads and to favorable news

Table 6
Impact of Greek newswires on CDS spreads.

	Greek	Sig	Ireland	Sig	Italy	Sig	Portugal	Sig	Spain	Sig
Panel A: mean equation										
δ0	−13.2633	***	0.7576		0.3363		0.3911		0.9093	
λ1	0.7011	***	1.2728	***	1.2275	***	1.2552	***	1.1132	***
λ2	0.2571	***	−0.3640	***	−0.3177	***	−0.2334	***	−0.1645	***
λ3	0.1069	***	0.0734	**	0.0982	***	−0.0762		0.0217	
λ4	0.0119	***	0.0018		−0.0244		0.0349		−0.0448	
λ5	−0.1637	***	0.1057	***	0.0300		0.0729		0.1520	***
λ6	0.4272	***	−0.1257	***	0.0132		−0.0792		−0.1624	***
λ7	−0.5887	***	0.0441		−0.0444		0.0376		0.1342	***
λ8	0.2547	***	−0.0090		0.0171		−0.0111		−0.0503	
δ1 (POS)	−0.8754	***	−0.1007	*	−0.0485	*	−0.0552		−0.0624	
δ2 (NEG)	0.6516	***	0.0293		0.0139		0.0175		0.0164	
Panel B: variance equation										
ω	5.8470	***	−0.0673		−0.0616	*	−0.1424	***	−0.0829	***
α_1	1.6510	***	0.2635	***	0.1788	***	0.3653	***	0.2297	***
γ_1	−0.5212	***	0.1398	***	0.1391	***	0.1318	***	0.1173	***
β_1	0.1180	***	0.9759	***	0.9846	***	0.9793	***	0.9816	***
GED parameter	0.5696	***	1.1189	***	1.1229	***	1.0788	***	1.3475	***

Notes: ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively. Notice that the coefficient (−0.059) of POS for Portugal becomes significant at the 5% level when the lags of the CDS spreads is set to 2. For the remaining countries, the coefficients of POS and NEG are robust to the choice of the CDS spreads' lag structures in the mean equation.

Table 7
Impact of Irish newswires on CDS spreads.

	Ireland	Sig	Greece	Sig	Italy	Sig	Portugal	Sig	Spain	Sig
Panel A: mean equation										
δ0	2.8285		4.1641	***	0.3635		1.1822		2.3714	
λ1	1.2857	***	0.7110	***	1.2252	***	1.2393	***	1.1139	***
λ2	−0.3638	***	0.2581	***	−0.3151	***	−0.2440	***	−0.1644	***
λ3	0.0472		0.0991	***	0.1013	***	−0.0279		0.0161	
λ4	0.0116		0.0182	***	−0.0332	***	−0.0037		−0.0369	
λ5	0.1034	***	−0.1615	***	0.0391		0.1129	***	0.1413	***
λ6	−0.1284	***	0.4172	***	0.0027		−0.1185	***	−0.1532	***
λ7	0.0599		−0.5942	***	−0.0392		0.0539		0.1291	***
λ8	−0.0169		0.2532	***	0.0185		−0.0117		−0.0466	
δ1 (POS)	−0.1940	***	−0.0327	***	−0.0529		−0.0886	*	−0.1026	
δ2 (NEG)	0.0054		−0.1446		0.0184		0.0089		−0.0176	
Panel B: variance equation										
ω	−0.0766		−0.0683		−0.0653	*	−0.1409	***	−0.0860	***
α_1	0.2775	***	0.3527	***	0.1866	***	0.3647	***	0.2372	***
γ_1	0.1361	***	0.1006	***	0.1358	***	0.1262	***	0.1141	***
β_1	0.9757	***	0.9782	***	0.9842	***	0.9790	***	0.9811	***
GED parameter	1.1297	***	0.7222	***	1.1245	***	1.0776	***	1.3585	***

Notes: ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively.

Table 8
Influence of Italian newswires on CDS spreads.

