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# **Euro Crash Risk**

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## **Abstract**

We identify crucial events during the European sovereign debt crisis and investigate their impact on the euro currency. In particular, we analyze how specific announcements related to vulnerable Eurozone member states, European Central Bank (ECB) actions, and credit rating downgrades affect the value and the crash risk of the euro. We proxy the value changes of the euro by its abnormal foreign exchange (FX) rate returns with respect to 35 currencies. The crash risk of the euro is proxied by the conditional skewness of the FX rate return distribution with respect to the same currencies. We find that the market reacts positively to news related to countries under the European and International Monetary Fund (IMF) rescue umbrella. We discover that ECB actions on average result in a euro depreciation on the day of the announcement reflecting obvious concerns of market participants, but the effect is partly corrected the day after. Our analysis also shows that sovereign and corporate credit rating downgrades tend to lead to a depreciation of the euro and, more importantly, to an increase of the euro crash risk. Interestingly, we find that specific announcements about Greece on average do not substantially affect the euro exchange rate directly, however, it does have an overall significant effect on the euro crash risk, imposing a substantial risk for the stability of the common currency in the Eurozone.

**Keywords:** Sovereign debt crisis; News announcements; Euro value; Euro crash risk

**JEL Classification:** G01, G14

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## **I. Introduction**

In recent years, numerous papers have focused on the European sovereign debt crisis. Both academics and policymakers are trying to explain the roots, looking for ways out, and assessing the steps that need to be made to overcome the economic downturn. For instance, Gros (2011) stresses the importance of a discussion of the roots of the current financial crisis in order to prevent the economy from financial downturns in the future. De Santis (2014) analyzes the euro area long-term government bond yields over the period September 2008 to August 2011 and finds three factors that can explain the upward trends in sovereign spreads for countries with weaker fiscal fundamentals: an aggregate regional risk factor, the country-specific credit risk, and spillover effects from Greece. Lee, Aizenman, Jinjark and Park (2012) estimate the responsiveness of equity and bond markets in developing countries to global crisis news and euro crisis news. The authors find that whereas global crisis news has a consistently negative effect on returns of equity and bond markets in developing countries, the effect of euro crisis news is more mixed and limited. Filbien and Labondance (2011) examine the Eurozone stock market reactions to the ECB monetary policy announcement surprises. Using an event study methodology over the period of 1999-2008, the authors find that the impact of ECB monetary policy surprises is not significant for Eurozone stock markets. However, the stock market reaction around unexpected ECB monetary policy announcements is significant when accounting for business conditions and industry effects. Furthermore, they observe that the impact of a surprising monetary policy is negative in bad business conditions and positive in good times. Tavares da Luz Soares and Cardoso (2011) test the efficiency of macroeconomic forecasts using a rolling-event approach. The authors construct a monthly economic surprise index, aggregating several macroeconomic news surprises for the nine largest economic areas, and further analyze their impact on stock, bonds and foreign exchange markets. They argue that past economic surprises can be used to predict future returns.

Ehrmann, Osbat, Strasky and Uusküla (2014) use daily euro foreign exchange rate data to investigate the determinants of exchange rate returns and return volatility during the sovereign debt crisis. They examine the impact of macroeconomic fundamentals, policy actions and the public debate by policy makers. Their research shows that macroeconomic fundamentals have low explanatory power on the common currency foreign exchange (FX) rate returns. However, policy actions at the EU level and the ones made by the ECB do have an impact on the euro exchange rate returns. They also find that the public debate by policy makers appears to be less influential on the exchange rate returns as previously feared (Franscher, 2006). Furthermore, the return volatility increases when some negative news from the AAA-rated countries is released.

Sun, Rezaei, Rachev and Fabozzi (2011) study the intraday effects of scheduled economic releases on the EUR/USD, JPY/USD, and GBP/USD exchange rates. They use wavelets to analyze volatility behavior and show that intraday volatility clusters increase before the time of the releases and decrease exponentially after the releases. Han (2010) also analyzes intraday dynamics of the USD/EUR and USD/JPY exchange rates. The author specifies a FIGARCH model with a mixture distribution that allows for time-varying jumps induced by U.S. macroeconomic surprises. The author finds that the U.S. macroeconomic surprises tend to affect the movements in the volatility process of the FX rates asymmetrically depending on the signs of the surprises and spuriously increasing the long memory persistence in the volatility process due to the jumps. Evans and Speight (2011) investigate the intraday news impact from the unexpected component of international macroeconomic announcements for the USD/EUR, GBP/EUR and JPY/EUR exchange rates. The authors find that news related to leading U.S. economic indicators causes the most pronounced reactions in euro exchange rate returns, while the few statistically significant non-U.S. announcements relate primarily to Eurozone labor costs and German business expectations. They also provide evidence of asymmetric responses of FX rates to good and bad

news and find that positive surprises in poor economic climates have strong influence on short-term returns.

Academics usually analyze currency crash risk either from the underlying FX rate return distribution or from the implied risk-neutral distribution of option prices. Bekkour, Jin, Lehnert, Rasmouki and Wolff (2015), for instance, take the risk-neutral skewness of USD/EUR exchange rate options as a proxy of the euro crash risk and find that vulnerable Eurozone member countries' credit risk measured by the spreads of its sovereign credit default swaps (CDS) is a major determinant of the euro crash risk. Rafferty (2011), instead, models a global currency skewness risk factor and analyzes three types of currency portfolios: carry portfolios, momentum portfolios and value portfolios. The author argues that differences in exposure to the global currency skewness risk factor explains the variation in average excess currency returns within all three sets of portfolios much better than the existing FX risk factors in the literature. Our analysis is also within the strand of the literature elaborating on skewness of FX returns distribution.

The relationship between foreign exchange rate returns and credit rating downgrades through credit default swaps is well explored in the financial literature (Afonso et al. 2011; Carr and Wu, 2011). It is expected that when a country's credit worthiness is downgraded, spreads of CDS written on its debt rise, whereas an increase of country's CDS causes a depreciation of the domestic currency. Consequently, as the greater part of rating agencies actions during the sovereign debt crisis involves credit rating downgrades of the European Union (EU) member states in trouble, we expect rating agencies related announcements to cause a euro depreciation and an increase in the euro crash risk.

The results of Ehrmann et al. (2013) suggest that those troubled European member states that received financial support from the EU/IMF Economic Adjustment Program were more positively treated by financial markets compared to other EU member states experiencing the economic slowdown. Filbien and Labondance (2011) find that financial markets tend to react negatively to the ECB actions during bad

times and positively during good times. Based on that evidence, we hypothesize that during the European sovereign debt crisis, ECB actions lead to a depreciation of the euro and an increase in the euro crash risk.

In this paper, we analyze how specific announcements related to vulnerable Eurozone member states, ECB actions, and credit rating changes affect the value of the common currency. We consider announcements related to vulnerable Eurozone countries like Greece, Ireland, Italy, Portugal, Spain, as well as critical ECB actions and sovereign credit rating downgrades. In particular, we study the impact of sovereign debt crisis events on the crash risk of the euro, proxied by the time varying skewness of a set of euro foreign exchange rate return distributions. We hypothesize that negative news related to the vulnerable member states increase the euro crash risk, whereas positive news reduce the probability of a substantial euro depreciation. Our empirical findings show that the sovereign debt crisis events had a strong impact on the euro value. We show that the impact of country related announcements was positive for Ireland and Portugal but negative for Italy and Spain. ECB related announcements had a negative initial impact on the euro value but the effect was partly corrected the next trading day. Credit rating downgrades of vulnerable Eurozone member states caused an euro depreciation. We also show that partly for Ireland and Spain, but mainly for Greece, country related events have a significant effect on the euro crash risk.

## **II. Data and methodology**

***Sovereign debt crisis events.*** Our sample period covers the European sovereign debt crisis period and ranges from September 21, 2009 till November 23, 2012. In order to ensure the consistency of event selection criteria, we work with one source of sovereign debt crisis events, the CFA Institute blog. The detailed list of events taken from the CFA Institute blog on December 5, 2012 is provided in the Appendix. The event sample was further subdivided into 7 groups (number of events assigned to each category is given in brackets): announcements related to the ECB (27), Greece (84), Ireland (7), Italy

(17), Portugal (8), sovereign rating actions by the three major rating agencies Moody's, Standard & Poor's, and Fitch Ratings (24) and Spain (45). Certain events were classified to more than one category. For example, the downgrade of Greece's sovereign debt to BB+ by Fitch Ratings on January 14, 2011, was assigned to two categories: Greece and rating agencies.

The groups of events related to countries (Greece, Ireland, Italy, Spain and Portugal) contain policy announcements made by the countries' officials or other EU member states such as Germany or France as well as decisions made by European or international organizations such as the ECB or the IMF. These lists also contain economic and financial announcements such as changes in bond yields, unemployment rates and announcements related to the banking sector of the specified countries. Press releases about changes in sovereign credit ratings for Greece, Italy, Spain, Portugal and Ireland are also included in the groups of events assigned to the respective countries. The ECB category consists of announcements tied to European institutions such as the ECB decisions made regarding collateral rules or, for instance, German Chancellor Angela Merkel's agreement to work with the ECB to help Greece during the sovereign debt crisis on June 18, 2011. The list of events of credit rating agencies is mainly composed of rating downgrades announced by Moody's, Standard & Poor's, or Fitch Ratings.

***Euro exchange rate data.*** Our empirical analysis is conducted using daily observations of 35 euro foreign exchange reference rates from September 21, 2004 till November 23, 2012, taken from the ECB website. The rates are based on the regular daily concentration procedure between central banks, which typically takes place at 2.15 p.m. CET. We further subdivide the sample into a pre-crisis period from September 21, 2004 to October 13, 2009, and the sovereign debt crisis period from October 14, 2009 to November 23, 2012. Mid-October, 2009 is typically considered to be the onset of the crisis (Bekkour et al., 2015) when the Panhellenic Socialist Movement (PASOK) won the general election in Greece (October 4,



2009), George Papandreou was sworn the Prime Minister (October 6, 2009) and the real situation of public finances in the country started to unfold.

We report annualized logarithmic euro foreign exchange rate returns with the euro being the base currency. This implies that the positive FX rate returns show an appreciation of the euro and negative FX rate returns the depreciation of the euro with respect to the foreign currency. Summary statistics of both the pre-crisis and the crisis period of the euro FX rate returns are provided in Tables 1 and 2.

