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ABSTRACT

The Impact of News and the SMP on Realized (Co)Variances in the Eurozone Sovereign Debt Market*

We use realized variances and covariances based on intraday data from Eurozone sovereign bond market to measure the dependence structure of eurozone sovereign yields. Our analysis focuses on the impact of news, obtained from the Eurointelligence newsflash, on the dependence structure. More news raises the volatility of interest rates of financially distressed countries and decreases the covariance of distressed countries' yields with German bond yields, suggesting a flight-to-quality effect. Common news about the euro crisis and news about specific countries itself tend to raise the covariance of yields between distressed countries, indicating potential crisis spill-over effects. However, we do not detect spillover effects from news about third countries to the covariance between other country pairs. Bond purchases by the ECB under its Securities Markets Programme (SMP) mitigate the negative crisis spillovers among the distressed countries and reduce the flight-to-safety from the distressed countries to Germany.

JEL Classification: E62, G01, G12, G15 and H63
Keywords: crisis, eurozone, realized covariances, SMP, sovereign debt and spillovers

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Non-technical summary

The European debt crisis has caused both a general increase in sovereign debt yields of vulnerable countries and an increase in the volatility of those yields. By contrast, some other countries, most notably Germany, have seen their sovereign debt yields fall, suggesting flight-to-safety behavior of investors in these markets. There is by now quite an active literature that explores the behavior of sovereign debt yields during the crisis and whether this behavior has spill overs to other countries in the Eurozone. This is important, because stronger negative spill overs during the crisis strengthen the case for intervention by the authorities.

In studying the consequences of the debt crisis, this paper takes a new approach. It uses intraday data on sovereign debt yields to calculate daily variances of individual country yield changes and daily covariances of yield changes between pairs of countries. In the literature these are referred to as realized variances, respectively realized covariances. This paper tries to explain the behavior of these realized variances and covariances on the basis of news about the crisis as well as control variables that capture credit risk, market liquidity and general market turbulence. The news about the crisis is obtained from Eurointelligence, a daily news briefing that arrives at the start of the European office day and that captures the main financial, economic and political events of the previous day. The implicit assumption is that more (relevant) events relating to some item or country elicit more coverage in the briefing and thus quantify the intensity of the coverage. The news variables comprise common crisis news and country-specific news. The analysis also explores how realized variances and co-variances are affected by bond purchases of the ECB under its Securities Markets Programme (SMP). The sample period for most of the analysis is 29 November 2010 - 12 April 2013. This is the period for which we have intraday data.

The results of the analysis are the following. We find that more news raises the volatility of yield changes of the distressed countries Greece, Ireland, Italy, Portugal and Spain. More news also leads to a decrease of the covariance of distressed countries' yield changes with German bond yield changes. This suggest a flight-to-quality effect. The results for the covariances of pairs of distressed countries are somewhat mixed. In a pooled regression using all country pairs, we find that common news about the euro crisis and news about a country itself tends

to raise the covariance of yield changes between each country pair, indicating potential crisis spillover effects. However, we do not detect spillover effects from news about third countries to the covariance between other country pairs. We always find that it is important to control for credit risk, liquidity and the volatility of German bond yields. An increase in the KfW-Bund spread and an increase German yield volatility lead to higher realized variances of the distressed countries, lower realized co-variances between the distressed countries and Germany, and higher realized covariances between distressed country pairs. All these effects are particularly strong for the pair Italy-Spain.

Most of our analysis is done for realized variances and co-variances calculated at the daily level. Yet, we also conduct our analysis at the weekly level. This has the advantage that we do not need to model a fully dynamic structure and that we can work with less noisy observations for the realized variances and co-variances. The main results remain essentially unchanged. However, the most important reason to look at weekly data is that we can now also include data from the ECB's Securities Markets Programme into the analysis. Our sample covers the second wave of bond purchases under the program. This wave was concentrated in the period August-December 2011, which also was a period of extreme pressure in the Italian and Spanish sovereign debt markets.

We find strong effects both statistically and economically of SMP bond purchases. In particular, increases in those purchases reduce realized variances, raise realized co-variances between Germany and distressed countries, and reduce realized co-variances between pairs of distressed countries. Hence, increases in SMP act to precisely reverse the effects of increases in common and individual country crisis news, credit risk and liquidity effects on realized variances and co-variances. In other words, the ECB seems effective in deploying its SMP purchases to mitigating the negative yield spillovers among distressed countries and, related to this, reducing the flight-to-safety from the distressed countries to Germany.

1 Introduction

The recent crisis in the eurozone has led to large movements in the sovereign bond yields of eurozone countries. Often, yields change in the same direction, but sometimes they change in opposite directions, in particular between the northern European countries and the more economically and financially distressed countries in the European periphery.[1] Beetsma, Giuliodori, de Jong and Widijanto (2013) show that yields of the distressed countries respond strongly to news about the eurozone crisis. Moreover, they find that they respond also to news about other countries within the group of distressed countries.

In this paper, we take the analysis of Beetsma *et al.* (2013) a step further and investigate how the realized volatilities and cross-country covariances of eurozone sovereign yield changes respond to news about the eurozone. Among the covariances, we consider the covariances between Germany and distressed countries separately from the covariances among distressed countries, because Germany has generally been considered a safe haven during the crisis, while the distressed countries are often perceived as affecting each other in a negative way. The literature on spillovers and contagion typically estimates volatilities and correlations over a relatively long time span (at least several months) and then tests for breaks in these variables when there is a crisis. We improve upon this methodology by using intraday data on bond yields to estimate daily volatilities and covariances of bond yield changes, and relate these to daily news variables. This approach yields a much more refined picture of the relationship between volatilities and news and their relationship to the euro crisis.

Our analysis is inspired by the factor models of Bekaert, Harvey and Ng (2005) and Bekaert, Ehrmann, Fratscher and Wehl (2012), in which a number of common factors and country-specific variables determine sovereign yield changes. The common factors determining the covariances of yield changes are taken from the literature on spillovers, and include bond market volatility, credit risk and liquidity. As the country-specific variables we use the (updated) set of news variables of Beetsma *et al.* (2013) extracted from Eurointelligence. We employ two types of news variables. First, there are common news variables that reflect information about

[1] In the following our set of financially distressed countries consists of Greece, Ireland, Italy, Portugal and Spain.

the whole eurozone and potentially affect the behavior of the yields of all countries. Second, there are country-specific news variables that can affect the volatility of that country and the covariances of that country with other countries. In addition, the news of a third country may also affect the covariance between the yields of two other countries, indicating spillover effects of crisis news.

An important event in the European treasury bond market during our sample period was the Securities Market Programme (SMP) of the European Central Bank (ECB). Under this programme, the ECB bought large quantities of bonds of the distressed countries. The most important period was the late summer of 2011, when the total purchases were around 145 billion euro. The stated objective of this programme was "to address tensions in certain market segments that hampered the monetary policy transmission mechanism".[2] We therefore also investigate the impact of the SMP on the volatilities and covariances of the sovereign debt yields of the financially distressed countries. The outcomes of such an analysis may help in finding appropriate policy responses to the Eurozone debt crisis and, more in particular, shed light on contribution that ECB policies can make in this regard.

Our results show that more news raises the volatility of yield changes of the distressed countries. From the set of common news variables, our proxy for the total amount of common news has the biggest impact on volatilities. Also an increase in the number of news items pertaining to a specific country raises the volatility for that country. However, we do not observe strong spillover effects from the amount of news of third countries to the volatility of the other distressed countries. We find that more news leads to a decrease of the covariance of distressed countries' yields with German bond yields, suggesting a flight-to-quality effect. The results for the covariances between distressed country pairs are mixed. In a pooled regression using all distressed country pairs, we find that common news about the euro crisis and news about the countries themselves tends to increase the covariance of yields between that country and other countries. This effect is particularly strong for the combination of Italy and Spain. However, we do not detect spillover effects from news about third countries to the covariance between other country pairs.

[2] See `http://www.ecb.int/ecb/educational/facts/monpol/html/mp_011.en.html`.

For all the models, we find that it is important to control for market volatility (as measured by the German yield volatility) and liquidity (as measured by the KfW-Bund spread). Both controls exert a strong and positive effect on realized standard deviations and realized covariances between distressed countries, and a strong and negative effect on realized covariances between Germany and the distressed countries. The latter is in line with role that De Santis (2013) finds for the KfW-Bund spread in explaining the safe-haven role of German bunds during the crisis.

Estimating our models at a weekly level and including the bond purchases of the ECB under its SMP, we find that increases in purchases result in lower realized variances, lead to higher realized covariances of Germany with the distressed countries and reduce the positive co-movement of the yields among distressed countries. Apparently, the ECB was effective in deploying the SMP to mitigate the negative crisis spillovers among the distressed countries and, related to this, to reduce the flight-to-safety from the distressed countries to Germany. Hence, our findings provide a case for these interventions at times of heightened tensions in Eurozone bond markets. The SMP bond purchases exerted a particularly strong downward effect on the positive co-movement in yields between Italy and Spain, which suggests that the second wave of the SMP was specifically targeted at those two countries.