	Italy	Sig	Greece	Sig	Ireland	Sig	Portugal	Sig	Spain	Sig
Panel A: mean equation										
δ0	1.2731		3.9293	***	2.9447	*	1.8879	*	2.5000	
λ1	1.2194	***	0.6720	***	1.2586	***	1.2464	***	1.1132	***
λ2	−0.3108	***	0.3941	***	−0.3042	***	−0.2421	***	−0.1630	***
λ3	0.0948	*	−0.0237		0.0060		−0.0385		0.0149	
λ4	−0.0142		−0.0159		0.0113		−0.0032		−0.0359	
λ5	0.0279	***	−0.1017	***	0.1168	**	0.1072	***	0.1412	***
λ6	0.0043	***	0.3282	***	−0.1270	***	−0.1052	***	−0.1533	***
λ7	−0.0448		−0.4972	***	0.0479		0.0553		0.1292	***
λ8	0.0222		0.2446	***	−0.0109		−0.0197		−0.0469	
δ1 (POS)	−0.0867	**	−0.2021	***	−0.1871	***	−0.1129	**	−0.1109	
δ2 (NEG)	0.0049		−0.0224		0.0037		−0.0031		−0.0180	
Panel B: variance equation										
ω	−0.0642	*	−0.0357		−0.0683		−0.1357	***	−0.0830	***
α_1	0.1898	***	0.3170	***	0.2653	***	0.3632	***	0.2325	***
γ_1	0.1350	***	0.1177	***	0.1389	***	0.1297	***	0.1148	***
β_1	0.9834	***	0.9771	***	0.9757	***	0.9783	***	0.9812	***
GED parameter	1.1312	***	0.6987	***	1.1401	***	1.0778	***	1.3634	***

Notes: ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively.

(i.e., POS) by decreasing those spreads. Third, there is evidence of interconnectedness of the CDS markets across the GIIPS countries, with spillover effects being a natural phenomenon.

A shock to the sovereign in Greece can propagate through the network of borrowing and lending relationships in various countries to generate a sovereign debt crisis in the eurozone. The CDS spreads of other countries under study are affected by positive news in Greece, except Spain and Portugal (Column 5-6, Table 6), with a 1% increase in Greece's good news it decreases the CDS spreads in Ireland by 0.1007 b.p. (Column 2, Table 6). However, the shock is found to be asymmetric, as the negative news in Greece has no effect on the CDS spreads of other countries (Column 3-6, Table 6). In terms of news from Ireland, the findings illustrate that the Irish CSD spreads are decreased by 0.1940 b.p., as a response to 1% increase in its good news (Column 2, Table 7). For the cases of the cross-country effect, the results document that only the CDS spreads of Greece and Portugal are affected by the Irish good news. In particular, a 1% increase in Ireland's good news decreases the CDS spreads in Portugal by 0.0886 b.p. (Column 5, Table 7).

Now turning to the case of Italy, we note that the Italian CDS spreads are decreased by 0.0867 b.p. as a response to 1% increase in good news (Column 2, Table 8), while the cross-country effect is larger. It is evident that the Italian good news have impact on the CDS spreads across all markets, except for Spain (Column 6, Table 8). In particular, when there is a 1% increase in Italy's good news Greek CDS spreads will be decreased by 0.2021 b.p. (Column 2, Table 8). For the impact of news from Portugal, a 1% increase in the country's good news, leads to a 0.0549 b.p. decline in its own CDS spreads (Column 2, Table 9). The cross-country effect for Ireland is larger; in particular, a 1% increase in Portugal's good news reduces the CSD spreads in Ireland by 0.1842 b.p. (Column 4, Table 9). Finally, for the case of Spanish news, a 1% increase in its good news, reduces its own CDS spreads by 0.1333 b.p (Column 2, Table 10)., while its effect on Greece is larger, i.e. a 1% increase in Spain's good news reduces Greece CDS spreads by 0.2188 b.p. (Column 3, Table 10).

3.4. The Diebold-Yilmaz price and volatility spillover index

There is a particular strand in the literature that measures the dynamics of prices and volatility spillovers using the Diebold and Yilmaz (DY) (2012) Vector Autoregressive (VAR) methodology. This approach has been widely employed to examine spillover effects across financial markets (Diebold & Yilmaz, 2012; Yarovaya et al., 2016a). However, to the best of our knowledge, this methodology has not been employed to investigate the connectedness of the CDS spreads across the GIIPS

Table 9
Influence of Portuguese newswires on CDS spreads.