*[Please insert Tables 1 and 2 about here]*

We observe a leptokurtic distribution of the euro foreign exchange rate returns for both the pre-crisis and the crisis periods. Kurtosis values for all euro foreign exchange rate returns distributions in both periods are greater than 3. However, when looking at the extremes, the pre-crisis period is characterized by far more leptokurtic distributions: 13 out of 35 exchange rate returns distributions have kurtosis values greater than 10 in the pre-crisis, whereas during the crisis period only 2 such extreme kurtosis values are observed. Both the pre-crisis and the crisis periods possess similar risk of a euro depreciation; however, the chances of the euro decreasing in value are slightly greater in the crisis period. 17 out of 35 euro FX rate returns distributions are negatively skewed in the crisis period versus 15 out of 35 negative skews during the pre-crisis.

Figure 1 shows that the euro on average depreciates during the crisis rather than during the pre-crisis period as seen from the negative euro FX rate returns. In particular, 26 out of 35 average euro FX rate returns during the crisis period are negative, whereas during the pre-crisis only 12 negative returns are observed.

*[Please insert Figure 1 about here]*

**The basic model.** When dealing with a crisis period, we are typically confronted with a heteroscedastic time-series, because of a crisis-induced volatility (Schwert, 1989; Coudert et al. 2011). Standard event

study methodologies (Fama et al. 1969; Binder, 1998) do not account for that. In the following, we propose a method that accounts for time-variation in volatility and cross-country differences in exchange rate volatility.

We employ a variation of the generalized autoregressive conditional heteroskedasticity model (GARCH) introduced by Engle (1982). More specifically, to account for a possible asymmetry in the volatility dynamics, we employ the exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model that was first presented by Nelson (1991). The specific volatility equation used in our analysis is taken from the model developed by Grammatikos et al. (2015). Our EGARCH-based model is:

$$r_{i,t} = \mu_i + \lambda_{i,j} D_{j,t} + \varepsilon_{i,t}, \quad (1)$$

with  $\varepsilon_{i,t} = \sigma_{i,t} e_{i,t}$  and  $\{e_{i,t}\} \sim N(0, 1)$ , and

$$\ln(\sigma_{i,t+1}^2) = \alpha_{0,i} + \alpha_{1,i} [|e_{i,t}| - \gamma_i e_{i,t}] + \beta_i \ln(\sigma_{i,t}^2), \quad (2)$$

where  $r_{i,t}$  is a logarithmic euro FX rate return related with currency  $i$  at time  $t$ .  $\mu_i$  represents the mean log return of euro exchange rate return related to currency  $i$  over the whole sample period September 21, 2004 – November 23, 2012.  $\lambda_{i,j}$  represents the abnormal announcement effect for currency  $i$  and  $j$  stands for one of our specified 7 announcement categories (Italy, Spain, Greece, Ireland, Portugal, the ECB, and credit rating agencies).  $D_{j,t}$  is a binary dummy variable taking the value 1 on the day of the announcement of event  $j$  and 0 otherwise.  $\varepsilon_{i,t}$  denotes an error term which is normally distributed with mean 0 and variance  $\sigma_{i,t}^2$  [ $\varepsilon_{i,t} \sim N(0, \sigma_{i,t}^2)$ ].  $\{e_{i,t}\}$  is assumed to be a sequence of independent and identically distributed random variables (i.i.d.), following the standard normal distribution,  $\{e_{i,t}\} \sim N(0, 1)$ .

Equations (1) and (2) are estimated for each logarithmic daily foreign exchange rate series  $i$  and each announcement category  $j$ . The heteroskedastic nature of the euro exchange rate return volatility weakens the power of traditional tests of significance of abnormal returns. Therefore, we use the EGARCH setting and account for the crisis-induced volatility of foreign exchange rate returns as defined

by Equation (2). We use the test developed by Savickas (2003) and verify whether category  $j$  announcements have statistically significant effects on the euro exchange rate returns of currency  $i$ . The event dummy  $\lambda_{i,j}$  included in Equation (1) enables us to control for the cross-country diverged crisis-induced volatility. Therefore, we implement the following test statistics for standardized abnormal event returns:

$$test(\hat{\lambda}_j) = \frac{\sum_{i=1}^N \frac{S_{i,j}}{N}}{\sqrt{\frac{1}{N(N-1)} \sum_{i=1}^N (S_{i,j} - \sum_{m=1}^N (S_{m,j}/N))^2}} \quad (3)$$

and

$$S_{i,j} = \frac{\hat{\lambda}_{i,j}}{\hat{\sigma}_{i,t}}. \quad (4)$$

$\hat{\lambda}_{i,j}$  is the estimate of  $\lambda_{i,j}$  – the abnormal announcement effect,  $\hat{\sigma}_{i,t}$  stands for the estimated volatility of currency  $i$  at time  $t$ ,  $N$  is the number of currencies considered and equals 35 in our case.  $S_{i,j}$  denotes the standardized abnormal event returns of currency  $i$  and category  $j$ , averaged over all events of type  $j$ . The final test statistic is a cross-country average over all currencies and is student- $t$  distributed with  $N-1$  degrees of freedom.

**The robust model.** We can differentiate two main theoretical approaches in the literature describing the relationship between the foreign exchange markets and stock markets: the flow-oriented approach (Dornbusch and Fisher, 1980) and the stock-oriented approach (Branson, 1983). Flow-oriented models advocate that foreign exchange markets affect stock markets, whereas the stock-oriented approach claims the opposite relationship. Additionally, Aloui (2007) study the mean, volatility and causality transmission mechanism between foreign exchange and stock markets for the United States and some major European markets pre- and post-euro. The results show strong evidence of causality in the mean and variance between the stock prices and FX rates in both pre- and post-euro periods with the stock prices having a more significant effect on FX rates for the two subsamples. Besides, Walid, Chaker and Masood (2011)

employ the Markov regime switching methodology to analyze the relationship between changes of FX rate returns and stock returns volatility. They distinguish two different regimes in both the conditional mean and the conditional variance of stock returns: the first corresponds to a high mean-low variance regime during tranquil times, while the second one is characterized by a low mean and a high variance during crisis periods. The authors provide strong evidence that the relationship between stock and foreign exchange markets is regime dependent and stock price volatility responds asymmetrically to events in the foreign exchange markets.

In order to control for the possible impact of the stock returns volatility on FX rate returns during the crisis period, we introduce the European implied volatility index, VStoxx, as an explanatory variable. Here, VStoxx was chosen as a major index measuring market participants' expectations of short-term stock returns volatility in Europe. Additionally, to account for the crisis period effect on the euro exchange rate returns, we introduce pre-crisis and crisis dummies to separate mean log returns of the two timeframes. Our robust model is specified as:

$$r_{i,t} = D_t^{pre} \mu_{pre} + D_t^{cri} \mu_{cri} + \phi D_t^{cri} \Delta VStoxx + \lambda_{i,j}^{rob} D_{j,t} + \sigma_{i,t} e_{i,t}. \quad (5)$$

$D_t^{pre}$  is a binary dummy variable taking the value 1 during the days of the pre-crisis period (September 21, 2004 till October 13, 2009), and 0 otherwise,  $D_t^{cri}$  is a dummy variable taking the value 1 during the days of the crisis period from October 14, 2009 till November 23, 2012, and 0 otherwise.  $\phi$  represents the effect of VStoxx index changes on the euro exchange rate returns with respect to currency  $i$  during the crisis period.  $\lambda_{i,j}^{rob}$  is the abnormal event  $j$  effect on the euro exchange rate returns, where *rob* stands for robust.  $\sigma_{i,t}$  follows the dynamics defined in Equation (2).

**Modeling crash risk.** Our aim is to model the euro crash risk, which can be proxied by the conditional skewness of the euro exchange rate return distribution. We make use of a method that builds on a Gram-

Charlier series expansion (Jarrow and Judd, 1982; Corrado and Su, 1996; León, Rubio and Serna, 2005) to allow for non-zero skewness. Thus, we employ the following Gram-Charlier series expansion of the normal distribution density function:

$$g(e_i|I_{t-1}) = \text{pdf}(e_{i,t}) \left[ 1 + \frac{s_i}{3!}(e_{i,t}^3 - 3e_{i,t}) + \frac{k_i-3}{4!}(e_{i,t}^4 - 6e_{i,t}^2 + 3) \right] = \text{pdf}(e_{i,t})\Psi(e_{i,t}), \quad (6)$$

and

$$\Psi(e_{i,t}) = 1 + \frac{s_i}{3!}(e_{i,t}^3 - 3e_{i,t}) + \frac{k_i-3}{4!}(e_{i,t}^4 - 6e_{i,t}^2 + 3), \quad (7)$$

where  $\text{pdf}(e_{i,t})$  denotes a probability density function of the error term  $e_{i,t}$  corresponding to the normal distribution,  $s_i$  is the skewness and  $k_i$  denotes the kurtosis of the euro foreign exchange rate return distribution with respect to currency  $i$ . Due to the  $\Psi(e_{i,t})$  component,  $g(\cdot)$  can be negative and an integral of  $g(\cdot)$  on  $\mathbb{R}$  is not equal to one. Therefore  $g(\cdot)$  is not a probability density function<sup>1</sup>. Consequently, we further transform  $g(\cdot)$  according to the method proposed by Gallant and Tauchen (1989) to obtain a true probability density function  $f(\cdot)$ , which is of the form:

$$f(e_{i,t}|I_{t-1}) = \text{pdf}(e_{i,t})\Psi(e_{i,t})^2/\Gamma_{i,t}, \quad (8)$$

and

$$\Gamma_{i,t} = 1 + \frac{s_i^2}{3!} + \frac{(k_i-3)^2}{4!}. \quad (9)$$

The parameters can be estimated by maximizing the log-likelihood function in the usual way (Wooldridge, 2010). In principle, the conditional volatility and skewness dynamics can be calibrated jointly. However, given the complexity of the estimation, a two-step procedure is preferable and substantially stabilizes the estimation process.

In a first step, we re-estimate the robust model, Equations (2), (5) and (8), allowing for non-normality,  $s_i \neq 0$ ,  $k_i \neq 3$ , and obtain the parameter estimates. In a second step, we keep all the estimated

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<sup>1</sup> The probability density function of the continuous random variable is non-negative everywhere and its integral is equal to 1 (Wooldridge, 2013).

parameters as given, except  $s_i$ , but additionally allow the skewness to be time-varying. Therefore, we estimate now the following model, conditional on the assumption that all other parameters take the previously estimated values:

$$s_{i,t+1} = a_i + c_i s_{i,t} + b_i (\varepsilon_{i,t} - d_i)^3 + h_{i,j} D_{j,t} \varepsilon_{i,t}^3, \quad (10)$$

where  $s_{i,t}$  and  $s_{i,t+1}$  represent skewness at time  $t$  and at time  $t+1$  of the euro foreign exchange rate return distribution with respect to currency  $i$ .  $D_{j,t}$  is a dummy variable equal to 1 on the day of  $j$  category event happening, and 0 otherwise. Respectively,  $a_i$ ,  $b_i$ ,  $c_i$ ,  $d_i$  and  $h_{i,j}$  are the parameters to be estimated. Here  $a_i$  is a constant, and  $c_i$  is an autoregressive component that controls for the impact of previous period skewness.  $h_{i,j}$  measures the abnormal effect for currency  $i$  and event  $j$  on  $s_{i,t+1}$ , where a  $t$ -test can be conducted over all currencies for each event  $j$ . The coefficients  $b_i$  and  $d_i$  control for the news impact on skewness. For example, if  $b_i > 0$  and  $d_i > 0$ , then positive news affect skewness positively, whereas negative news makes the skewness more negative. The impact of  $h_{i,j}$  on the skewness is twofold. In particular, a positive  $h_{i,j}$  implies that bad news makes the skewness more negative - it increases the euro crash risk - and good news has a positive effect on skewness - it reduces the euro crash risk.