The structure of this paper is as follows. Section 2 discusses the related literature. Section 3 describes the empirical model and introduces the realized volatility estimators. Section 4 describes the data. Section 5 discusses the empirical results for our analysis at the daily frequency, while Section 6 does this at the weekly frequency. Section 7 concludes the paper.

2 Related literature

Our paper relates to several strands of literature. Much work has been done on modeling the determinants of the bond yields and sovereign CDS spreads of countries in the eurozone. Examples of contributions to this literature are Beber, Brandt and Kavayecz (2009), Manganelli and Wolswijk (2009), Favero, Pagano and von Thadden (2010), Ang and Longstaff (2012), Bhanot, Burns, Hunter and Williams (2012), De Santis (2013) and Mohl and Sondermann

(2013). Eser and Schwaab (2013) study the impact of ECB bond market interventions under the SMP. These papers explore how yields depend on fundamental variables or how they respond to news about the euro crisis. We differentiate from this literature by focusing directly on volatilities and covariances of yield changes and how these respond to relevant news, ECB interventions and "traditional" control variables employed in related literature.

The papers most closely related to our analysis directly model correlations between yield or CDS spread changes. Anderson (2011) models time variation in correlations between corporate CDS spreads. He finds that it is important to include controls for common changes in credit risk, risk premiums and liquidity. De Bruyckere, Gerhardt, Schepens and Vander Vennet (2013) study quarterly correlations between bank and sovereign CDS changes, and relate these to characteristics of the banks in their sample. Bhanot *et al.* (2012) model conditional correlations of distressed country yields in a VAR-GARCH framework as a function of fundamentals, news items and country-specific absolute CDS changes. In our study we employ intraday data to model both realized variances and covariances of sovereign yield changes during the crisis period.

Our paper also relates to the literature on contagion and interdependence in international financial markets. This literature is concerned with changes in cross-country return correlations in crisis periods. The typical structure is to separate crisis from non-crisis periods and test for increases in correlations during the crisis, corrected for exposure to common factors. Here, we refine this approach by estimating covariances on a daily basis and relating these to daily news items about the euro crisis. Bekaert *et al.* (2005) propose to estimate a factor model, possibly with time-varying factor loadings, and define contagion as non-zero correlation between the residuals of this factor model. Bekaert *et al.* (2012) define contagion differently as the factor loadings showing an increase during the crisis that cannot be explained by other variables. Our approach directly models covariances and therefore can be used to test for changes in the dependency structure as a function of fundamental variables and news about the euro crisis.

Finally, our paper connects to the literature on the impact of news on volatilities. Engle and Li (1998) find that the volatility of treasury bond futures is higher on days with macro-economic news announcements. Ederington and Lee (1993), Fleming and Remolona (1997,

1999) and Balduzzi, Elton and Green (2001) obtain that bond yield changes are significantly more volatile in the five minutes after macro-economic announcements than in intervals without news. Andersen and Bollerslev (1998) find that the volatility of the Deutschemark-U.S. dollar exchange rate is abnormally high in the five minutes after U.S. macro-economic announcements, while Andersen, Bollerslev, Diebold and Vega (2003, 2007) find that five-minute absolute exchange rate changes and bond yield changes respond positively to the absolute surprise in macro-economic news announcements. Huang (2007) estimates daily realized volatilities and jumps for futures contracts on the S&P500 stock index and the 30-year U.S. treasury bond. The paper then regresses the daily realized volatility and jumps on a standardized news surprise. Patton and Verardo (2012) study the effect of corporate news announcements on firms' realized betas and find significant increases in betas on corporate announcement days. We follow the latter two papers by modeling the impact of news on daily measures of realized volatility and covariances of bond yields. However, in contrast to this last set of papers we concentrate on the European debt crisis, the role of the ECB's SMP and, as mentioned above, exploit an original set of daily news.

3 The empirical model

We start from a general model for the covariances between yield changes of countries i and j:

$$Cov_t\left(r_{it}, r_{jt}\right) = \alpha_{ij} + \beta_{ij}' x_t + \delta_j' x_{it} + \delta_i' x_{jt} + \varepsilon_{ij,t}, \tag{1}$$

where x_t are common variables that affect the yield covariances of country i and country j, x_{it} and x_{jt} are country-specific variables that drive the covariances of specific countries, and $\varepsilon_{ij,t}$ is a mean-zero serially-independent shock. We analyze the impact of news on the volatilities and cross-country covariances of European bond yield changes. We focus on realized covariances, rather than correlations, because covariances measure the magnitude of the information flow, see for example de Jong and Schotman (2010). We also explore realized variances, which are a special case of equation 1 with $i = j$. In the empirical work, we estimate the left-hand side variable directly by the realized covariance based on intraday yield changes. The advantage

of this approach compared to the more traditional factor approach, such as in Bekaert *et al.* (2012), is that there is no need to specify an extensive model with all the factors that determine the yield changes. We only need to include the variables that drive changes in the factor exposures through time; factor exposures that do not change over time are captured by the fixed effects α_{ij}.

How should we think of equation (1) in terms of the variables that are available to us? Variable x_t contains control variables (to be discussed below) and daily news variables that are common to all countries, such as the total number of news items about the eurozone in our data source. We also have variables that are country-specific, such as the number of news items for a country. These variables are part of the country-specific variable vector x_{it} and x_{jt}.

Finally, how do we model spillovers? Bekaert *et al.* (2012) define contagion as the factor loadings showing an increase during the crisis, while this increase cannot be explained by a set of control variables x_t that always affect the factor loadings. In our context we could interpret the common news variables as crisis variables. If any of the coefficients on these variables is estimated significantly this could then be interpreted as a form of contagion. Alternatively, one can entertain a more restrictive definition and only consider the effect of news of third countries on the covariance of other country pairs as contagion. Here, we will not take a stand on what to interpret exactly as contagion and what not. We will estimate both how common variables affect covariances and third-country news affects those covariances.

To measure the covariances on a daily basis, we follow Bollerslev and Zhang (2003) and use intraday minute-by-minute bond yield changes for day t to calculate the realized covariance as follows:

$$RCOV_{ij,t} = \sum_{\ell=-L}^{L} \sum_{s=1}^{S} r_{it,s} r_{jt,s-\ell}, \tag{2}$$

where $r_{it,s} = y_{it,s} - y_{it,s-1}$ and s counts all one-minute intervals on day t.[3] Analogous to the realized covariance estimator, the realized variance estimator is calculated as

$$RVAR_{it} = \sum_{s=1}^{S} r_{it,s}^2 + 2 \sum_{\ell=1}^{L} \sum_{s=1}^{S} r_{it,s} r_{it,s-\ell}. \tag{3}$$

[3]If L were zero, then S would be exactly the number of one-minute intervals that make up trading day t and thus be the number of observations used to calculate the realized covariance for day t.

In some of the analysis we use the realized standard deviation, which is defined as the square root of the realized variance:

$$RSD_{it} = \sqrt{RVAR_{it}}. \tag{4}$$

The intuition for these estimators is quite simple. In the case of serially-independent minute-by-minute yield changes, the (co)variance of daily yield changes is simply the sum of the (co)variances of the underlying minute-by-minute yield changes. In reality, the yield changes may be serially correlated, either due to thin trading or because of market microstructure effects. The additional leads and lags (if $L > 0$) are there to correct for these serial correlation effects.[4] This correction is important, because the bonds of especially the smaller countries in our sample do not trade every minute. When a bond does not trade in a particular minute, we put the yield change $r_{it,s}$ for that minute equal to zero. Following Bollerslev and Zhang (2003), who use $L = 12$ for five-minute return intervals, we use $L = 60$ for our one-minute data so that yield changes within an interval of one hour are taken into account. All these computations assume that the expected yield change is zero, which for intra-day data is a good assumption.

An alternative to using the realized variances and covariances is to use the squared daily return or cross-product of daily returns. This approach has been used in the literature, but the realized variances and covariances provide more precise estimates of the second moments. Nevertheless, we also used daily return data for our analysis. One advantage of using daily returns is that we have these available for a longer sample period than the intraday returns. The results of that analysis are qualitatively similar to the ones based on the realized variances and covariances, and are available upon request.

4 Data

4.1 Bond yields and realized covariances

We collect intraday minute-by-minute yield data from Bloomberg for six countries: Germany, Greece, Italy, Ireland, Portugal and Spain. We use data for the five- and ten-year on-the-run

[4] See de Jong and Schotman (2010) and Griffin and Oomen (2011), who call this covariance estimator the Realized Covariance with Leads and Lags (RCLL).

bonds, or the closest maturities available. The data run from 29 November 2010 through 12 April 2013. Due to problems in collecting the intraday data, there are several gaps in the data series (specifically, 21 March 2011 - 3 May 2011, 17 November 2011 - 21 December 2011 and 8 October 2012 - 11 October 2012). Weekend days are excluded, as well as days when the realized variance of a country is zero (these are typically holidays). As a result, we have a maximum of 506 days of daily realized variance and covariance estimates for a given country. Due to the restructuring of the Greek debt in March 2012, there are no five-year yield observations for Greece after 12 March 2012. There are also no data on the ten-year yield for Ireland after 19 April 2012.