	Portugal	Sig	Greece	Sig	Ireland	Sig	Italy	Sig	Spain	Sig
Panel A: mean equation										
δ0	0.1295		−13.5701	***	2.4722		0.3381	*	1.6894	
λ1	1.2515	***	0.6976	***	1.2490	***	1.2181	***	1.1156	***
λ2	−0.2532	***	0.2531	***	−0.3092	***	−0.3085	***	−0.1689	***
λ3	−0.0300		0.1030	***	0.0320		0.0983	***	0.0225	
λ4	−0.0054		0.0113	*	0.0043		−0.0263		−0.0406	
λ5	0.1155	***	−0.1674	***	0.1082	**	0.0309		0.1436	***
λ6	−0.1222	***	0.4371	***	−0.1245	***	0.0094		−0.1580	***
λ7	0.0583		−0.5980	***	0.0488		−0.0378		0.1346	***
λ8	−0.0142		0.2634	***	−0.0100		0.0146		−0.0494	
δ1 (POS)	−0.0549		0.0603		−0.1842	***	−0.0469		−0.0722	
δ2 (NEG)	0.0307		0.2353		0.0104		0.0170		−0.0066	
Panel B: variance equation										
ω	−0.1405	***	9.1564	***	−0.0767	*	−0.0637	*	−0.0874	***
α_1	0.3655	***	0.1120	*	0.2728	***	0.1889	***	0.2354	***
γ_1	0.1287	***	0.0246		0.1346	***	0.1346	***	0.1139	***
β_1	0.9788	***	−0.0492		0.9764	***	0.9834	***	0.9816	***
GED parameter	1.0807	***	0.3362	***	1.1346	***	1.1266	***	1.3632	***

Notes: ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively. Notice that the coefficient (−0.077) of POS for Portugal becomes significant at the 5% level when the lags of the CDS spreads is set to 2.

Table 10
Impact of Spanish newswires on CDS spreads.

	Spain	Sig	Greece	Sig	Ireland	Sig	Italy	Sig	Portugal	Sig
Panel A: mean equation										
δ0	3.3854	*	5.5692	***	4.1458	***	1.7917	*	2.7840	***
λ1	1.1136	***	0.7352	***	1.2472	***	1.2254	***	1.2393	***
λ2	−0.1633	***	0.2567	***	−0.3028	***	−0.3259	***	−0.2424	***
λ3	0.0139		0.0881	***	0.0204		0.1138	***	−0.0302	
λ4	−0.0367		−0.0044	*	0.0154		−0.0284		−0.0009	
λ5	0.1444	***	−0.1712	***	0.1132	***	0.0348		0.1053	***
λ6	−0.1550	***	0.4040	***	−0.1352	***	−0.0190		−0.1052	***
λ7	0.1284	***	−0.5692	***	0.0453		−0.0002		0.0453	
λ8	−0.0463		0.2614	***	−0.0051		−0.0021		−0.0114	
δ1 (POS)	−0.1333	*	−0.2188	***	−0.2141	***	−0.1051	***	−0.1466	***
δ2 (NEG)	−0.0402		−0.1133		−0.0320		−0.0061		−0.0232	
Panel B: variance equation										
ω	−0.0864	***	−0.0581		−0.0709	*	−0.0652	*	−0.1387	***
α_1	0.2354	***	0.3308	***	0.2611	***	0.1924	***	0.3575	***
γ_1	0.1165	***	0.1033	***	0.1412	***	0.1364	***	0.1329	***
β_1	0.9814	***	0.9787	***	0.9766	***	0.9832	***	0.9795	***
GED parameter	1.3698	***	0.7148	***	1.1572	***	1.1330	***	1.0689	***

Notes: ***, ** and * indicate the 1%, 5%, and 10% significance levels, respectively. Notice that the coefficient (−0.077) of POS for Portugal becomes significant at the 5% level when the lags of the CDS spreads is set to 2.

economies. The main advantages of the DY framework is its ability to create spillover tables and use them as a tool to comprehend the dynamics and intensities of spillover indexes across markets (Diebold & Yilmaz, 2012). Using the notations of DY (2012), a covariance stationary of N-variable VAR (p) can be specified as follows:

$$X_t = \sum_{i=1}^{p} \Psi_i X_{t-i} + \varepsilon_t, \quad (15)$$

where X_t is a vector of price or volatilities for CDS spreads and news variables, Ψ_i is a parameter matrix, and $\varepsilon \sim (0, \Sigma)$ is a vector disturbance. The moving average representation of the VAR model yields:

$$X_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} \quad (16)$$

$$Q_i = \Psi_1 A_{i-1} + \Psi_2 A_{i-2} + \dots \Psi_p A_{i-p}, \quad (17)$$

where A_0 is an $N \times N$ identity matrix, with $A_i = 0$ for $i < 0$. N-variable VAR variance decompositions, introduced by Sims (1980), allow for each variable X_i to be added to the shares of its H-step-ahead error forecasting variance, in relevance to the shocks of variable X_j (where $\forall i \neq j$ for each observation). Using the H-step-ahead forecast errors, which are invariant to an ordering process, and can be defined for $H = [1, 2 \dots +\infty]$, as:

$$\vartheta^g_{ij}(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} \left(e_i' A_h \Omega e_j\right)^2}{\sum_{h=0}^{H-1} \left(e_i' A_h \Omega A_h' e_i\right)} \quad (18)$$

where Ω is the variance matrix for the error vector ε; σ_{jj} is the standard deviation of the error term for the jth equation; e_i is the selection vector, with one as the *i*th element and zero otherwise. The normalization of each entry of the variance decomposition matrix by the row sum provides:

$$\vartheta\sim^g_{ij}(H) = \frac{\vartheta^g_{ij}(H)}{\sum_{j=1}^{N} \vartheta^g_{ij}(H)} \quad (19)$$

where $\sum_{j=1}^{N} \vartheta\sim^g_{ij}(H) = 1$ and $\sum_{i,j=1}^{N} \vartheta\sim^g_{ij}(H) = N$. The 'Total Spillover Index' can be defined as:

$$S^g(H) = \frac{\sum_{\substack{i,j=1 \\ i \neq j}}^{N} \vartheta\sim^g_{ij}(H)}{\sum_{i,j=1}^{N} \vartheta\sim^g_{ij}(H)} \times 100 = \frac{\sum_{\substack{i,j=1 \\ i \neq j}}^{N} \vartheta\sim^g_{ij}(H)}{N} \times 100 \quad (20)$$

In addition, directional spillover indices are calculated to measure spillovers from market *i* to all markets *j*, as well as the reverse direction of transmission, i.e. from all markets *j* to market *i*, using Eqs. (21) and (22) as follows:

$$S_{.i}^{g}(H) = \frac{\sum_{\substack{j=1 \\ i \neq j}}^{N} \tilde{\vartheta}^{g}_{ji}(H)}{\sum_{i,j=1}^{N} \tilde{\vartheta}^{g}_{ij}(H)} \times 100 \quad (21)$$

$$S_{i.}^{g}(H) = \frac{\sum_{\substack{j=1 \\ i \neq j}}^{N} \tilde{\vartheta}^{g}_{ij}(H)}{\sum_{i,j=1}^{N} \tilde{\vartheta}^{g}_{ij}(H)} \times 100 \quad (22)$$

The net pairwise spillovers are calculated for each pairs of markets in the sample as:

$$S^g_{ij}(H) = \left(\frac{\vartheta\sim^g_{ji}(H)}{\sum_{i,k=1}^{N} \vartheta\sim^g_{ik}(H)} - \frac{\vartheta\sim^g_{ij}(H)}{\sum_{j,k=1}^{N} \vartheta\sim^g_{jk}(H)}\right) \times 100 = \frac{\vartheta\sim^g_{ji}(H) - \vartheta\sim^g_{ij}(H)}{N} \times 100 \quad (23)$$

We use the "Total Spillover Index" to explore the dynamics of spillover indexes for the GIIPS's CDS markets, along with their newswire messages, while the directional spillovers are used to visualize the relative contribution of both the CDS spreads and the newswire messages from one market to all the remaining markets. The empirical results are reported in Table 11.

The table details 'input-output' decompositions of spillover indices for CDS spreads. The findings indicate that the Total Spillover Index for CDS spreads is 47%. Following Yarovaya, Brzeszczynski, and Lau (2016b) Table 11 also displays values of net-spillover indices, indicating the net-contributors and net-recipients of CDS spreads spillovers across the GIIPS markets. In particular, the contribution of Portugal to other countries is the highest (i.e., 68.72%), while it contributes 26.61% to Ireland. Calice, Chen, and Williams (2013) find evidence that liquidity risks in the CDS markets play an important role in Portugal. They also provide solid evidence that Greek sovereign CDS spreads do not exhibit time-varying correlative patterns as the CDS markets have correctly priced the default risk. Greece transmits 27.96% to the other countries, however receives just 0.37%, making the market a net-contributor. While Italy receives more informational spillovers from the other countries (i.e., 66.83%) and contribute less (i.e. 40.43%), therefore the Italian

Table 11
CDS spreads spillovers across the GIIPS markets.