### III. Discussion of results

We first estimate the basic model, Equations (1), (2), (3) and (4). Table 3 displays our estimates of abnormal standardized returns on the event day for Spain, Portugal, Ireland, ECB and rating agencies actions. Foreign exchange markets react significantly negative to announcements concerning Spain and the ECB, however they react positively with respect to Portugal and Ireland. This finding is in line with our expectations: Events related to countries that participate in the EU/IMF Economic Adjustment Program reveal positive information and, therefore, have a positive impact on the euro value. This is in line with the argument introduced by Ehrmann et al. (2013) that the troubled EU member states that

received financial support from the EU/IMF Economic Adjustment Program were more positively treated by financial markets than other EU member states.

*[Please insert Table 3 about here]*

When we focus our analysis of foreign exchange markets' reaction on the next trading day after the announcement, we obtain statistically significant estimates of abnormal standardized events related to Italy, Portugal, the ECB, and credit rating agencies (downgrades). Table 3 shows that we find positive abnormal standardized event returns for Portugal and the ECB, whereas negative event returns appeared for Italy and the credit rating agencies. Greece related news came out to have no statistically significant impact on the euro exchange rates. This is partly explained by the relatively small contribution of Greece to the 'economic pie' of the eurozone: Greece's GDP in 2014 expressed in current market prices comprised less than 2 percent of eurozone's GDP according to data provided by Eurostat. Additionally, both positive and negative content of Greece related announcements added to the mixed markets sentiment. For example, announcement that Moody's cut Greece sovereign debt rating to Ba1 on June 14, 2010 can be considered as bad news. The fact that the finance ministers of the Economic and Monetary Union (EMU) agreed to help Greece but provided no details on March 15, 2010 are more or less neutral news. However, the announcement that Greece put in place its first austerity package on February 9, 2010, seems to be good news.

Portugal related announcements had a positive impact on the euro value both on the announcement day (abnormal standardized event return of 0.21) and the next trading day (0.30). On the contrary, the foreign exchange markets view to ECB actions changed from negative (-0.12) to positive (0.08) one trading day after the event, implying that markets reacted overall quite neutral to announcements made by the ECB. This outcome confirms our expectations for the foreign exchange markets to be quite neutral towards the ECB actions with possible initial negative effect on the euro value. Lee et al. (2012) prove stock markets to be quite neutral to the ECB actions with an exception of the surprise decisions that were

negatively perceived during economic downturns and welcomed during good times. Ehrmann et al. (2014) observe somewhat similar FX markets reaction to the ECB actions: markets react to the ECB decisions, however the impact on the euro FX rate returns is smaller than previously feared (Franscher, 2006). The correction the next trading day reflects the findings of the ECB trust analysis that indicated the upward trend of trust level in the ECB with more event related information provided to the markets (Ehrmann et al. 2013). Announcements related to Italy (-0.17) and the credit rating agencies (-0.06) had an expected negative, however lagged impact on the euro foreign exchange rate returns. Negative reaction to Italy related announcements is well understood considering that Italy is the fourth biggest economy in the eurozone (based on Eurostat data Italy's GDP expressed in current prices was 1.6bn EUR in 2014 which was nearly 16 percent of eurozone's GDP). Market participants were cautious with respect to Italy related news and adjusted their portfolios the next trading day.

The delayed (significant only on the next trading day) effect of sovereign downgrades can be justified by the time difference between the time credit rating agencies communicate downgrades (usually in the late afternoon of CET) and the time the ECB determines the Euro FX reference rates at 2.15 p.m. CET. As a result, the new information is only incorporated in the euro foreign exchange rates on the following trading day. Additionally, institutional investors rebalance their portfolios following the downgrades, which affect the foreign exchange markets only with a short time lag.

In a next step, we estimate the robust model, Equations (2), (3), (4) and (5), where we account for potential differences in the pre- as well as crisis-period and for the impact of stock market volatility (changes of  $V_{Stoxx}$ ) on the foreign exchange market. The abnormal standardized event returns and t-statistics of this analysis are provided in Table 4.

*[Please insert Table 4 about here]*

Table 4 shows that the estimate of the robust model compared to the basic model generates similar but more nuanced results. Significant estimates on the announcement day are obtained for Spain (-0.10),



Portugal (0.16), Ireland (0.12), the ECB (-0.16), and credit rating agencies (0.08). We also find for the next trading day statistically significant estimates for Italy (-0.16), Portugal (0.27), the ECB (0.15), and the credit rating agencies (-0.10). In particular, when controlling for stock market volatility, rating agencies abnormal event return becomes positive and significant at 5% on the announcement day; however this effect is corrected the next trading day (-0.10), so that the overall reaction of foreign exchange markets is quite neutral to the rating agencies actions. Similar it is for the ECB announcements: The effect on the euro value is negative on the announcement day (-0.16) and positive on the next trading day (0.15), so that the overall effect for the robust model is close to 0. Additionally, estimated parameters of Equations (2) and (5) (robust model) are reported in Table 5.

*[Please insert Table 5 about here]*

In a final step, to check for possible skewness dynamics, we employ a methodology that allows for time variation in the skewness of exchange rate returns. We estimate the robust model, Equations (2), (5), together with the time varying skewness, Equation (10). The parameter estimates are presented in Table 6.

*[Please insert Table 6 about here]*

Parameter estimates suggest that the skewness dynamics are substantially more heterogeneous across currencies compared to the often-studied volatility dynamics of exchange rates. Furthermore, the skewness process is typically less persistent, while the news impact is much stronger. The parameters  $b$ ,  $d$  and  $h$  measure the general impact of news on the skewness dynamics. For example, positive values for  $b$  and  $d$  suggest that negative (positive) news has a negative (positive) impact on the conditional skewness, while the impact of negative news is stronger compared to positive news. The parameter  $h$  measures the additional impact of news on the skewness dynamics on the event day. Results presented in Table 7 suggest that we find interesting outcomes for the abnormal announcement effect on the skewness dynamics, and, therefore, on the euro crash risk.

*[Please insert Table 7 about here]*

We observe that the abnormal announcement effect on skewness for Greece is significant and positive both on the announcement day (0.02) and on the next trading day (0.03), which implies that bad news related to Greece increase the euro crash risk (the euro exchange rate returns distribution on average becomes more negatively skewed), whereas good news has the opposite effect. This is interesting considering our previous insignificant effect on the euro value for Greece.

Table 7 shows that we also obtain statistically significant abnormal effects on the conditional skewness on the announcement day for Spain (0.04), and on the subsequent trading day for Ireland (0.15) and for downgrades (0.10). This implies that good news related to Spain and Ireland reduced the euro crash risk and bad news increase it. Furthermore, credit rating downgrades were uniformly negatively perceived by financial markets, and, therefore, as we expected, increase the euro crash risk.

#### **IV. Conclusion**

We analyze how specific announcements related to vulnerable Eurozone member states, ECB actions, and credit rating downgrades affect the value and the crash risk of the euro. Our results show that the sovereign debt crisis events had a strong impact on the euro value. The size and the direction of this effect were different for separate event categories. The impact of country related announcements can be split into a positive impact of Ireland and Portugal related news and a negative impact of Italy and Spain related news. This is motivated by the greater part of positively perceived news in the Portugal and Ireland event categories, since both countries take part in the EU/IMF Economic Adjustment Program, whereas this was not the case for Spain and Italy. Greece related events had no impact on the euro value and this was partly caused by mixed market sentiment towards Greece caused by extreme media coverage, mixed announcement content and the relatively small economic impact of Greece on the eurozone's 'economic pie'.

The ECB related announcements had a negative initial impact on the euro value, but the effect was corrected the next trading day and resulted in an overall neutral foreign exchange market reaction to ECB actions. Our findings correspond to the controversial judgment of the ECB actions during the sovereign debt crisis. It is also in line with the trust level analysis that shows a decreased trust level in the ECB actions during the sovereign debt crisis and revealed that trust level shifts upwards overtime.

The credit rating downgrades of vulnerable Eurozone member states caused a euro depreciation. However, due to the time difference between credit rating agencies announcing the downgrades and the impact on the euro exchange rate, the effect was reflected only on the next trading day. In addition, and more importantly, the negative reaction was partially caused by institutional investors rebalancing their portfolios after the credit rating agencies news is released.

Furthermore, we find that Ireland, Spain and Greece related events have a significant effect on the euro crash risk. This result is particularly interesting, because Greece related announcements were not significantly affecting the euro value, but appears to be influencing the euro crash risk. This can be explained by the fact that Greece related news content was rather mixed from the country agreeing on the austerity package on one day to a credit rating downgrade announced on another day. In addition, credit rating agencies announcements were also sound determinants of the euro crash risk, on average increasing the probability of a strong euro depreciation.

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**Table 1. EUR foreign exchange rate summary statistics during the pre-crisis period**

This table reports statistics on the euro exchange rates expressed in euros per unit of each of the 35 currencies over the pre-crisis period September 21, 2004 – October 13, 2009. Return represents annualized arithmetic average of logarithmic daily returns. Volatility stands for annualized standard deviations from the mean calculated for logarithmic daily returns over the sample period. Min and max returns represent minimum and maximum logarithmic daily returns during the pre-crisis period. Skewness stands for the third moment of logarithmic daily returns distribution and kurtosis denotes the fourth moment of logarithmic daily returns distribution over the period.