Figure 1 graphs the realized standard deviations of yields for Germany and Italy. We choose Italy here, because it is the largest of the distressed countries. Peaks are clearly visible and indicate times of stress, such as August 2011 (when the Italian sovereign bonds were under "attack"), November 2011 (when Italy's prime minister Berlusconi resigned), and June and August 2012 (when there were concerns about Spain and other countries). Figure 2 presents realized covariances between Germany and Italy, and between Italy and Spain. The covariance between Germany and Italy shows large negative values in times of market stress. In contrast, the covariance between Italy and Spain is typically positive and peaks in times of stress.

Tables 1 and 2 provide some basic descriptive statistics about the realized standard deviations, correlations and covariances. First, Table 1 reports the mean and the standard deviation of the realized daily standard deviation per country and the number of days for which there are observations in the period 29 November 2010 to 12 April 2013. All yield changes are expressed in basis points. The yields of Greece, and to a lesser extent Ireland and Portugal, are much more volatile than those of Spain and Italy, while the German yields are the most stable. Unsurprisingly, the ten-year yields have slightly lower volatility than the five-year yields. Second, Table 2 provides the average realized correlations and covariances for all country pairs. We see that these averages are always positive for pairs of distressed countries, while they may be positive or negative between Germany and individual distressed countries. Specifically we see that they are negative for the pairs Germany - Italy and Germany - Spain.

4.2 News variables

We obtain our news from Eurointelligence, an independent internet-based service that was founded in 2007 and sends out a daily briefing with euro-area news, mainly on macroeconomics, financial markets and politics. The briefing is constructed by economic experts and generally arrives between 8.30 and 9.00 in the morning. It is mostly a summary of the main news in these areas from the previous business day (and the weekend for a Monday briefing). While it is widely read by influential policymakers and private sector experts, we cannot expect it to be the main source of information to investors. Neither is it a complete overview of the news.[5] Rather, we view it as a consistent and compact form of information provision that captures the main daily economic, financial and political concerns. The assumption underlying our analysis is that more (relevant) events relating to some item or country elicit more coverage in the briefing. Hence, the intensity of the coverage is used as a measure of the importance of some news event. The Eurointelligence data and the construction of the news variables are described in detail in Beetsma *et al.* (2013). We use an updated version of their dataset, which runs from 2 July 2007 to 12 April 2013.

We now describe the data briefly. The variable $WORDS$ counts the number of words of which the newsflash consists on that specific day. The idea behind including $WORDS$ is that co-movements and spillovers across countries may be linked to the amount of relevant news, which in turn we expect to increase with the length of the newsflash. Dates on which there is no news (due to weekends and holidays) are excluded from our sample. We also define the variables $MINISTER$ and $DEFAULT$, which are the numbers of times the word "minister", respectively "default", are used in the newsflash on a given day. These variables capture eurozone-wide news. Specifically, the variable $MINISTER$ is intended to capture the amount of political news, while the variable $DEFAULT$ is used as a proxy for uncertainty about fiscal sustainability. The second set of variables based on Eurointelligence are the country-specific news variables $NEWS_i$ for country i. More specifically, we define $NEWS_{GR}$ as the number of times the words "Greece" or "Greek" are mentioned, and similarly for the other countries. These variables are intended to serve as proxies for the amount of economic, financial and

[5]This contrasts to e.g. Ehrmann, Osbat, Strasky and Uusküla (2013), who use a much more detailed news database to study the behavior of the euro exchange rate during the crisis.

political turbulence associated with the specific country under consideration.

For each country we also define the variable

$$NEWSC_i = \sum_{k \neq i} NEWS_k, \tag{5}$$

This variable is intended to capture the spillover effects of news from the other distressed countries onto country i. For the covariance regressions we define for each country-pair

$$NEWS_{ij} = NEWS_i + NEWS_j, \tag{6}$$

and

$$NEWSC_{ij} = \sum_{k \neq i \text{ and } k \neq j} NEWS_k, \tag{7}$$

This variable is intended to capture the spillover effects of news from the other distressed countries to the covariance between countries i and j.

Summary statistics of the news data are reported in Table 3. There are relatively many news items for Germany and Greece, which are mentioned about twice per day on average, and relatively few for Ireland and Portugal, which are mentioned less than once per day. Italy and Spain are in-between, being mentioned about one-and-a-half times per day. Figure 3 depicts the number of news items concerning these countries. Comparing the covariances and the news data, there seems to be a similar pattern in both series, but the connection is not always too strong. Because there is an upward trend in all news variables, we rescale them by dividing through a scaling function which is fitted to $WORDS$; details of this procedure are provided in Appendix A.

4.3 Control variables and SMP data

We also include several control variables that we expect to influence the covariances. Obviously, market volatility is an important factor. We capture bond market volatility by the daily volatility estimate of the German bond yield, which acts as an indicator of the general unrest in European sovereign debt markets. Other control variables capture the exposure of bond

yields to credit risk and liquidity fluctuations. As an indicator for credit risk we use the ITRAXX Europe index. To some extent, this variable can also capture time variation in risk premiums. Anderson (2011) stresses the importance of liquidity factors for cross-correlations in CDS returns. We capture bond market liquidity effects by the KfW-Bund spread, which has been shown by Schuster and Uhrig-Homburg (2011) and Ejsing, Grothe and Grothe (2012) to correlate strongly with the transaction costs (bid-ask spreads) in the European bond markets.[6] De Santis (2013) shows that the KfW-Bund spread acts as a euro-area common risk factor.

The data sources and periods are as follows. The ITRAXX Europe index data are from Bloomberg, while the KfW-Bund yield spread data are from De Santis (2013), who constructed this series from Bloomberg data. These are all daily data with sample period 2 July 2007 to 12 April 2013. We measure the daily German yield volatility by the daily realized variance of the German yield changes, which is available over the sample period 29 November 2010 - 12 April 2013. Data on interventions under the ECB's SMP are weekly data on the amounts of eurozone sovereign debt purchased in the secondary market. These amounts in billions of euros will in the following be referred to as the variable SMP. The data are obtained from the ECB and span the period 14 May 2010 to 29 June 2012. Outside this period, the SMP purchases are zero.

5 Results: daily (co-)variances

In this section we discuss the empirical results, which come in four sets. First, we estimate a model for the volatility of yield changes for the distressed countries. Second, we look at the daily covariances between the distressed country and German yields. Third, we explore the covariances of yields between the distressed countries.

All the models are estimated both for the five-year and the ten-year maturity. In the regressions, we use several news variables that concern the whole euro area, $NEWS = (WORDS, MINISTER, DEFAULT)'$, and variables that measure the news of a specific country ($NEWS_i$ and $NEWSC_i$) or country pair ($NEWS_{ij}$ and $NEWSC_{ij}$). As the news

[6]Debt issued by the German Reconstruction Credit Institute (Kreditanstalt für Wiederaufbau) and the central government face identical default risk. Hence, the KfW-Bund spread must measure differences in liquidity of the two types of debt.

items are released on Eurointelligence early in the morning and summarize the news of the previous day, we include the news of the next morning in the regressions of today's variances and covariances. In a robustness check, we also use the same-day news in the regressions.

As control variables X we use the ITRAXX Europe index ($ITRAXX$), the KfW-Bund yield spread ($KFWBUND$) and the intraday volatility of the German treasury yield, defined as RSD_{DE} in the volatility regressions (which have RSD_i as the dependent variable) and $RVAR_{DE}$ in the regressions for covariances between countries (which have $RCOV_{ij}$ as the dependent variable).

The estimation method is always pooled estimated generalized least squares with fixed effects and cross-section weights, where each country or country-pair is weighed by the inverse of the residual standard deviation from an initial pooled OLS estimation. Standard errors are White heteroskedasticity-consistent estimates, which allows for cross-country correlation in the error terms.

5.1 Volatilities

We first look at how the volatilities of the distressed country yields are affected by news about the euro crisis. The model is a panel regression, with as dependent variable the realized standard deviation and as independent variables news, the interventions via the SMP, common control variables and country-fixed effects.[7] We also include five lags of the dependent variable to account for the high degree of persistence in volatility. Therefore, we estimate the following model:

$$RSD_{it} = \alpha_{1i} + \sum_{k=1}^{5} \phi_{1k} RSD_{i,t-k} + \beta_1' NEWS_t + \gamma_1 NEWS_{i,t} \tag{8}$$
$$+ \eta_1 NEWSC_{i,t} + \zeta_1 SMP_t + \lambda_1' X_t + \epsilon_{it},$$

where ϵ_{it} is a mean-zero and serially-independent shock. We first estimate equation (8) at the daily frequency. Equation (8) includes the ECB SMP interventions as an independent variable.