	GREECE	IRELAND	ITALY	PORTUGAL	SPAIN	From others[a]	Net	Conclusion
GREECE	99.63	0.03	0.04	0.28	0.03	0.37	27.59	Net-contributor
IRELAND	12.85	41.73	8.85	26.61	9.96	58.27	−3.48	Net-recipient
ITALY	4.04	16.95	33.17	20.55	25.30	66.83	−26.41	net-recipient
PORTUGAL	8.77	21.06	8.22	53.53	8.42	46.47	22.25	Net-contributor
SPAIN	2.30	16.77	23.31	21.28	36.34	63.66	−19.96	Net-recipient
Contribution to others[b]	27.96	54.80	40.43	68.72	43.70	235.60		
Contribution including own[c]	127.59	96.52	73.59	122.25	80.04	47%		

[a] From Others - directional spillover indices measure spillovers from all regions *j* to region *i*.
[b] Contribution to others - directional spillover indices measure spillovers from region *i* to all regions *j*.
[c] Contribution including own - directional spillover indices measure spillovers from region *i* to all regions *j*, including the contribution from own innovations to region *i*; Other columns contain net pairwise (*i,j*)-th spillovers indices.

Table 12
CDS spread volatility spillovers across GIIPS markets.

	GREECE	IRELAND	ITALY	PORTUGAL	SPAIN	From others[a]	Net	Conclusion
GREECE	99.44	0.12	0.28	0.07	0.08	0.56	−0.29	Net-recipient
IRELAND	0.16	38.31	20.41	23.83	17.29	61.69	−15.18	Net-recipient
ITALY	0.06	14.97	42.58	18.52	23.86	57.42	6.35	Net-recipient
PORTUGAL	0.02	18.53	19.89	42.50	19.06	57.50	2.78	Net-contributor
SPAIN	0.03	12.88	23.19	17.86	46.03	53.97	6.33	Net-contributor
Contribution to others[b]	0.27	46.51	63.77	60.29	60.30	231.14		
Contribution including own[c]	99.71	84.82	106.35	102.78	106.33	0.46		

[a] From Others - directional spillover indices measure spillovers from all regions j to region i.
[b] Contribution to others - directional spillover indices measure spillovers from region i to all regions j.
[c] Contribution including own - directional spillover indices measure spillovers from region i to all regions j, including contribution from own innovations to region i; Other columns contain net pairwise (i,j)-th spillovers indices.

market is a net-recipient. To summarize, Greece and Portugal are the net-contributors of the CSD spreads spillover index, while the net-recipients are Ireland, Italy, and Spain.

Following Forsberg and Ghysels (2007); Antonakakis and Kizys (2015), and Wang, Xie, Jiang, and Stanley (2016), we define the CDS volatility as the absolute return: $V_t = |\ln CDS_t - \ln CDS_{t-1}|$, where CDS_t is the daily closing value of the CDS spread at day t. Table 12 shows the Total Volatility Spillover Index for the CDS spreads (i.e., 46.2%); the contribution of Italy, in terms of volatility spillovers, turns out to be the highest (i.e., 63.77%), while it contributes 23.19% to Spain. Greece transmits only 0.212% to other countries, while Ireland receives the majority of volatility spillovers from the other countries (i.e., 61.69%). Overall, Portugal and Spain are the net-contributors of the CDS volatility, while the net-recipients are Ireland, Italy, and Greece.

3.5. Rolling window estimates

Finally, Figs. 1 and 2 illustrate the dynamics of the CDS spread spillovers, as well as the CDS spreads volatility spillovers using a three-months rolling window. More specifically, Fig. 1 shows time-varying dynamics for the CDS spreads spillovers indices; it can be noted a clear decreasing trend in the long run, as well as a sudden increase in the CDS spreads spillovers over the period December 2009 to February 2010, probably due to the rising fears of a sovereign debt crisis developing among fiscally conservative investors who are concerned for the fiscal future of the GIIPS countries in the late part in 2009, with the concerns becoming particularly worse in the early part of 2010.[6]