Data source: <http://sdw.ecb.europa.eu/browseSelection.do?DATASET=0&sfl1=4&FREQ=D&sfl3=4&sfl4=4&node=2018795>

Currency	Code	Return	Volatility	Min	Max	Skewness	Kurtosis
Argentine peso	ARS	0.09	0.11	-0.05	0.05	0.30	7.18
Australian dollar	AUD	-0.01	0.12	-0.06	0.06	0.81	14.58
Brazilian real	BRL	-0.06	0.20	-0.09	0.12	0.53	14.12
Canadian dollar	CAD	-0.01	0.10	-0.04	0.03	-0.03	2.23
Swiss franc	CHF	0.00	0.05	-0.02	0.03	0.08	10.39
Chinese yuan renminbi	CNY	0.00	0.10	-0.04	0.04	-0.02	5.20
Czech koruna	CZK	-0.04	0.07	-0.03	0.03	0.30	7.70
Danish krone	DKK	0.00	0.00	0.00	0.00	-0.22	4.60
Algerian dinar	DZD	0.04	0.12	-0.04	0.05	0.11	5.10
UK pound sterling	GBP	0.06	0.08	-0.03	0.03	0.58	6.21
Hong Kong dollar	HKD	0.04	0.10	-0.05	0.04	-0.07	5.41
Croatian kuna	HRK	0.00	0.03	-0.02	0.01	-0.44	8.17
Hungarian forint	HUF	0.02	0.11	-0.03	0.05	0.41	6.25
Indonesian rupiah	IDR	0.05	0.13	-0.05	0.06	-0.05	7.94
Israeli shekel	ILS	0.00	0.11	-0.04	0.04	0.29	3.55
Indian rupee	INR	0.04	0.10	-0.04	0.03	-0.28	3.57
Japanese yen	JPY	0.00	0.13	-0.06	0.04	-0.59	5.71
Korean won	KRW	0.04	0.15	-0.08	0.07	-0.03	14.02
Latvian lats	LVL	0.01	0.02	-0.01	0.01	1.30	21.87
Moroccan dirham	MAD	0.01	0.04	-0.01	0.02	-0.23	5.04
Mexican peso	MXN	0.07	0.16	-0.07	0.10	0.99	21.83
Malaysian ringgit	MYR	0.02	0.09	-0.05	0.03	-0.19	4.61
Norwegian krone	NOK	0.00	0.08	-0.04	0.04	-0.10	9.50
New Zealand dollar	NZD	0.02	0.12	-0.04	0.05	0.64	4.81
Philippine peso	PHP	0.00	0.10	-0.04	0.04	-0.18	3.71
Polish zloty	PLN	0.00	0.11	-0.04	0.04	0.33	5.47
Romanian leu	RON	0.01	0.09	-0.03	0.05	1.03	10.16
Russian rouble	RUB	0.04	0.08	-0.03	0.04	1.04	10.70
Swedish krona	SEK	0.03	0.07	-0.02	0.03	0.33	5.51
Singapore dollar	SGD	0.00	0.07	-0.03	0.03	0.03	3.39
Thai bhat	THB	0.00	0.11	-0.04	0.04	0.14	3.90
Turkish lira	TRY	0.03	0.16	-0.07	0.06	0.55	5.81
New Taiwan dollar	TWD	0.03	0.09	-0.05	0.03	-0.24	5.17
US dollar	USD	0.04	0.10	-0.05	0.04	-0.08	5.25
South African rand	ZAR	0.06	0.17	-0.06	0.08	0.44	4.72

**Table 2. EUR foreign exchange rate summary statistics during the crisis period**

This table reports statistics on the euro exchange rates expressed in euros per unit of each of the 35 currencies over the European sovereign debt crisis period from October 14, 2009 to November 23, 2012. Return represents annualized arithmetic average of logarithmic daily returns. Volatility stands for annualized standard deviations from the mean calculated for logarithmic daily returns over the sample period. Min and max returns represent minimum and maximum logarithmic daily returns during the crisis. Skewness stands for the third moment of logarithmic daily returns distribution and kurtosis denotes the fourth moment of logarithmic daily returns distribution over the period.

Data source: <http://sdw.ecb.europa.eu/browseSelection.do?DATASET=0&sfl1=4&FREQ=D&sfl3=4&sfl4=4&node=2018795>

Currency	Return	Volatility	Min	Max	Skewness	Kurtosis
Argentine peso	0.03	0.11	-0.03	0.02	-0.37	4.09
Australian dollar	-0.09	0.10	-0.02	0.03	0.42	4.88
Brazilian real	0.02	0.12	-0.04	0.03	-0.23	5.82
Canadian dollar	-0.05	0.10	-0.02	0.03	0.07	4.49
Swiss franc	-0.07	0.10	-0.03	0.08	3.01	43.61
Chinese yuan renminbi	-0.07	0.10	-0.03	0.02	-0.23	3.49
Czech koruna	-0.01	0.06	-0.01	0.01	0.14	4.14
Danish krone	0.00	0.00	0.00	0.00	-0.33	8.00
Algerian dinar	-0.01	0.09	-0.02	0.02	-0.19	3.73
UK pound sterling	-0.05	0.08	-0.02	0.03	-0.08	5.01
Hong Kong dollar	-0.04	0.10	-0.03	0.02	-0.23	3.39
Croatian kuna	0.01	0.02	-0.01	0.01	0.02	7.37
Hungarian forint	0.01	0.11	-0.03	0.05	0.38	7.43
Indonesian rupiah	-0.04	0.10	-0.03	0.02	-0.17	4.94
Israeli shekel	-0.03	0.08	-0.02	0.02	0.14	4.44
Indian rupee	0.01	0.10	-0.02	0.02	-0.15	3.58
Japanese yen	-0.07	0.13	-0.03	0.04	0.02	4.46
Korean won	-0.07	0.10	-0.03	0.03	0.09	4.97
Latvian lats	-0.01	0.01	-0.01	0.00	-1.81	27.36
Moroccan dirham	-0.01	0.03	-0.01	0.01	0.00	3.25
Mexican peso	-0.05	0.11	-0.04	0.03	0.02	4.90
Malaysian ringgit	-0.08	0.09	-0.02	0.03	-0.09	4.36
Norwegian krone	-0.04	0.07	-0.02	0.03	0.74	7.38
New Zealand dollar	-0.08	0.11	-0.03	0.03	0.40	4.39
Philippine peso	-0.08	0.09	-0.03	0.02	-0.19	4.74
Polish zloty	-0.01	0.10	-0.03	0.03	0.25	6.26
Romanian leu	0.02	0.05	-0.01	0.02	-0.01	6.85
Russian rouble	-0.03	0.08	-0.02	0.04	0.73	7.82
Swedish krona	-0.06	0.07	-0.02	0.02	0.16	3.86
Singapore dollar	-0.09	0.07	-0.02	0.02	-0.09	3.92
Thai bhat	-0.07	0.09	-0.02	0.02	-0.15	3.60
Turkish lira	0.02	0.09	-0.02	0.02	0.02	4.04
New Taiwan dollar	-0.08	0.09	-0.02	0.02	-0.14	3.23
US dollar	-0.04	0.10	-0.03	0.02	-0.24	3.36
South African rand	0.02	0.12	-0.04	0.05	0.40	6.31



**Table 3. Abnormal standardized event returns and *t*-statistics for the basic model**

This table reports point estimates from the models (1), (2), (3) and (4):

$$r_{i,t} = \mu_i + \lambda_{i,j} D_{j,t} + \varepsilon_{i,t}, \text{ where } \varepsilon_{i,t} = \sigma_{i,t} e_{i,t} \text{ and } \{e_{i,t}\} \sim N(0, 1),$$

where  $r_{i,t}$  is the euro foreign exchange rate return with respect to currency  $i$  at time  $t$ ,  $\mu_i$  is the mean euro foreign exchange rate return with respect to currency  $i$ ,  $\lambda_{i,j}$  is the abnormal standardized event return of the euro foreign exchange rate return with respect to currency  $i$  for the event category  $j$ ,  $D_{j,t}$  is the event dummy equal to 1 on the days when events of category  $j$  happens and 0 otherwise.  $\varepsilon_{i,t}$  is normally distributed error term  $\varepsilon_{i,t} \sim N(0, \sigma_{i,t}^2)$ . Here  $\sigma_{i,t}^2$  is defined as follows:

$$\ln(\sigma_{i,t+1}^2) = \alpha_{0,i} + \alpha_{1,i} [e_{i,t} - \gamma_i e_{i,t}] + \beta_i \ln(\sigma_{i,t}^2),$$

where  $\alpha_{0,i}$  denotes a constant,  $\alpha_{1,i}$  represents the impact of the previous period positive returns,  $\gamma_i$  captures the leverage effect or the impact of the previous period negative returns on today's variance, and  $\beta_i$  accounts for the impact of the previous period volatility on the volatility of today. The test statistic is obtained using the following specification:

$$test(\hat{\lambda}_{i,j}) = \sum_{i=1}^N \frac{S_{i,j}}{N} / \sqrt{\frac{1}{N(N-1)} \sum_{i=1}^N (S_{i,j} - \sum_{m=1}^N (S_{m,j}/N))^2}$$

and

$$S_{i,j} = \frac{\hat{\lambda}_{i,j}}{\hat{\sigma}_{i,t}}$$

$\hat{\lambda}_{i,j}$  is the estimate of  $\lambda_{i,j}$ , the abnormal standardized announcement effect,  $\hat{\sigma}_{i,t}$  stands for the implied volatility of abnormal returns for currency  $i$  at time  $t$ ,  $N$  is the number of the 35 euro foreign exchange rates considered.  $S_{i,j}$  denotes the cross-sectional mean of abnormal event returns of  $j$  category. The test statistic is Student- $t$  distributed with  $N-1$  degrees of freedom. \*\*\* and \* denote significance at the 1% and at the 10% level, respectively.

	Announcement day		Next trading day	
	$\lambda$	<i>t</i> -statistics	$\lambda$	<i>t</i> -statistics
Greece	-0.01	-0.77	-0.004	-0.18
Spain	-0.09***	-4.43	-0.01	-0.36
Italy	-0.04	-1.19	-0.17***	-7.06
Portugal	0.21***	4.42	0.30***	7.09
Ireland	0.14***	2.85	-0.07	-1.22
ECB	-0.12***	-4.37	0.08***	2.86
Rating agencies	0.04	1.23	-0.06*	-1.88

**Table 4. Abnormal standardized event returns and *t*-statistics for the robust model**

This table reports point estimates from the model (2), (3) (4) and (5):

$$r_{i,t} = D_t^{pre} \mu_{pre} + D_t^{cri} \mu_{cri} + \phi D_t^{cri} \Delta VStoxx + \lambda_{i,j}^{rob} D_{j,t} + \sigma_{i,t} e_{i,t},$$

where  $D_t^{pre}$  is binary dummy variable taking the value 1 during the days of the pre-crisis period (September 21, 2004 – October 14, 2009) and 0 otherwise,  $D_t^{cri}$  is a dummy variable taking the value 1 during the days of the crisis period from October 14, 2009 - November 23, 2012 and 0 otherwise.  $\phi$  represents the effect of VStoxx index returns changes on euro foreign exchange rate return with respect to currency  $i$  during the crisis period.  $\lambda_{i,j}^{rob}$  is abnormal event  $j$  effect on the euro foreign exchange rate return, where *rob* stands for robust. The volatility of the error term is described in the following way:

$$\ln(\sigma_{i,t+1}^2) = \alpha_{0,i} + \alpha_{1,i} [|e_{i,t}| - \gamma_i e_{i,t}] + \beta_i \ln(\sigma_{i,t}^2),$$

where  $\alpha_{0,i}$  denotes a constant,  $\alpha_{1,i}$  represents the impact of the previous period positive returns,  $\gamma_i$  captures the leverage effect or the impact of previous period negative returns on today's variance and  $\beta_i$  accounts for the impact of the previous period volatility on the volatility of today. The test statistic is obtained using the below specification:

$$test(\hat{\lambda}_{i,j}) = \frac{\sum_{i=1}^N S_{i,j}}{N} / \sqrt{\frac{1}{N(N-1)} \sum_{i=1}^N (S_{i,j} - \sum_{m=1}^N (S_{m,j}/N))^2}$$

and

$$S_{i,j} = \frac{\hat{\lambda}_{i,j}}{\hat{\sigma}_{i,t}}$$

$\hat{\lambda}_{i,j}$  is the estimate of  $\lambda_{i,j}$  - abnormal standardized announcement effect,  $\hat{\sigma}_{i,t}$  stands for implied volatility of abnormal returns for currency  $i$  at time  $t$ ,  $N$  is the number of the 35 euro foreign exchange rates considered.  $S_{i,j}$  denotes the cross-sectional mean of abnormal event returns of  $j$  category. The test statistic is Student- $t$  distributed with  $N-1$  degrees of freedom. \*\*\* and \*\* denote significance at the 1% and at the 5% level, respectively.