[7] Individual-country variables such as the bid-ask spreads and CDS spreads that have been used in related studies cannot be included as controls, as they are likely to be endogenous and driven by the same variables that are driving our realized variances and covariances.

However, because SMP_t is only available at the weekly level, we initially set $\zeta_1 = 0$. Below, when we estimate the model also at the weekly frequency we will also estimate ζ_1.

Table 4 reports the results for both maturities available. In line with equation (8), the first four columns are based on next morning's news, while the last four columns are based on this morning's news. We first discuss the results for next morning's news. There does not seem to be too much effect from common news. Only for five-year debt an increase in $WORDS$ raises the realized standard deviation. However, an increase in domestic news consistently raises the realized standard deviation. Finally, there is no significant evidence of news spillovers from other countries, although the coefficient on this variable is always positive, as one might expect, and for the case of the five-year debt it is not too far from significance. The size of the estimated coefficients provides us with some indication of the effect of an increase in the amount of news on the volatilities. Take for example the estimates for 5-year debt based on next-morning's news. A one-standard deviation increase in the news item for Italy or Spain raises the realized standard deviation by approximately 0.6 basis points.[8]

The KfW-Bund spread and the German yield volatility both have a positive effect on the yield volatilities of the distressed countries, indicating that both deteriorating liquidity and market unrest push up those yield volatilities. Somewhat counter-intuitively, the ITRAXX credit risk variable in two instances has a significantly negative effect. This may be the result of the fairly strong correlation (0.8) with the KfW-Bund spread, which seems to be confirmed by the reduced size of the coefficient on the KfW-Bund spread when we drop the ITRAXX from the regression. The German yield volatility is also an important control variable, which always has a positive and significant coefficient.

Recall that we construct the news variable from the Eurointelligence report of the next day. The reason is that the reports are issued early in the morning and most likely summarize the news of the previous day. However, there may be some reverse causality here, as high yield volatility on a particular day may lead to a longer and more detailed news bulletin. Therefore, we repeat the regressions with the news variables based on the same day's report. The results are almost the same, and therefore we use next day's news in all the following regressions.

[8]The standard deviation of the rescaled $NEWS$ variable is around 0.4 for Italy and Spain, and the regression coefficient is 1.50.

5.2 Covariances between distressed countries and Germany

Now we turn to the covariance between the yields of the distressed countries with the German yields. Again, we estimate a pooled regression with as dependent variable the realized covariance between country i and Germany. We do not include lagged dependent variables as the regression residuals show almost no serial correlation. As an additional explanatory variable the news about Germany is included. Thus, the model is

$$RCOV_{iDE,t} = \alpha_{2i} + \beta_2' NEWS_t + \gamma_2 NEWS_{i,t} + \delta_2 NEWS_{DE,t} + \eta_2 NEWSC_{i,t} + \zeta_2 SMP_t + \lambda_2' X_t + \mu_{it},$$

where μ_{it} is a mean-zero serially-independent shock. Again, we first estimate the model using daily data, so we set $\zeta_2 = 0$ for now and estimate ζ_2 later when we switch to weekly estimates. The results in Table 5 show that the covariances of the distressed countries with Germany decrease when there is news about the eurozone as a whole as captured by $WORDS$, when there is news about the own country and when there is news from the other distressed countries. A one standard-deviation increase in the amount of own-country news for Italy or Spain reduces the covariance with Germany by about 4 basis points squared. This is quite a large effect compared to the average covariance between Germany and Italy of roughly -20 basis points squared and Germany and Spain of -14 basis points squared (from Table 2). Most of the news in our sample is crisis-related news. Hence, these findings are in line with the general perception of a flight-to-safety when there is news about financial distress in a periphery country. The effect of own-country news is particularly strong. However, news about Germany does not seem to have much of an effect. The German yield volatility and the KfW-Bund spread have a strongly significant negative effect on the covariances of the distressed countries with Germany. Also the effects of these controls point at flight-to-safety effects with yields of the distressed countries decoupling from Germany in times of stress.

5.3 Covariances among distressed countries

In this section we run fixed effects panel-data regressions for the realized covariance for all the distressed country pairs

$$RCOV_{ij,t} = \alpha_{3,ij} + \beta_3' NEWS_t + \gamma_3 NEWS_{ij,t} + \eta_3 NEWSC_{ij,t} + \zeta_3 SMP_t + \lambda_3' X_t + \upsilon_{ij,t},$$

where $\upsilon_{ij,t}$ is a serially-independent shock. Again, we set $\zeta_3 = 0$, until we turn to the weekly data. Notice that only the covariances for the country pairs $i > j$ have to be included if the regressors are symmetric across country pairs, as is the case here. Table 6 reports the results. The covariances of the distressed countries among each other increase when there is news about the eurozone as a whole ($WORDS$ is the only significant driver), although the effect is significant only at the 10% level and in one instance only close to significance at the 10% level. An increase in own-country news has a positive, and usually significant, effect on the covariances among the distressed countries. This is also the case for an increase in the German yield volatility. However, there is no evidence of spillovers of news from other distressed countries.

So far, all the regressions use data pooled over all countries or country-pairs. Of course, pooling may increase efficiency, but it may also hide country-specific or country-pair specific effects. Therefore, we also report results for the effect of news on the covariance between the two largest periphery countries, Italy and Spain. The size of these countries is of particular importance, as the fate of the euro as a common currency may depend a lot on whether these countries manage to keep their public finances sustainable. Table 7 shows that the main results also hold for this country pair. News about Italy or Spain strongly increases the covariance between their yields. A one standard-deviation increase in the amount of Italian and Spanish news raises the covariance between Italy and Spain by about 20 basis points squared.[9] This is quite a large effect compared to the average covariance between Italy and Spain of 28 basis points squared (the average of the five-year and the ten-year maturity covariance, see Table 2). This finding suggests that financial stress in one of the two countries should be taken by

[9]The standard deviation of the rescaled $NEWS$ variable is around 0.4 for Italy and Spain, and the regression coefficient is around 50 for the 5-year yield.

the European policymakers as a matter of broader concern and any policy aimed at limiting financial stress in one of the two countries has wider benefits. Also, the control variables remain very important. However, the total amount of news ($WORDS$) is no longer significant. Also, there is no spillover effect of news from the other countries.

5.4 Additional news variables and good-bad news split

Appendix B describes an extension in which we include in our regressions additional news variables based on statements by the ECB, the Bundesbank and the prime and finance ministers of the countries in our sample, i.e. the main actors during the crisis. These additional variables are rarely significant, while they leave the existing coefficient estimates essentially unaffected. In the same appendix we also split the news variable into bad, good and neutral news, where each type of news is judged in terms of its expected effects on the sustainability of the public budget of a country. The coefficients on the three news categories tend to be quite similar to each other, while they do not differ significantly from the coefficient of the news variable in the basic regressions. This may be explained by the possibility that it is really the amount of news rather than its nature that determines realized variances and covariances, that the amount of judgement involved in the split is so large that the three groups do not effectively differ from each other or that the number of observations in the various categories is too small to draw firm conclusions about potential differences in the influences of the three news categories on the outcomes.

6 Results: weekly (co-)variances and SMP effects

In this section we analyze the data on a weekly basis. There are several reasons to do this. First, there may be some lagged adjustments in the response of (co-)variances to news. Instead of modeling a full dynamic lead and lag structure, aggregating the data to weekly levels may pick up most of such lagged effects (if there are any, that is). A second reason for aggregating the data is that weekly estimates of realized volatilities and covariances are less noisy than daily data. The third and most important reason to look at weekly data is that it allows us to

study the impact of the interventions of the ECB in the market for distressed country bonds. The weekly aggregate bond purchase volumes under the SMP are available to us.

Under its SMP, the ECB bought large volumes of treasury bonds of the distressed countries. There were two waves of purchases, the first in mid-2010 (before our sample period for the realized covariances) and the second that started in August 2011 and lasted until the end of that year. The total amount purchased over these two periods was 250 billion euro (of which around 170 billion during the second wave). The second wave is particularly important for our sample period, as it happened in a period with large stress in especially the Italian and Spanish bond markets.

The models are similar to those for the daily realized volatilities and covariances, with two changes. First, we include one lag of the dependent variable in all regressions. This captures the (mild) autocorrelation in the covariances. Second, we include the weekly SMP purchase volume as an additional explanatory variable.

Tables 8 through 11 report the results for the weekly data. They confirm the results for the daily data. In all instances, the effects of the own news variables have become even stronger in terms of size and in most cases also in terms of significance. In particular, the effect of own news on the realized standard deviations of the distressed countries has more than doubled (see Table 8), while the effect of the combined news variable $NEWS_{IT,SP}$ on the realized covariance between Italy and Spain has also become substantially larger (see Table 11). The effects of the common news and spillover news variables have become weaker in most cases and are now insignificant in all instances, which may also be due to the lower number of observations. The role of the control variables is very similar to what we found for the daily data. In particular, the coefficients of $KFWBUND$ and $RVAR_{DE}$ in Tables 8 through 11 are close to their counterparts in the daily regression. In fact, in some instances they have become even larger in absolute magnitude.