3.6. Influence of newswire on total spillover index

We use the estimated "Total Spillover Index" from Eq (20) to examine the influence of the sovereign news index (i.e. $NEWS_{it} = POS_{it} - NEG_{it}$) on the degree of CDS market connectedness. We specify the relationship between CDS market total spilover index and the sovereign news index as:

$$TSICDS_t = \delta_0 + \sum_{i=1}^{5}\lambda_i\, CDS_{t-1} + \sum_{i=1}^{5}\delta_i\, NEWS_{it} + \upsilon_t \tag{24}$$

where *TSICDSt* is the total spillover index for CDS market, *NEWSit* are the sovereign news index for country *i* and time *t*. The E–GARCH (1, 1) model was used and we include the variance equation to capture the conditional heteroscedasticity. Thus, the variance equation can be written as:

$$\ln(h_t) = \omega + \sum_{i=1}^{p}\alpha_i\left|\frac{\upsilon_{t-i}}{h^2_{t-i}}\right| + \sum_{k=1}^{r}\gamma_k\frac{\upsilon_{t-k}}{h^2_{t-k}} + \sum_{j=1}^{q}\beta_j h_{t-j} \tag{25}$$

The empirical results for the above equations are reported in Table 13. The left panel of Table 13 reports the results for the CDS spread total spillover index while the influence of sovereign news index on CDS volatility total spillover index is reported in the right panel. The effect of sovereign news index is generally positive on the total spillover index on the CDS market. Whenever there is 1% increases of dominance of good news over bad news in Portugal the spillover index of CDS market will be increased by 0.0283 base points (i.e. δ4 in the left panel of Table 13). The magnitude is minimal but the results reveal an interesting phenomena, that news from Italy and Portugal has more significant impact on the total CDS spread toal spillover index.

For the case of CDS volatility total spillover index, the results are reported in the right panel of Table 13, it shows positive impact of sovereign news index on CDS volatility total spillover index; in particular whenever there is 1% increases of dominance of good news over bad news in Spain the spillover index of CDS volatility will be increased by 0.0728 base points. Sovereign news index of all markets except Portugal have influential power on the CDS market's volatility total spillover index.

[6] For example: In October 2009, the new socialist Greek government led by the Panhellenic Socialist Movement (PASOK) party was formed. On February 24, 2010, the strike against the austerity measures halted public services and the entire transportation system.

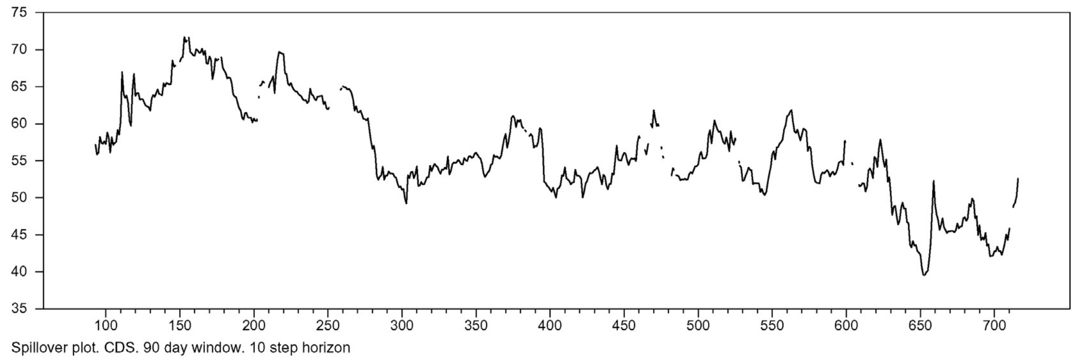

Fig. 1. Total CDS spread spillovers plot.

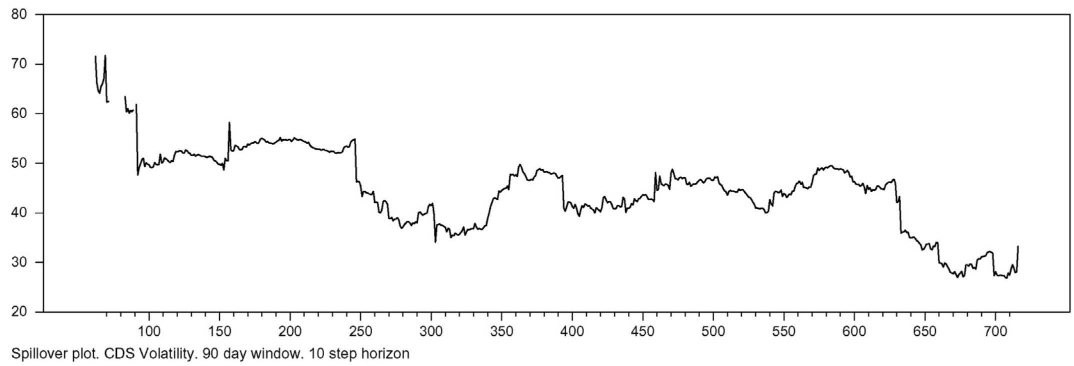

Fig. 2. Total CDS volatility spillovers plot.