	Announcement day		Next trading day	
	$\lambda_{i,j}^{rob}$	<i>t</i> -statistics	$\lambda_{i,j}^{rob}$	<i>t</i> -statistics
Greece	0.00	0.04	0.01	1.47
Spain	-0.10***	-5.84	-0.01	-0.40
Italy	-0.02	-0.48	-0.16***	-5.48
Portugal	0.16***	3.63	0.27***	6.23
Ireland	0.12***	2.91	-0.07	-1.30
ECB	-0.16***	-5.80	0.15***	7.87
Rating agencies	0.08**	2.42	-0.10***	-2.98

**Table 5. Estimated parameters of the robust model**

This table reports the point estimates from the models (2) and (5):

$$r_{i,t} = D_t^{pre} \mu_{pre} + D_t^{cri} \mu_{cri} + \phi D_t^{cri} \Delta VStoxx + \lambda_{i,j}^{rob} D_{j,t} + \sigma_{i,t} e_{i,t} \text{ and } \ln(\sigma_{i,t+1}^2) = \alpha_{0,i} + \alpha_{1,i} [|e_{i,t}| - \gamma_i e_{i,t}] + \beta_i \ln(\sigma_{i,t}^2),$$

where  $D_t^{pre}$  is a binary dummy variable taking the value 1 during the days of the pre-crisis period (September 21, 2004 – October 14, 2009), and 0 otherwise,  $D_t^{cri}$  is a dummy variable taking the value 1 during the days of the sovereign debt crisis period from October 14, 2009 - November 23, 2012, and 0 otherwise.  $\phi$  represents the effect of VStoxx index returns changes on the euro foreign exchange rate return with respect to currency  $i$  during the crisis period.  $\lambda_{i,j}^{rob}$  is the abnormal event  $j$  effect on the euro foreign exchange rate return, where *rob* stands for robust. Respectively in the volatility equation (2),  $\alpha_{0,i}$  denotes a constant,  $\alpha_{1,i}$  represents the impact of the previous period positive returns,  $\gamma_i$  captures the leverage effect or the impact of the previous period negative returns on today's variance, and  $\beta_i$  accounts for the impact of the previous period volatility on the volatility of today. The number of stars shows the significance level of a parameter obtained by two tailed Student's  $t$ -test with T-1 degrees of freedom: \*\*\* 1% level of significance, \*\* 5% level of significance, \* 10% level of significance.

Currency	$\beta$	$\alpha_1$	$\gamma$	$\phi$
Argentine peso	0.98***	0.14***	-0.04	-0.34***
Australian dollar	0.98***	0.16***	-0.30***	0.20***
Brazilian real	0.96***	0.28***	-0.27***	0.03
Canadian dollar	0.99***	0.10***	0.01***	0.02
Swiss franc	0.99***	0.28***	0.14	-0.02
Chinese yuan renminbi	0.99***	0.08***	-0.01	-0.32***
Czech koruna	0.98***	0.16***	0.14	0.11***
Danish krone	0.95***	0.24***	-0.09	0.00*
Algerian dinar	0.95***	0.17**	-0.22	-0.27***
UK pound sterling	0.99***	0.11***	-0.26*	-0.14***
Hong Kong dollar	0.99***	0.08***	0.02	-0.33***
Croatian kuna	0.98***	0.15***	-0.16	0.01
Hungarian forint	0.99***	0.13***	-0.53***	0.32***
Indonesian rupiah	0.98***	0.15**	-0.16	-0.17
Israeli shekel	0.99***	0.12***	0.10	-0.09***
Indian rupee	0.99***	0.09***	-0.12	-0.07*
Japanese yen	0.99***	0.13***	0.31***	-0.50***
Korean won	0.99***	0.20***	-0.12	-0.02
Latvian lats	0.88***	0.36**	-0.07	0.00
Moroccan dirham	0.87***	0.44***	-0.11	-0.06***
Mexican peso	0.97***	0.20***	-0.30***	0.09**
Malaysian ringgit	0.99***	0.08***	-0.01	-0.10***
Norwegian krone	0.98***	0.16***	-0.29**	0.11***
New Zealand dollar	0.99***	0.12**	-0.10	0.18***
Philippine peso	0.99***	0.11	-0.12	-0.14***
Polish zloty	0.98***	0.16***	-0.34***	0.30***
Romanian leu	0.95***	0.39***	0.03	0.04***
Russian rouble	0.97***	0.22***	-0.28***	0.00
Swedish krona	0.99***	0.16***	-0.27***	0.15***
Singapore dollar	0.99***	0.08***	0.00	-0.10***
Thai bhat	0.99***	0.14***	0.07	-0.22***
Turkish lira	0.97***	0.22***	-0.37***	0.04
New Taiwan dollar	0.99***	0.07***	0.03	-0.24***
U.S. dollar	0.99***	0.08***	0.01	-0.34***
South African rand	0.94***	0.22***	-0.53***	0.18***

**Table 6. Estimated parameters of the skewness dynamics**

This table reports estimates from model (10):

$$s_{i,t+1} = a_i + c_i s_{i,t} + b_i (\varepsilon_{i,t} - d_i)^3 + h_{i,j} D_{j,t} \varepsilon_{i,t}^3,$$

where  $s_{i,t}$  and  $s_{i,t+1}$  represent skewness at time  $t$  and at time  $t+1$  of the euro foreign exchange rate returns with respect to currency  $i$ ,  $\varepsilon_{i,t}$  is an error term and  $D_{j,t}$  is a dummy variable equal to 1 on the day of  $j$  event happening, and 0 otherwise. Respectively,  $a_i$ ,  $b_i$ ,  $c_i$ ,  $d_i$  and  $h_{i,j}$  are parameters to be estimated. Here  $a_i$  is a constant,  $c_i$  shows the impact of previous period skewness (autoregressive component), and  $h_{i,j}$  stands for an abnormal currency  $i$  and event  $j$  effect on  $s_{i,t+1}$ . The parameters  $b_i$  and  $d_i$  measure the news effect on skewness. The number of stars shows the significance level of a parameter obtained by two tailed Student's  $t$ -test with T-1 degrees of freedom: \*\*\* 1% level of significance, \*\* 5% level of significance, \* 10% level of significance.

Currency	$a$	$b$	$c$	$d$
Argentine peso	-0.005***	-0.005*	0.451**	0.137***
Australian dollar	0.036***	-0.005***	0.492***	0.019***
Brazilian real	-0.008**	0.008***	0.413***	0.130***
Canadian dollar	-0.001*	0.007**	0.493*	-0.229*
Swiss franc	-0.042***	-0.002***	0.350***	1.289***
Chinese yuan renminbi	-0.004*	-0.005**	0.541***	0.051*
Czech koruna	-0.001	0.003*	0.456*	0.329
Danish krone	0.008**	0.001**	0.397*	0.006
Algerian dinar	-0.008	-0.014***	0.525***	0.274***
UK pound sterling	0.004	0.005***	0.489**	-0.704***
Hong Kong dollar	-0.015**	-0.005*	0.467**	0.228***
Croatian kuna	0.013	0.000	0.591*	0.025
Hungarian forint	-0.019***	0.004	0.411**	0.138
Indonesian rupiah	-0.017**	-0.005***	0.815***	0.605**
Israeli shekel	-0.028	0.000	0.968***	1.334
Indian rupee	-0.021**	0.001***	0.502*	-0.312
Japanese yen	-0.104***	-0.003**	0.532***	-0.039***
Korean won	-0.108**	0.000	0.472**	-1.142***
Latvian lats	0.077**	-0.005***	0.412*	-0.597
Moroccan dirham	0.031*	-0.011*	0.598*	-0.377*
Mexican peso	0.023***	-0.013***	0.660***	-0.192***
Malaysian ringgit	-0.002	-0.003	0.777***	-0.067
Norwegian krone	0.062***	0.002**	0.384***	0.088***
New Zealand dollar	0.005**	-0.005***	0.951***	0.083
Philippine peso	0.002	-0.002	0.980***	-0.438
Polish zloty	-0.018	0.007*	0.423*	0.144
Romanian leu	0.053***	-0.005***	0.437***	-0.024
Russian rouble	0.023**	-0.003**	0.789***	-0.489*
Swedish krona	0.008**	-0.002*	0.617***	1.528**
Singapore dollar	-0.002**	-0.003***	0.871***	-0.073
Thai bhat	0.005**	0.001	0.250**	0.275
Turkish lira	0.071***	-0.005***	0.401**	-0.018**
New Taiwan dollar	-0.028***	-0.006**	0.523**	0.184**
U.S. dollar	-0.013***	-0.004***	0.477***	0.210***
South African rand	-0.016***	-0.003***	0.418***	0.158