The most important results for the weekly data concern the effects of the SMP. An increase in SMP purchases has a highly significant negative effect on the realized standard deviation of the distressed countries. In particular, a one-billion euros rise in SMP purchases lowers the realized standard deviation by around half a basis point (see Table 8). Similarly, an increase

in SMP purchases has a highly significant positive effect on the realized covariance between Germany and the distressed countries at the 5-year maturity (see Table 9). The effect is weaker and no longer significant for the 10-year maturity. Interestingly, when SMP purchases are included the coefficient on other countries' news shrinks in size and loses significance in the 5-year debt market, which suggests that the ECB is particularly active when there more news about the countries in our sample. The ECB also manages, through its SMP purchases, to lower the realized covariances between the distressed countries (see Table 10). Table 11 shows this effect of the SMP purchases on the realized covariance between Italy and Spain, where its negative effect is even much stronger than for the average distressed country pair reported in the previous table. This suggests that the second wave of the SMP was specifically targeted at those two countries. Further, we see that now news about the countries loses significance in the 10-year debt market.

Some important conclusions can be drawn from the estimates with the SMP purchases. Apparently, the ECB was effective in deploying its SMP purchases to mitigating the yield spillovers among distressed countries and, related to this, reducing the flight-to-safety from the distressed countries to Germany. Whether the effect of ECB interventions operates through raising the demand for public debt relative to its supply or whether it operates mostly by signalling the ECB determination to calming down those markets is an open question.

7 Conclusions

In this paper we have used realized variances and covariances of intraday yield changes in the distressed countries (Greece, Ireland, Italy, Portugal and Spain) and Germany during the crisis to establish a number of results. First, for the distressed countries both more news in general and more news about a country itself raises the volatility of the country's yield. Second, in contrast to common perception, we do not find strong spillover effects from the amount of news about third countries to the volatility of the other distressed countries. Third, more news causes a decrease in the covariance of distressed country yields with German bond yields, suggesting a flight-to-quality effect. Fourth, common news about the euro crisis and news about countries themselves tends to raise the covariance of yield changes between each

country-pair of distressed countries. Fifth, we fail to detect spillover effects from news about third countries to the covariance between other distressed country pairs. Sixth, we find that the ECB's bond purchases under the SMP have a stabilizing effect on the yields, while, moreover, they seem to weaken the negative yield spillovers between Germany and the distressed countries and the positive co-movement in yields among distressed countries. In particular, they exert a strong downward pressure on the positive co-movement in yields between Italy and Spain. Apparently, the ECB was effective in deploying the SMP to sever the crisis spillovers among the distressed countries and, related to this, to reduce the flight-to-safety from the distressed countries to Germany. Hence, our findings provide a case for these interventions at times of heightened tensions in Eurozone bond markets. Finally, in line with the related literature on the behavior of sovereign yields during the crisis, we confirm that the controls for volatility, credit risk and liquidity are important determinants of realized variances and covariances.

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Figure 1: **Realized volatilities of German and Italian bond yields**

This figure graphs the realized standard deviation of five year bond yield changes for Germany (lower, dashed line) and Italy (upper, solid line)

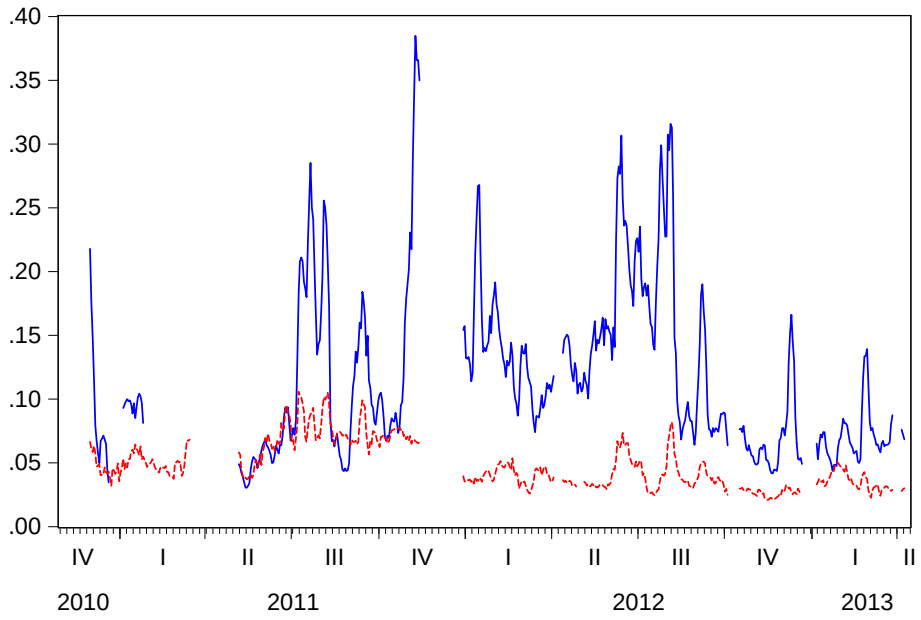
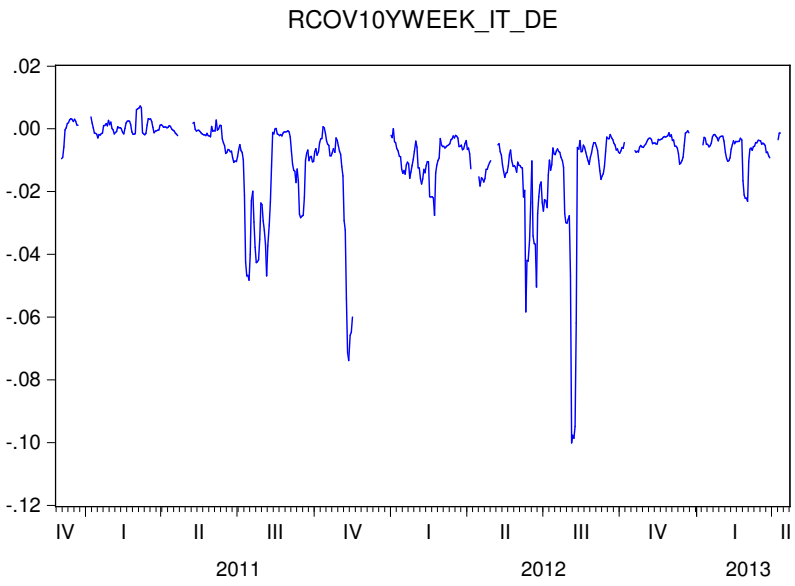