4. Conclusion

This paper provides evidence that newswire messages had a significant impact on CDS spreads spillovers during the European sovereign crisis, spanning the period 2009 to 2012. While there has been much discussion and interest in the role of mass psychology or 'animal spirits' in the most recent crisis, empirical support for this argument had not been provided. This paper presents the first empirical evidence on the impact of such newswire messages on CDS spillovers by capturing the tone of local news across the major newspapers in five European countries that were at the center of the heat circle over that period, i.e. Greece, Ireland, Italy, Portugal, and Spain, and where three of them (i.e., Greece, Ireland and Portugal) had to yield their sovereign economic policy in the fundamentals of bail-out programs.

The empirical findings demonstrate solid evidence that such newswire messages had a positive impact on CDS spreads spillovers across those CDS markets. In other words, the results display that the newswire messages play their own idiosyncratic role in driving CDS spreads

Table 13
Influence of sovereign news index on CDS total spillover index.

Dependent variable: CDS spread total spillover index	Coefficient	Std. error	z-Statistic	Prob.	Dependent variable: CDS volatility total spillover index	Coefficient	Std. error	z-Statistic	Prob.
Panel A: mean equation					Panel A: mean equation				
δ0	1.1388	0.2290	4.9723	0.0000			0.086	4.492	0.000
λ1	0.9931	0.0022	451.9257	0.0000		0.834	0.001	1066.823	0.000
λ2	−0.0476	0.0208	−2.2914	0.0219		0.051	0.012	4.408	0.000
λ3	0.0968	0.0273	3.5493	0.0004		0.173	0.004	46.081	0.000
λ4	−0.0351	0.0275	−1.2762	0.2019		−0.057	0.017	−3.343	0.001
λ5	−0.0418	0.0265	−1.5791	0.1143		0.005	0.016	0.324	0.746
λ6	−0.0641	0.0147	−4.3614	0.0000		−0.002	0.014	−0.133	0.894
λ7	0.1209	0.0159	7.6136	0.0000		−0.008	0.011	−0.664	0.507
λ8	−0.0367	0.0172	−2.1374	0.0326		0.0001	0.002	0.048	0.962
δ1 (Greece)	0.0121	0.0104	1.1669	0.2433		0.0172	0.006	3.013	0.003
δ2 (Ireland)	0.0264	0.0191	1.3787	0.1680		0.0521	0.010	5.015	0.000
δ3 (Italy)	−0.0840	0.0148	−5.6864	0.0000		−0.1502	0.011	−13.598	0.000
δ4 (Portugal)	0.0283	0.0145	1.9491	0.0513		−0.0002	0.008	−0.023	0.981
δ5 (Spain)	0.0157	0.0135	1.1629	0.2449		0.0728	0.009	8.416	0.000
Panel B: variance equation					Panel B: variance equation				
ω	−0.090	0.046	−1.957	0.050		−0.346	0.120	−2.883	0.004
α_1	0.181	0.086	2.094	0.036		0.402	0.136	2.954	0.003
γ_1	0.094	0.061	1.551	0.121		0.048	0.081	0.587	0.557
β_1	0.859	0.083	10.296	0.000		0.725	0.122	5.921	0.000
GED parameter	0.768	0.057	13.452	0.000		0.640	0.035	18.545	0.000

spillovers, implying that such news could explain a significant part of variation in CDS spreads above and beyond fundamentals.

The findings are expected to have certain potential implications. The evidence suggests that this type of news can potentially render an important effect on the (sovereign) risk profile of economies. Expectations formed by newswire messages can have a more complex relationship with CDS spreads and to generate contagion type of spillovers across various sovereign CDS markets. The ability of such newswire messages to generate CDS spillovers suggests that such news may be useful indicators to monitor empirically. The central finding of this paper, however, highlighted that newswire messages could play an important role on the role of CDS markets that determine and inform about the risk profile of an economy, thus, suggesting an enhanced attention in future works.

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