**Table 7. Abnormal announcement effect on skewness (crash risk)**

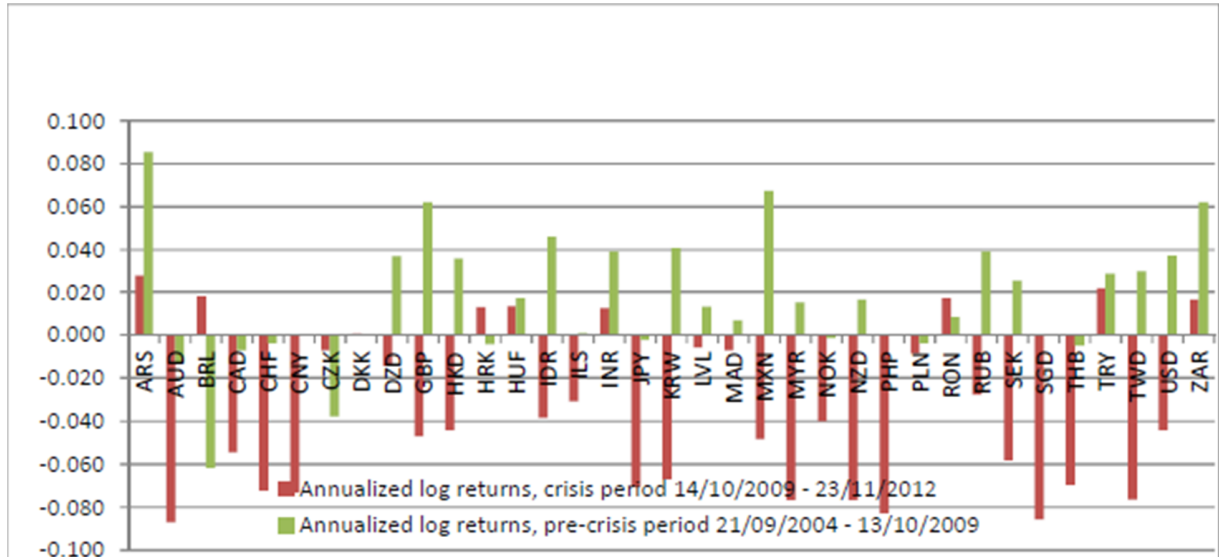
This table reports point estimates from model (10):

$$s_{i,t+1} = a_i + c_i s_{i,t} + b_i (\varepsilon_{i,t} - d_i)^3 + h_{i,j} D_{j,t} \varepsilon_{i,t}^3,$$

where  $s_{i,t}$  and  $s_{i,t+1}$  represent skewness at time  $t$  and at time  $t+1$  of the euro foreign exchange rate returns with respect to currency  $i$ ,  $\varepsilon_{i,t}$  is an error term, and  $D_{j,t}$  is a dummy variable equal to 1 on the day of  $j$  event happening, and 0 otherwise. Respectively,  $a_i$ ,  $b_i$ ,  $c_i$ ,  $d_i$  and  $h_{i,j}$  are parameters to be estimated. Here  $a_i$  is a constant,  $c_i$  shows the impact of previous period skewness (autoregressive component), and  $h_{i,j}$  stands for an abnormal event  $j$  effect on  $s_{i,t+1}$ . The parameters  $b_i$  and  $d_i$  measure news effect on skewness. The number of stars shows the significance level of a parameter obtained by two tailed Student's  $t$ -test with T-1 degrees of freedom: \*\*\* 1% level of significance, \*\* 5% level of significance, \* 10% level of significance.

	Announcement day		Next trading day	
	$h$	$t$ -statistics	$h$	$t$ -statistics
Greece	0.02***	2.31	0.03***	3.67
Spain	0.04*	1.83	-0.01	-0.48
Italy	-0.04	-1.53	0.01	0.12
Portugal	-0.06	-1.08	0.10	1.48
Ireland	-0.09	-1.11	0.15***	3.41
ECB	-0.02	-0.91	0.01	0.54
Downgrade	0.02	1.20	0.10**	2.22

**Figure 1. Comparison of annualized log returns**



This figure plots the logarithmic annualized euro foreign exchange rate returns in the pre-crisis period (September 21, 2004 – October 14, 2009) and during the sovereign debt crisis period (October 14, 2009 - November 23, 2012). The breakpoint between the pre-crisis and the crisis period is considered to be mid-October when after political changes in Greece the real situation of countries finances started to unfold. We take the daily euro FX reference rates from the website of the ECB Statistical Data Warehouse: <http://sdw.ecb.europa.eu/browse.do?node=2018794>

## Appendix: Events

The table lists European sovereign debt crisis news announcements from September 21, 2009 till November 23, 2012 divided into 7 categories: Spain (45), Italy (17), Ireland (7), Greece (84), the European Central Bank (27) and the rating agencies (24). Events are assigned to one or several categories based on the content. For example, the downgrade of Greece's sovereign debt to BB+ by Fitch Ratings on January 14, 2011, is assigned to two categories: rating agencies and Greece.

Source: CFA Institute (<http://blogs.cfainstitute.org/investor/2011/11/21/european-sovereign-debt-crisis-overview-analysis-and-timeline-of-major-events/>)

<b>Spain</b>	
Date	Event
2010.01.29	Spain announces austerity measures designed to save the nation €50 billion by cutting government spending by 4% of GDP and cutting government employees' pay by 4%.
2010.04.28	Standard & Poor's downgrades Spain's sovereign credit rating from AAA to AA-.
2010.05.27	Spain's parliament approves a €15 billion austerity package. The measure passes by one vote.
2010.05.29	Fitch Ratings downgrades Spain's sovereign credit rating from AAA to AA+.
2011.10.07	Fitch Ratings cuts the sovereign debt rating of Italy from AA- to A+; it also cuts the sovereign debt rating of Spain to AA- from AA+.
2011.10.13	Standard & Poor's cuts the sovereign debt rating of Spain to AA- from AA, outlook negative.
2011.11.20	With yields on Spanish sovereign debt hitting highs, the center-right opposition People's party (PP) of Mariano Rajoy wins Spain's general election. The country's Socialist prime minister is the third leader within a two-week period to be felled by economic malaise and the Eurozone crisis.
2011.12.12	Italian and Spanish bond yields rise, which many see as a vote of low confidence on the long-term efficacy of Eurozone measures agreed to on December 9.
2011.12.19	Bad debt ratio (i.e., loans at least 3-months in arrears) for Spain's banking sector reaches 7.42% or €131.9 billion. That is equivalent to 13% of Spain's gross domestic product.
2011.12.20	Spain sells 5.64 billion of three- and six-month treasuries at an average yield of 1.735%, down from the previous sale's 5.11% on 22 November. Most credit the ECB's move to provide banks with three-year loans for the increased investor confidence.
2012.01.06	Italian debt costs jump again as 10-year bond yields rise to 7.12%, necessitating the ECB to step in to markets to buy Italian and Spanish debt to help keep a lid on yields.
2012.01.12	Spain sells €9.98 billion of 3-year treasury notes at an average yield of 3.384%, down from 5.187% at the previous December 1 auction.
2012.03.02	Spanish Prime Minister Mariano Rajoy announces that Spain will violate its budget target for the year. The announcement is in contravention to the recently agreed to fiscal compact.
2012.03.13	Spain bows to pressure from EU finance ministers and agrees to make bigger budget cuts than originally intended on March 2, 2012.
2012.03.16	Spain's central bank announces that the nation's debt has hit 68.5% of GDP — the highest level since 1990.
2012.03.29	Strikes spread throughout Spain in protest to increased austerity measures insisted upon by Eurozone leaders.
2012.04.01	A number of large European banks that received funds in the ECB's Long-Term Refinancing Operation (LTRO) announce that they are returning large portions of the inexpensive three-year funding they received. Banks include Italy's UniCredit, France's BNP Paribas and Société Générale, and Spain's La Caixa.
2012.04.05	An IMF official, Gerry Rice, states that Spain faces "severe" challenges. He highlights the poor grip Spain has on its regions' indebtedness and growing borrowing needs and commensurate interest cost increases.
2012.04.09	Spain states that it will cut €10 billion in spending on education and on health.
2012.04.11	Mariano Rajoy states that Spain's future is on the line in its efforts to tame rising debt yields.

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2012.04.16	Spain warns its regions that it may seize control of their finances in order to help shore up ailing finances.
2012.04.24	Budget plan in Spain is passed with the toughest austerity measures since the Franco dictatorship.
2012.04.27	Standard & Poor's downgrades Spain two notches to BBB+ because of increased severity of its recession.
2012.05.11	Spain announces that it will force banks to increase provisions against €123 billion of real estate loans by about €30 billion. The increased provision raises coverage from 7% to 30%. The nation also announces that it will hire two auditors to value banks' assets in a fourth attempt to clean up its banking industry. Spain also says that it will provide funds to those institutions that need support of up to €15 billion and without increasing the budget deficit.
2012.05.24	Spanish Prime Minister Mariano Rajoy called on the ECB to act to bring down rising borrowing costs after Spanish bond yields approached the levels that pushed Greece, Ireland, and Portugal into bailouts.
2012.05.28	Spain moves to bail out its third largest bank, Bankia, with a €19 billion infusion. This effectively nationalizes the bank.
2012.05.30	The ECB declares it is opposed to Spain's bailout of Bankia.
2012.05.30	Spain says that it will pay for the bailout of Bankia by issuing treasury bonds. The news sends Spanish CDS soaring.
2012.06.07	Spain's credit rating is lowered three notches by Fitch from A to BBB.
2012.06.09	Spain becomes the fourth European nation to seek a bailout asking the EU for up to €100 billion in aid for its banking sector. Exact numbers are to be determined once the audit is announced.
2012.06.18	Data released by Spain's central bank show that bad debts held by the nation's banks rose to 18-year high.
2012.06.20	Spain's budget minister, Cristobal Montoro, announces that his nation does not need a bailout from the EU.
2012.06.25	Spain formally requests €100 billion in aid for its banks from the euro group — details about the plan are scant. Moody's downgrades 28 of the 33 banks in its coverage universe.
2012.07.10	Eurozone finance ministers agree to a plan for Spain's €100 billion bank bailout plan. It is expected that the first €30 billion will be delivered by the end of July.
2012.08.07	Spain's national statistics institute (INE) announces that number of companies operating in the country is at a five year low. Not surprisingly, the industries with largest losses are tied to real estate and construction.
2012.08.28	Catalonia becomes the third Spanish region to ask the nation's central government for a €5 billion bailout. The region faces €5.6 billion of further bond maturities in 2012.
2012.08.30	Germany's Association of German Chambers of Industry and Commerce (DIHK) reports that labor costs in Greece, Ireland, and Spain have dropped. Further, the countries are reported to be lowering their trade imbalances.
2012.09.03	Spaniards withdrew a record €75 billion from Spanish banks in July; an amount equal to 7% of GDP.
2012.09.10	The European Commission (i.e., its antitrust authority) approves Spain's state aid of the BFA banking group, the parent of troubled Bankia SA. Bankia is at the forefront of the Spanish banking crisis.
2012.09.24	To help bail out its regional governments Spain proposes selling €6 billion of bonds through the state-run lottery operator, Sociedad Estatal Loterías & Apuestas del Estado SA.
2012.09.25	Spanish protests number 6,000 in Madrid and are broken up by police using rubber bullets.
2012.09.27	Details of the latest proposed Spanish austerity measures are announced. Among them are: a 12% average cut in ministerial spending; a freeze on public sector pay; establishment of a public spending auditor; and a "cash for clunker cars" program.
2012.10.01	Bailing out its banks will widen the budget deficit of the Spanish government and increase its debt load, too.
2012.10.01	Unemployment in the Eurozone reaches an all-time high of 18.2 million according to Eurostat. For those under 25 in Spain, it is 52.9%.
2012.10.02	Spain's regional governments agree to budget deficit targets set by the central government. It is hoped that the agreement will allow the Spanish government to negotiate in good faith with the nation's creditors and prospective bail out arbiters.
2012.10.10	Spain credit rating cut by S&P to BBB-
2012.10.23	Spain's economy shrinks again, by 0.4% in the second quarter 2012.