Figure 2: **Realized covariances between Italy and Germany and Italy and Spain**



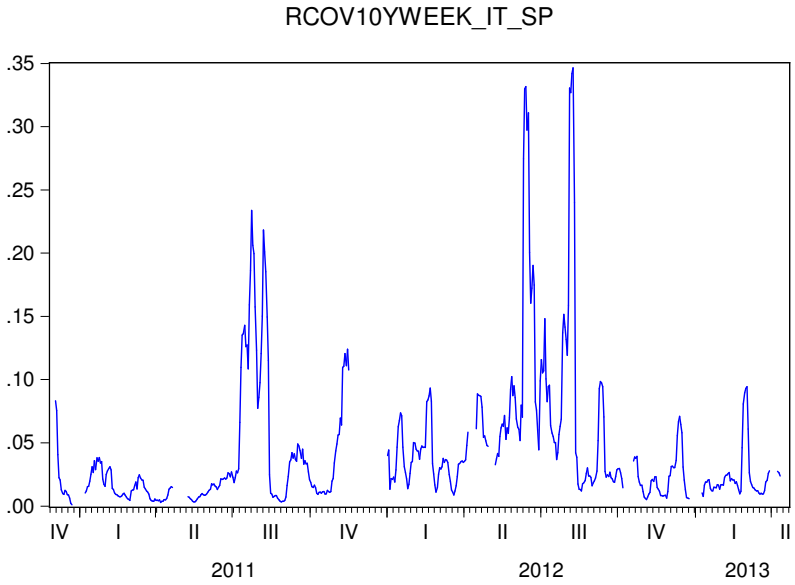


Figure 3: **News about Italy and Spain**

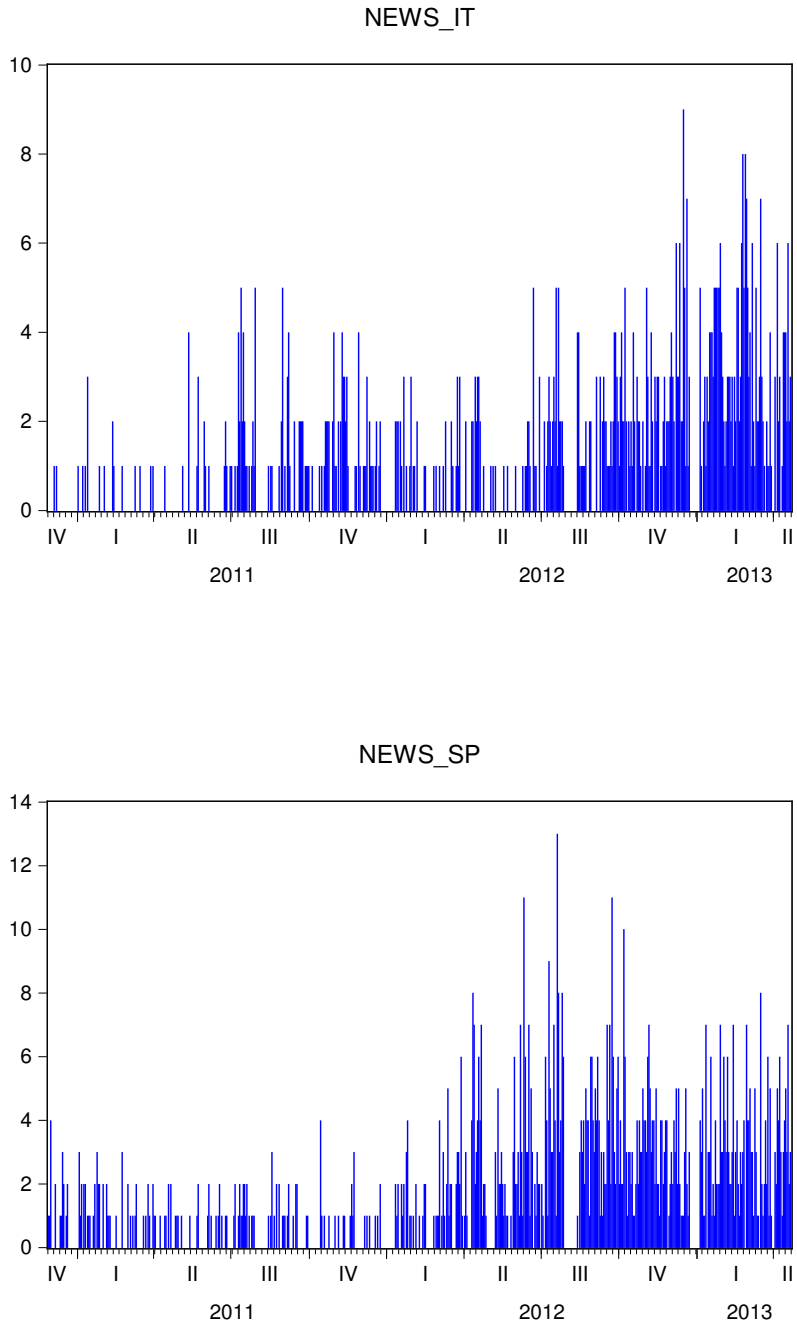


Table 1: **Descriptive statistics of realized standard deviations**
This table shows means, standard deviations (stdv) and number of observations (N) for the five-year (5Y) and ten-year (10Y) daily realized standard deviations (RSD) of yield changes (in basis points) for Germany (DE), Greece (GR), Ireland (IR), Italy (IT), Portugal (PT) and Spain (SP).

	DE	GR	IR	IT	PT	SP
$5Y$						
mean	4.7	104.0	15.6	11.6	30.2	11.5
stdv	2.3	152.9	16.1	8.4	28.0	8.1
N	547	269	513	511	546	511
$10Y$						
mean	4.7	52.9	12.8	8.9	19.5	8.9
stdv	2.1	64.0	10.6	6.0	18.0	5.8
N	570	564	301	569	570	572

Table 2: **Descriptive statistics of realized correlations and covariances**
This table shows average daily realized correlations and realized covariances for the five-year (5Y) and ten-year (10Y) yield changes (in basis points) for all pairs of (i, j) of Germany (DE), Greece (GR), Ireland (IR), Italy (IT), Portugal (PT) and Spain (SP).

Countries		Correlations		Covariances	
i	j	5Y	10Y	5Y	10Y
DE	GR	0.022	0.033	-9.36	3.96
DE	IR	0.049	0.098	0.85	1.50
DE	IT	-0.286	-0.306	-20.59	-19.13
DE	PT	0.088	0.081	10.83	4.80
DE	SP	-0.186	-0.240	-13.74	-15.62
GR	IR	0.135	0.096	414.48	104.14
GR	IT	0.081	0.052	81.77	44.99
GR	PT	0.079	0.118	12.70	226.92
GR	SP	0.086	0.065	16.00	40.03
IR	IT	0.053	0.077	23.19	18.52
IR	PT	0.123	0.117	74.96	29.33
IR	SP	0.072	0.125	31.80	26.16
IT	PT	0.065	0.069	29.36	16.93
IT	SP	0.653	0.727	139.21	86.05
PT	SP	0.113	0.085	62.27	10.82

Table 3: **Descriptive statistics of news variables**

This table shows the average number of daily news items for the common news variables and the country-specific news counts for Germany (DE), Greece (GR), Ireland (IR), Italy (IT), Portugal (PT) and Spain (SP). The sample period is 29 November 2010 - 12 April 2013. The first column shows the average for the raw data, the second column for the rescaled data (see Appendix A for details about the rescaling).

	raw data	rescaled
$DEFAULT$	0.25	0.08
$MINISTER$	0.42	0.11
$WORDS$	257	66.5
$NEWS_{DE}$	1.92	0.52
$NEWS_{GR}$	2.13	0.57
$NEWS_{IR}$	0.72	0.22
$NEWS_{IT}$	1.19	0.28
$NEWS_{PT}$	0.63	0.19
$NEWS_{SP}$	1.71	0.41

Table 4: **Realized standard deviations of distressed countries' yields**
This table shows the point estimates and t-statistics (in brackets) for a pooled regression of daily realized standard deviations (RSD) of the five-year (5Y) and ten-year (10Y) yield of the distressed countries. $NEWSC$ is the sum of the news variable for the other distressed countries (excluding country i itself), and $NEWS_i$ is the news variable for the country itself. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. Country fixed effects are included. The first four columns use the next morning news bulletin, the last four columns the same morning news bulletin.

Dependent variable: RSD_i

news timing	next morning				same day			
bond maturity	5Y	10Y	5Y	10Y	5Y	10Y	5Y	10Y
$RSD_{i,-1}$	0.388	0.422	0.389	0.427	0.378	0.417	0.378	0.415
	(8.73)	(8.70)	(8.78)	(8.71)	(8.44)	(8.17)	(8.40)	(8.33)
$RSD_{i,-2}$	0.175	0.150	0.174	0.149	0.164	0.151	0.160	0.148
	(4.07)	(3.30)	(4.03)	(3.30)	(3.95)	(3.45)	(3.84)	(3.28)
$RSD_{i,-3}$	0.044	-0.007	0.044	-0.007	0.074	0.006	0.069	0.005
	(1.21)	(0.16)	(1.22)	(0.15)	(2.11)	(0.13)	(1.95)	(0.10)
$RSD_{i,-4}$	0.086	0.091	0.090	0.093	0.097	0.083	0.104	0.089
	(2.49)	(2.40)	(2.59)	(2.46)	(2.87)	(2.11)	(3.12)	(2.33)
$RSD_{i,-5}$	0.147	0.085	0.147	0.084	0.131	0.078	0.132	0.084
	(4.03)	(2.40)	(4.00)	(2.36)	(3.36)	(2.07)	(3.34)	(2.23)
$DEFAULT$	-0.71	-1.04			-2.35	-1.26		
	(0.60)	(1.39)			(2.04)	(1.41)		
$MINISTER$	-0.78	-0.16			-0.67	-0.35		
	(0.77)	(0.23)			(0.61)	(0.51)		
$WORDS$	0.051	0.015	0.046	0.016	0.022	0.007	0.021	0.007
	(2.25)	(1.06)	(2.19)	(1.17)	(0.88)	(0.49)	(0.81)	(0.48)
$NEWS_i$	1.50	1.14	1.56	1.17	1.64	1.15	1.70	1.19
	(2.56)	(2.70)	(2.67)	(2.87)	(2.32)	(2.32)	(2.43)	(2.40)
$NEWSC_i$	0.56	0.22	0.55	0.27	0.33	0.18	0.20	0.21
	(1.55)	(1.06)	(1.67)	(1.34)	(1.00)	(0.85)	(0.59)	(0.98)
$KFWBUND$	0.084	0.090	0.077	0.045	0.065	0.086	0.066	0.048
	(2.37)	(3.76)	(3.52)	(3.07)	(1.88)	(3.39)	(2.92)	(3.21)
$ITRAXX$	-0.004	-0.023			0.000	-0.019		
	(0.28)	(2.31)			(0.01)	(1.85)		
RSD_{DE}	0.50	0.67	0.47	0.60	0.57	0.68	0.51	0.61
	(3.66)	(4.22)	(3.68)	(3.94)	(3.81)	(4.27)	(3.82)	(4.11)
adjusted R^2	0.602	0.577	0.602	0.576	0.603	0.576	0.601	0.573

Table 5: **Realized covariances between Germany and the distressed countries** This table shows the point estimates and t-statistics (in brackets) for a pooled regression of daily realized covariances between the five-year (5Y) and ten-year (10Y) yield changes of Germany and the five distressed countries. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. Country fixed effects are included.