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### Italy

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2010.05.25	Italy agrees to a fiscal austerity package worth €25 billion designed to reduce its budget deficit to 2.7% by 2012 from 5.3% in 2009.
2010.06.25	Protests in Italy lead to the Italian government reducing the size of its €25 billion austerity package, which was announced May 25, 2010
2010.07.29	Italy's austerity package of €25 billion, announced on May 25, 2010, passes lower house of parliament.
2011.07.15	Italy's parliament agrees to its first austerity package.
2011.09.14	Italy's parliament agrees to its second austerity package to try to save €124 billion.
2011.09.18	Standard & Poor's downgrades its credit ratings of 24 Italian banks, 7 of which are major institutions.
2011.09.19	Standard & Poor's downgrades Italy's sovereign debt rating from A+ to A-, outlook negative.
2011.10.07	Fitch Ratings cuts the sovereign debt rating of Italy from AA- to A+; it also cuts the sovereign debt rating of Spain to AA- from AA+.
2011.11.12	Italian Prime Minister Silvio Berlusconi resigns his post clearing the way for a new government headed by the new prime minister, Mario Monti, a former EU commissioner. The hope is that Monti's new government will help to restore investor confidence in Italy's ability to resolve its sovereign debt crisis.
2011.12.12	Italian and Spanish bond yields rise, which many see as a vote of low confidence on the long-term efficacy of Eurozone measures agreed to on December 9.
2011.12.14	Italian debt yields hit 6.47% from 6.29% in the latest auction of 5-year bonds.
2011.12.16	Prime Minister of Italy, Mario Monti, wins wide Chamber of Deputies support (402 vs. 75) for his emergency austerity budget of €30 billion.
2011.12.30	Italy sees funding costs remain stubbornly high as it sells 10-year bonds at 6.98%, barely below the 7% threshold that many consider the dividing line between solvency and insolvency; all within the context of the €30 billion austerity package announced 16 December.
2012.01.06	Italian debt costs jump again as 10-year bond yields rise to 7.12%, necessitating the ECB to step in to markets to buy Italian and Spanish debt to help keep a lid on yields.
2012.01.12	To the relief of many investors, Italy sells €12 billion of bills at a rate of 2.735% down from 5.952% at its most recent auction.
2012.04.01	A number of large European banks that received funds in the ECB's LTRO announce that they are returning large portions of the inexpensive three-year funding they received. Banks include Italy's UniCredit, France's BNP Paribas and Société Générale, and Spain's La Caixa.
2012.05.15	Eurostat reports that the Eurozone economy grew at 0.1% in the first quarter 2012 as compared to the fourth quarter 2011. However, there is a growing divide between the "haves" and "have-nots" with the German economy growing 0.5%, while Italy's contracts by 0.8%.

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### Portugal

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2010.04.27	Standard & Poor's downgrades the sovereign debt of Portugal by two notches.
2010.05.13	Portugal's government announces plans to step up its budget deficit reduction.
2010.07.13	Moody's cuts the sovereign debt rating of Portugal to A1.
2011.05.17	Portugal agrees with the other Eurozone members and the IMF to a €78 billion bailout package.
2012.06.04	Portugal indicates that it will inject €6.6 billion into its largest banks. Monies are to come from the €12 billion earmarked for bank bailouts in last year's EU-IMF bailout program.
2012.10.03	Portugal's debt agency, IGCP, is able to exchange €3.76 billion of debt maturing in 2013 for debt maturing in 2015, reducing the upcoming refinancing risk of the country.
2012.10.05	Germany's parliamentary budget committee approves Portugal's next debt tranche.
2012.10.16	Portugal announces its 2013 budget. It includes a raise in the average tax rate from 9.8% to 13.2%, as well as additional spending cuts.

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### Ireland

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2009.12.09	Ireland announces a fiscal plan that will provide savings of €4 billion, in part by raising the public pension
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	retirement age from 65 to 66 years.
2010.08.24	Standard & Poor's cuts the sovereign debt rating of Ireland to AA-.
2010.11.13	Irish debts sell off as anxiety about an Irish sovereign debt interest payment holiday grips bondholders, sending the credit spread of Ireland's 10-year bond to 652 basis points (i.e., 6.52%) over a German bond of comparable maturity.
2010.11.16	Ireland begins talks with Eurozone nations about a bailout.
2010.11.28	Ireland agrees with the other Eurozone members and the IMF to a €85 billion bailout package.
2012.08.30	Germany's DIHK reports that labor costs in Greece, Ireland, and Spain have dropped. Further, the countries are reported to be lowering their trade imbalances.
2012.09.06	The IMF approves a new €920 million tranche for Ireland, the latest in financial aid that started in 2010.

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### Greece

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2009.10.04	Panhellenic Socialist Movement (PASOK) wins general election.
2009.10.06	George Papandreou is sworn as prime minister.
2009.11.05	New Greek Prime Minister, George Papandreou, announces that Greece's annual budget deficit will be 12.7% of GDP — more than twice the previously announced figure.
2009.12.08	Fitch Ratings cuts Greece's sovereign credit rating to BBB+ from A-. The outlook is "negative."
2009.12.14	Papandreou outlines the details of his government's first austerity package.
2009.12.16	Standard & Poor's cuts Greece's sovereign credit rating to BBB+ from A-.
2009.12.22	Moody's cuts Greece's sovereign credit rating to A2 from A1.
2010.01.14	Greece announces its Stability and Growth Program, which is designed to cut the country's budget deficit from 12.7% in 2009 to 2.8% by 2012. This would bring the deficit into alignment with the convergence criteria outlined in the Maastricht Treaty.
2010.02.02	Greece's federal government freezes the wages of public employees earning less than €2,000 per month.
2010.02.03	The European Commission endorses Greece's Stability and Growth Program and urges the nation to reduce its overall wage costs.
2010.02.09	Greece puts in place its first austerity package.
2010.03.05	Greece puts in place its second austerity package, which is designed to save €4.8 billion.
2010.03.15	Finance ministers of the EMU countries agree to help Greece but provide no details.
2010.03.18	Papandreou warns that borrowing costs are too high, putting pressure on the deficit and increasing the likelihood of a bailout from the IMF.
2010.04.09	Greece announces a reduction in debt of 39.2%
2010.04.11	EMU leaders agree to a bailout plan for Greece.
2010.04.13	ECB voices its support for the Greek rescue plan announced by the EMU on 11 April.
2010.04.22	Eurostat, the EU's statistical agency, announces that Greece's 2009 budget deficit was 13.6% of GDP, not the previously reported 12.7%.
2010.04.23	Greece realizes that its austerity packages are not enough to save itself fiscally and asks for a bailout from the Eurozone and the IMF.
2010.04.27	Standard & Poor's downgrades Greece's sovereign credit rating below investment-grade status.
2010.05.01	Greece proposes its third austerity package.
2010.05.02	Greece, the Eurozone nations, and the IMF agree to a €110 billion bailout plan. Eurozone nations will provide €80 billion and the IMF €30 billion.
2010.05.03	ECB announces that it will accept Greek sovereign debt as collateral no matter the country's rating.
2010.05.04	Greece's third austerity package is put to parliament for a vote.
2010.05.06	Spreading anxiety about the Eurozone's inability to stem the Greek sovereign debt crisis sends financial markets across the world sharply down.
2010.05.24	Greece announces that it has reduced its federal budget deficit by 41.5% in the first four months of 2010.
2010.06.14	Moody's cuts the sovereign debt rating of Greece to Ba1, junk status.

2010.06.15 ECB announces that it will apply a 5% surcharge to Greek debt offered to it as collateral to account for Greece's credit downgrade.

2010.06.24 The cost of CDS to insure Greek debt hits a record; it now costs €958,000 to insure €10 million worth of Greek sovereign debt.

2010.06.29-30 Greece's parliament approves, in separate votes, its third austerity package.

2010.07.05 Greece's central bank, Bank of Greece, announces a reduction in the nation's deficit of 41.8% for the first six months of 2010.

2010.08.05 The so-called troika of Eurozone finance ministers — the IMF, ECB, and EU — applaud the austerity measures undertaken by Greece, endorsing an additional €9 billion payment to Greece.

2010.09.05 Credit spreads on Greek debt widen to around 800 basis points (i.e., 8.0%).

2010.09.07 Members of the Eurozone approve a second tranche of bailout monies for Greece amounting to €6.5 billion.

2010.09.11 The IMF approves a second tranche of bailout monies for Greece amounting to €2.6 billion.

2011.01.14 Fitch Ratings downgrades Greek sovereign debt to BB+, or junk status.

2011.05.02 Greek finance minister, George Papaconstantinou, rules out restructuring Greece's debt and expresses hope that the Eurozone nations and the IMF will extend loan payments under the bailout package.

2011.05.21 Papandreou and senior officials from the ECB agree that Greece must avoid restructuring its debt to resolve the crisis. Both parties emphasize that fiscal austerity for Greece is the way to resolve the crisis.

2011.05.23 Greece unveils its intent to privatize certain industries in an attempt to raise €50 billion to pay down its sovereign debt.

2011.06.09 German finance minister, Wolfgang Schäuble, in an open letter to the European and international communities states, "Any additional financial support for Greece has to involve a fair burden of sharing between taxpayers and private investors."

2011.06.11 Head of the Eurozone finance ministers, Jean-Claude Juncker, backs Germany's proposal for a "soft restructuring" of Greek debt. Additionally, he says that any contribution from private creditors be "voluntary."

2011.06.17 Merkel and French President Nicolas Sarkozy agree that private creditors of Greek debt will have a voluntary role in resolving the Greek debt crisis. This is a reversal from earlier, stronger statements, in which both leaders were strongly in favor of private creditors taking substantial losses on the value of their Greek sovereign debt.

2011.06.29 Greece's parliament agrees to the terms of the fourth austerity package.

2011.10.27 Members of the Eurozone agree on a new plan to resolve the European sovereign debt crisis. Important provisions include: asking holders of Greek debt to cut the value of their holdings by 50%; increasing the tier 1 capital of European banks to 9% (approximately €106 billion); and leveraging the capacity of the EFSF up to €1 trillion.