Dependent variable: $RCOV_{DE,i}$		
maturity	5Y	10Y
$WORDS$	-0.23	-0.14
	(1.99)	(1.62)
$NEWS_i$	-11.4	-10.8
	(2.99)	(3.59)
$NEWSC_i$	-4.7	-2.0
	(2.56)	(1.64)
$NEWS_{DE}$	-1.2	-2.6
	(0.43)	(1.24)
$KFWBUND$	-0.42	-0.37
	(4.88)	(5.59)
$RVAR_{DE}$	-0.34	-0.33
	(3.98)	(2.98)
adjusted R^2	0.101	0.108

Table 6: **Realized covariances between distressed countries**
This table shows the point estimates and t-statistics (in brackets) for a pooled regression of daily realized covariances between the five-year (5Y) and ten-year (10Y) yield changes of all pairs of the five distressed countries. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. Country-pair fixed effects are included.

Dependent variable: $RCOV_{ij}$		
maturity	5Y	10Y
$WORDS$	1.21	0.63
	(1.67)	(1.57)
$NEWS_{ij}$	19.9	14.8
	(1.20)	(1.80)
$NEWSC_{ij}$	2.3	-1.0
	(0.34)	(0.30)
$KFWBUND$	1.21	0.61
	(2.94)	(2.98)
$RVAR_{DE}$	1.08	0.71
	(1.69)	(2.34)
adjusted R^2	0.033	0.038

Table 7: **Realized covariance between Italy and Spain**
This table shows the point estimates and t-statistics (in brackets) for a regression of daily realized covariances between the five-year (5Y) and ten-year (10Y) yield changes of Italy and Spain. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. An intercept is included in the regression.

Dependent variable: $RCOV_{IT,SP}$		
maturity	5Y	10Y
$WORDS$	-0.43	-0.08
	(0.45)	(0.17)
$NEWS_{IT,SP}$	49.1	37.9
	(2.81)	(4.11)
$NEWSC_{IT,SP}$	12.2	4.6
	(1.49)	(1.15)
$KFWBUND$	4.34	2.05
	(4.85)	(4.43)
$RVAR_{DE}$	1.84	2.53
	(5.25)	(11.14)
adjusted R^2	0.111	0.256

Table 8: **Weekly realized standard deviations of distressed countries**
This table shows the point estimates and t-statistics (in brackets) for a pooled regression of weekly realized standard deviations (RSD) of the five-year (5Y) and ten-year (10Y) yield of the distressed countries. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. Country fixed effects are included.

Dependent variable: $RSTD_i$				
maturity	5Y	10Y	5Y	10Y
$RSTD_{i,-1}$	0.73	0.58	0.70	0.56
	(10.03)	(7.85)	(9.79)	(7.57)
$WORDS$	0.06	0.02	0.08	0.04
	(0.93)	(0.43)	(1.30)	(1.14)
$NEWS_i$	6.8	4.5	6.2	3.8
	(4.23)	(3.69)	(4.28)	(3.42)
$NEWSC_i$	2.1	1.5	1.1	0.7
	(2.14)	(2.12)	(1.24)	(1.02)
$KFWBUND$	0.134	0.105	0.177	0.114
	(3.34)	(4.36)	(4.13)	(5.64)
RSD_{DE}	0.72	0.83	1.12	1.11
	(3.06)	(3.24)	(3.06)	(2.77)
SMP			-0.56	-0.49
			(2.60)	(4.01)
adjusted R^2	0.691	0.613	0.703	0.628

Table 9: **Weekly realized covariances between Germany and the distressed countries** This table shows the point estimates and t-statistics (in brackets) for a pooled regression of weekly realized covariances between the five-year (5Y) and ten-year (10Y) yield changes of Germany and the distressed countries. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. Country fixed effects are included.

Dependent variable: $RCOV_{DE,i}$				
maturity	5Y	10Y	5Y	10Y
$RCOV_{DE,i,-1}$	0.18	0.28	0.13	0.26
	(2.79)	(4.77)	(1.79)	(4.42)
$WORDS$	-0.28	-0.19	-0.36	-0.20
	(1.35)	(0.97)	(1.70)	(1.13)
$NEWS_i$	-16.0	-16.5	-12.9	-15.5
	(2.93)	(4.50)	(2.55)	(4.25)
$NEWSC_i$	-4.6	-2.4	-1.8	-1.4
	(1.94)	(1.01)	(0.66)	(0.58)
$NEWS_{DE}$	-5.3	-6.5	-1.3	-5.7
	(1.05)	(1.78)	(0.26)	(1.54)
$KFWBUND$	-0.30	-0.31	-0.40	-0.34
	(3.40)	(4.33)	(4.06)	(4.55)
$RVAR_{DE}$	-0.22	-0.23	-0.33	-0.25
	(2.90)	(2.50)	(3.41)	(2.32)
SMP			1.46	0.50
			(2.68)	(1.22)
adjusted R^2	0.247	0.320	0.267	0.318

Table 10: **Weekly realized covariances between distressed countries**
This table shows the point estimates and t-statistics (in brackets) for a pooled regression of weekly realized covariances between the five-year (5Y) and ten-year (10Y) yield changes of all pairs of the five distressed countries. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. Country-pair fixed effects are included.

Dependent variable: $RCOV_{ij}$				
maturity	5Y	10Y	5Y	10Y
$RCOV_{ij,-1}$	0.03	0.13	0.03	0.13
	(0.42)	(3.81)	(0.40)	(3.53)
$WORDS$	2.78	0.19	3.17	0.42
	(1.12)	(0.25)	(1.26)	(0.54)
$NEWS_{ij}$	33.5	24.8	20.5	21.1
	(1.33)	(2.88)	(0.75)	(2.15)
$NEWSC_{ij}$	-10.4	1.2	-21.0	-3.5
	(0.98)	(0.36)	(1.50)	(0.81)
$KFWBUND$	1.61	0.84	2.41	1.31
	(2.60)	(2.93)	(2.71)	(3.75)
$RVAR_{DE}$	1.17	0.75	1.85	1.20
	(1.40)	(2.57)	(1.68)	(3.73)
SMP			-10.88	-5.40
			(2.00)	(3.36)
adjusted R^2	0.075	0.120	0.105	0.159

Table 11: **Weekly realized covariance between Italy and Spain**
This table shows the point estimates and t-statistics (in brackets) for a pooled regression of daily realized covariances between the five-year (5Y) and ten-year (10Y) yield changes of Italy and Spain. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. An intercept is included in the regression.

Dependent variable: $RCOV_{IT,SP}$				
maturity	5Y	10Y	5Y	10Y
$RCOV_{IT,SP,-1}$	0.49	0.41	0.44	0.34
	(6.25)	(5.48)	(6.01)	(4.79)
$WORDS$	0.14	-0.45	0.68	-0.04
	(0.07)	(0.51)	(0.42)	(0.04)
$NEWS_{IT,SP}$	130.4	80.8	107.4	66.0
	(4.36)	(5.20)	(3.79)	(4.49)
$NEWSC_{IT,SP}$	16.8	15.8	-4.0	7.4
	(1.13)	(2.16)	(0.27)	(1.05)
$KFWBUND$	3.41	1.43	4.51	2.07
	(3.17)	(2.54)	(4.35)	(3.82)
$RVAR_{DE}$	1.99	2.19	3.05	2.78
	(3.40)	(5.94)	(5.03)	(7.58)
SMP			-16.1	-9.4
			(3.93)	(4.34)
adjusted R^2	0.498	0.581	0.568	0.644

A Rescaling of the news variables

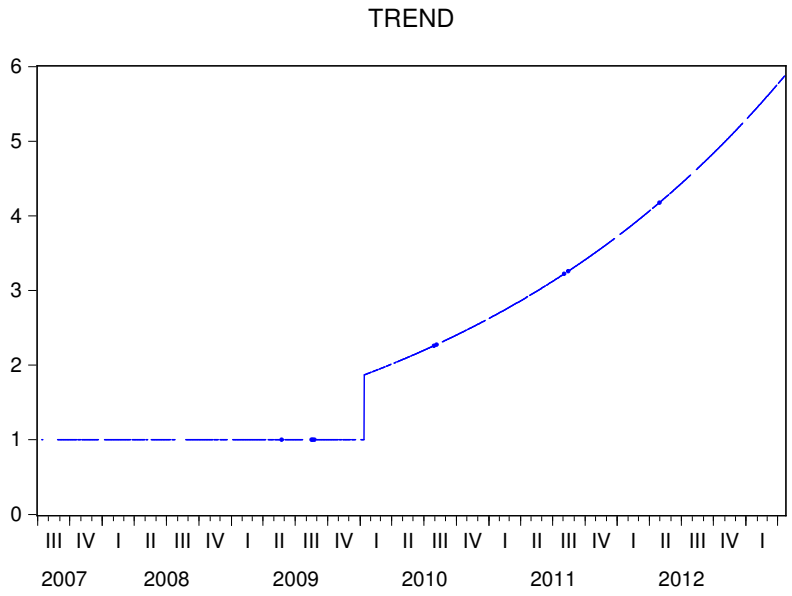
The length of the Eurointelligence news items shows an upward trend over time. Before 13 January 2010, the length of the news items is around 66 words, after that day there is a sudden jump in the length, and then a steady increase. We fit this pattern by the following functional form over the sample period 2 July 2007 to 12 April 2013:

$$\ln WORDS_t = \lambda_0 + \lambda_1 D_t + \lambda_2 D_t t + \epsilon_t, \tag{9}$$

where t is time and D_t is a dummy that takes the value zero before 13 January 2010 and one after that. The equation is estimated by OLS using data from 2 July 2007 to 12 April 2013. The fitted values of this regression define the trend

$$TREND_t = \exp\left(\widehat{\lambda_1} D_t + \widehat{\lambda_2} D_t t\right). \tag{10}$$

Notice that the intercept is left out, such that the value of this trend before 13 January 2010 (when $D_t = 0$) is one. Then, every news variable is divided by $TREND_t$ to obtain the rescaled values. The fitted trend is graphed in the following figure:



B Additional news variables and good-bad news split

In this appendix we investigate how of our results are affected by the inclusion of additional news variables in the regressions, such as statements by the European Central Bank (ECB) and the Deutsche Bundesbank ($BUBA$), and statements by the prime minister and finance minister of individual countries ($PMFM$). ECB is the number of times the ECB is mentioned, $BUBA$ is the number of times the Bundesbank is mentioned, while $PMFM$ is the number of times the prime minister or the finance minister of a country is mentioned. The idea is that statements by the main economic decision makers might have had an influence on the sovereign debt markets. The results are reported in Tables B.1 to B.3. For reasons of space, these tables do not report the coefficients of the lagged dependent variables and the control variables; the variables included are exactly the same as those in the basic regressions of Tables 4 to 6. Most of these additional news variables are insignificant, although an increase in $PMFM$ does indeed reduce the covariances between the distressed countries and Germany, while adding them does not materially change the effect of the other news variables.

A limitation of $NEWS_i$ is that it lumps togethers all the news, irrespective of whether this is good news, bad news or news that is irrelevant for the behavior of the debt yields. Assuming that the behavior of the debt yields is largely driven by perceptions of sustainability of the public budget, irrelevant news is news that does not yield any information about the budgetary sustainability, while bad news is negative news about the budgetary sustainability, and vice versa for good news. Examples of bad news are high deficit (forecasts), negative output developments, etc.[10] As it is conceivable that good and bad news have different consequences for the second moments of yield changes, we thus dissect $NEWS_i$ into the number of times country i is mentioned in connection with good news ($GOOD_i$), the number of times it is mentioned in connection with bad news (BAD_i) and the number of times the news is irrelevant ($NEUTRAL_i$). Instances when it is a priori not clear whether news is positive or negative are counted as "irrelevant news". Further, we define $GOOD_{ij} \equiv GOOD_i + GOOD_j$ and likewise for BAD_{ij} and $NEUTRAL_{ij}$. The results of the split are also reported in Tables B.1 to B.3. The coefficients of the three categories of news variables are typically quite similar to each

[10] Many specific examples are given in the Appendix of Beetsma *et al.* (2013).

other and they are never significantly different from the coefficient of $NEWS$ in the basic regressions. Only in the regressions for the pairwise covariances of the distressed countries the coefficient of especially the $GOOD$ news variable increases a lot, but the standard error of this coefficient is so large that it is not significant.

Table B.1: **Realized standard deviations of distressed countries: additional news variables**
This table shows the point estimates and t-statistics (in brackets) for a pooled regression of daily realized standard deviations of the five-year (5Y) and ten-year (10Y) yield changes of all distressed countries. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. Country fixed effects are included.

Dependent variable: $RSTD_i$								
maturity	five year (5Y)				ten year (10Y)			
$WORDS$	0.047	0.048	0.048	0.046	0.015	0.016	0.015	0.015
	(2.19)	(2.22)	(2.23)	(2.13)	(1.18)	(1.18)	(1.09)	(1.17)
$NEWSC_i$	0.54	0.54	0.53	0.56	0.27	0.27	0.29	0.27
	(1.67)	(1.70)	(1.66)	(1.74)	(1.34)	(1.31)	(1.42)	(1.34)
$NEWS_i$	1.56	1.56	1.60		1.17	1.16	1.12	
	(2.69)	(2.71)	(2.66)		(2.78)	(2.82)	(2.56)	
ECB		-0.28				0.03		
		(0.38)				(0.06)		
$BUBA$		1.47				-0.45		
		(0.74)				(0.42)		
$PMFM_i$			-0.35				0.43	
			(0.36)				(0.58)	
$GOOD_i$				3.46				1.18
				(1.46)				(0.76)
BAD_i				0.96				1.08
				(1.13)				(2.20)
$NEUTRAL_i$				1.75				1.26
				(1.93)				(1.73)
adjusted R^2	0.602	0.602	0.602	0.603	0.576	0.577	0.576	0.576

Table B.2: **Realized covariances between distressed countries and Germany: additional news variables**

This table shows the point estimates and t-statistics (in brackets) for a pooled regression of daily realized covariances between the five-year (5Y) and ten-year (10Y) yield changes of the five distressed countries and Germany. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. Country fixed effects are included.

Dependent variable: $RCOV_{i,DE}$								
maturity	five year (5Y)				ten year (10Y)			
$WORDS$	-0.23	-0.23	-0.21	-0.22	-0.14	-0.14	-0.12	-0.13
	(1.99)	(2.01)	(1.85)	(2.07)	(1.62)	(1.65)	(1.45)	(1.64)
$NEWS_{DE}$	-1.2	-1.2	-1.3	-1.5	-2.6	-2.6	-2.7	-2.8
	(0.43)	(0.43)	(0.46)	(0.54)	(1.24)	(1.24)	(1.30)	(1.31)
$NEWSC_i$	-4.7	-4.7	-5.0	-4.8	-2.0	-2.0	-2.3	-2.1
	(2.56)	(2.54)	(2.56)	(2.52)	(1.68)	(1.68)	(1.94)	(1.73)
$NEWS_i$	-11.4	-11.3	-10.3		-10.8	-10.8	-9.8	
	(2.99)	(3.00)	(2.56)		(3.59)	(3.64)	(2.94)	
ECB		1.7				0.9		
		(0.55)				(0.35)		
$BUBA$		-8.6				-4.9		
		(0.72)				(0.65)		
$PMFM_i$			-10.1				-10.0	
			(1.80)				(1.79)	
$GOOD_i$				-17.4				-13.4
				(0.87)				(1.74)
BAD_i				-8.5				-8.8
				(1.42)				(2.06)
$NEUTRAL_i$				-12.8				-12.7
				(2.48)				(2.86)
adjusted R^2	0.101	0.101	0.103	0.099	0.108	0.107	0.111	0.108

Table B.3: **Realized covariances between distressed countries: additional news variables**

This table shows the point estimates and t-statistics (in brackets) for a pooled regression of daily realized covariances between the five-year (5Y) and ten-year (10Y) yield changes of all pairs of the five distressed countries. The sample period is 29 November 2010 to 12 April 2013. The explanatory variables are defined in the text. Country-pair fixed effects are included.

Dependent variable: $RCOV_{ij}$								
maturity	five year (5Y)				ten year (10Y)			
$WORDS$	1.21	1.21	1.19	1.01	0.63	0.62	0.63	0.58
	(1.67)	(1.66)	(1.60)	(1.69)	(1.57)	(1.54)	(1.49)	(1.72)
$NEWSC_{ij}$	2.3	2.2	2.4	2.5	-0.9	-0.9	-0.9	-1.0
	(0.34)	(0.33)	(0.37)	(0.39)	(0.31)	(0.27)	(0.28)	(0.34)
$NEWS_{ij}$	17.7	17.6	16.9		15.7	15.8	15.3	
	(1.50)	(1.49)	(1.34)		(2.58)	(2.60)	(2.31)	
ECB		-4.4				2.9		
		(0.29)				(0.37)		
$BUBA$		9.1				-1.1		
		(0.21)				(0.06)		
$PMFM_{ij}$			6.5				3.2	
			(0.32)				(0.28)	
$GOOD_{ij}$				244.7				91.2
				(1.57)				(1.37)
BAD_{ij}				-4.6				8.3
				(0.24)				(0.95)
$NEUTRAL_{ij}$				-21.1				-0.7
				(1.35)				(0.06)
adjusted R^2	0.033	0.033	0.033	0.049	0.038	0.038	0.038	0.044