2011.10.31 Papandreou shocks the world by calling for a Greek referendum vote on the new Eurozone bailout proposal.

2011.11.03 Papandreou backs down from his referendum request after members of his own political party desert him in parliament.

2011.11.05 Papandreou's ruling parliamentary party narrowly wins a vote of confidence.

2011.11.06 Papandreou works with other Greek politicians to negotiate his resignation.

2011.11.11 The new Greek prime minister, Lucas Papademos, is sworn in along with a new coalition government.

2012.01.20 Negotiators come to initial terms with private investors about a write-down of Greek sovereign debt, though details are scarce.

2012.01.22 Discussions between Greece and its creditors snag over a disagreement in the level of interest rates to be assigned to new debt issued in exchange for old sovereign debt.

2012.01.25 Defying private creditors the ECB insists that it will not agree to a write-down of its own Greek debt holdings.

2012.02.07 Greek Prime Minister Lucas Papademos announces his intention to convene his nation's leaders in order to gain consensus on budget cuts necessary to secure the next round of bailout funding from the Troika.

2012.02.07 ECB agrees to exchange its Greek bonds at a price below par value in an effort to achieve a deal between Greece and its creditors.

2012.02.09 Greece's leaders reach an accord over cuts to budgets, wages and pensions. Eurozone finance ministers insist that the agreement be put to a vote of the Greek parliament before additional bailout monies is paid to Greece.

2012.02.21 A new Greek debt deal is finally agreed to between Greece, its creditors and Eurozone finance ministers. Details of the plan include: current creditors agreeing to lose 53.5% of the face value of their debt to satisfy the IMF; the ECB and other European central banks take no loss on debt holdings with any profit made on the holdings transferred to Greece; a lower interest rate on new debts; and the oversight of a debt servicing account by official creditors. The next step is getting a large percentage of the debt holders to agree to the

- debt swap that will allow for new bailout monies to be given to Greece. Particularly controversial is the Greek legislature's retroactive change to debt covenants executed by passage of a new law called "collective action clauses." The new debt deal triggers fears about whether or not the agreement constitutes a default and thus massive payouts on CDS.
- 2012.02.24 Greece formally launches its debt swap plan for private creditors, the Private Sector Initiative (PSI). The Finance Ministry needs at least 90% of the face amount of the bonds to participate in the deal for it to proceed without it constituting a default event. However, a separate threshold of 75% tendered is also thought to be acceptable under an agreement with private sector creditors. It is uncertain what recourse creditors who do not tender their bonds will have under this alternate plan.
- 2012.02.25 Organization for Economic Cooperating and Development (OECD) figures show that Greeks, contrary to popular opinion, actually work the most number of hours in Europe. However, Greece is also amongst the least productive nations in the survey.
- 2012.02.28 ECB announces that Greek sovereign debt can no longer be used as collateral.
- 2012.02.28 Standard and Poor's (S&P) announces that it considers Greece to be in default on its sovereign debt obligations.
- 2012.02.28 Much attention is paid to the International Swaps and Derivative Association's (ISDA) discussions about whether or not the Greek debt restructuring plan will constitute a default event.
- 2012.03.01 The ISDA declares that the recent Greek debt restructuring does not constitute a default event.
- 2012.03.09 Greece closes a €200 billion (\$266 billion) restructuring deal with its creditors. The ISDA declares that the restructuring does constitute a credit event and that there will be payouts to holders of CDS.
- 2012.03.14 Eurozone governments agree to a second bailout program for Greece in the amount of €130 billion (\$169 billion) in conjunction with funds from the IMF.
- 2012.03.16 IMF formally approves its share of bailout funds for Greece: €28 billion.
- 2012.03.20 Greece formally votes to accept its second round of bailout funds: 213 for the bailout, 79 opposed, and 8 abstaining.
- 2012.03.30 Greece states that it may need a third bailout.
- 2012.04.12 Greece's unemployment rate rose to 21.8% in January.
- 2012.05.01 Thousands protest austerity measures in Greek May Day rally.
- 2012.05.05 Greek parliamentary elections usher in new parties mostly opposed to austerity deals negotiated with the Troika. Many begin to fear a Greek exit from the Eurozone.
- 2012.05.07 Discussions about forming a new coalition government in Greece break down.
- 2012.05.15 Greece agrees to repay in full a €435 million bond after declaring earlier in the year that it would default on any investors that did not participate in its €206 billion debt swap.
- 2012.05.16 It is reported that on 14 May Greek depositors withdrew €700 million from banks sparking fears of a bank run.
- 2012.05.17 Greece swears in its caretaker government and parliament before runoff elections can be held in June.
- 2012.05.17 The ECB says that it will stop lending to some banks in Greece to limit its risk exposure to the troubled country.
- 2012.05.18 Greece's radical left party head, Alexis Tsipras, says that if Europe cuts off funding that Greece will stop paying its debts.
- 2012.06.17 Greece holds its runoff elections with New Democracy leader Antonis Samaras eking out a very slim victory over the socialist party's Alexis Tsipras. Coalition talks begin the next day.
- 2012.06.20 Greece forms a three-party coalition government composed of the New Democracy, Socialist, and Democratic Left parties. New Democracy leader, Antonis Samaras, is sworn in as Greek prime minister.
- 2012.06.26 Greece appoints a new finance minister, Yannis Stournaras, an economics professor.
- 2012.07.05 Greece's new finance minister admits that the country is off track in its debt-reduction plans.
- 2012.07.17 Greece seeks extra money from creditors to cover a €3.1 billion bond redemption maturing 20 August.
- 2012.07.18 Agreement is reached by the Greek coalition government on austerity measures of €11.5 billion.
- 2012.07.27 EU regulators agree to €18 billion in aid for four Greek banks: Alpha Bank AE, EFG Eurobank Ergasias SA, Piraeus Bank SA, and National Bank of Greece SA.
- 2012.08.10 It is announced that Greek unemployment in the month of May hit a record of 23.1%. For under 25-year olds — the population most likely to engage in political protest — the rate hit a staggering 54.9%.
- 2012.08.22 Greek Prime Minister, Antonis Samaras, calls for more time to carry out policy measures designed to address his country's debt problems. These comments were made just prior to the arrival of Luxembourg Prime Minister Jean-Claude Juncker. Simultaneously, a study from the Irish central bank shows that Greece has undertaken the most severe austerity measures (as measured by tax hikes and spending cuts) in EU history.

2012.08.30	Germany's Association of German Chambers of Industry and Commerce (DIHK) reports that labor costs in Greece, Ireland, and Spain have dropped. Further, the countries are reported to be lowering their trade imbalances.
2012.09.07	Herman van Rompuy publicly declares that Greece's future is within the Eurozone. His comments are designed to quell speculation that the tiny nation is set to exit the Eurozone.
2012.09.18	Greece reports that its current account entered a surplus in July of €642 million; this is the first surplus since May 2010.
2012.09.26	Protests in Athens, Greece, erupt in violence, and tear gas is fired at the tens of thousands of protestors.
2012.10.01	The Greek government submits its 2013 budget draft. The plan outlines further austerity measures of around €8 billion designed to placate the nation's lenders.

### European Central Bank (ECB)

Date	Event
2010.03.25	The President of the ECB, Jean-Claude Trichet, extends less-restrictive collateral rules in order to prevent the possibility that one ratings agency determines whether a EMU country's bonds are eligible for use as ECB collateral.
2010.04.13	ECB voices its support for the Greek rescue plan announced by the EMU on 11 April.
2010.05.03	ECB announces that it will accept Greek sovereign debt as collateral no matter the country's rating.
2010.06.15	ECB announces that it will apply a 5% surcharge to Greek debt offered to it as collateral to account for Greece's credit downgrade.
2010.08.05	The so-called troika of Eurozone finance ministers — the IMF, ECB, and EU — applaud the austerity measures undertaken by Greece, endorsing an additional €9 billion payment to Greece.
2011.05.21	Papandreou and senior officials from the ECB agree that Greece must avoid restructuring its debt to resolve the crisis. Both parties emphasize that fiscal austerity for Greece is the way to resolve the crisis.
2011.06.18	Merkel agrees to work with the ECB to help resolve the Greek sovereign debt crisis. This is a reversal from her previous reticence.
2011.12.01	European Central Bank president Mario Draghi states that the ECB might be willing to expand its European bond purchase program if European governments implement greater fiscal controls.
2011.12.08	ECB President Mario Draghi states, "We shouldn't try to circumvent the spirit of the [Maastricht] treaty, no matter what the legal trick is," in response to calls for the ECB to do more to help mitigate the European Sovereign Debt Crisis.
2012.01.06	Italian debt costs jump again as 10-year bond yields rise to 7.12%, necessitating the ECB to step in to markets to buy Italian and Spanish debt to help keep a lid on yields.
2012.01.20	Bowing to demands made by the ECB President Mario Draghi, European Union members agree to return to spending discipline limits. The agreement does not include a provision requested by Germany that EU members build debt limits into their constitutions.
2012.01.25	Defying private creditors the ECB insists that it will not agree to a write-down of its own Greek debt holdings.
2012.02.07	ECB agrees to exchange its Greek bonds at a price below par value in an effort to achieve a deal between Greece and its creditors.
2012.02.28	ECB announces that Greek sovereign debt can no longer be used as collateral.
2012.02.29	ECB lends €529.5 billion of inexpensive three-year loans to 800 different lenders. These loans are in addition to €489.2 billion to 523 banks in late December 2012.
2012.02.29	Head of Germany's Bundesbank, Jens Weidmann, publicly criticizes the ECB's relaxation of collateral rules.
2012.03.09	ECB President Mario Draghi states that the central bank has done enough to combat the sovereign debt crisis, thus laying the ground work for exiting record low interest rates and economic stimulus.
2012.03.26	The ECB allows its member central banks to reject certain types of collateral being offered to them by financial institutions.
2012.05.17	The ECB says that it will stop lending to some banks in Greece to limit its risk exposure to the troubled country.
2012.05.30	The ECB declares it is opposed to Spain's bailout of Bankia.
2012.06.22	The ECB states that it will now accept some mortgage-backed securities, car loans, and loans to smaller firms in exchange for loans it gives to Eurozone banks. This is a significant relaxation of credit standards on the part of the ECB.
2012.07.03	In a reversal, the ECB tightens its lending rules for banks seeking capital via their low-cost loan program. Specifically, it caps at current levels the amount of government-guaranteed debt that banks can offer as

collateral.

2012.07.05	The ECB cuts interest rates to record lows; by 25 basis points to 0.75%.
2012.07.16	In a reversal, the ECB says that senior holders of Spanish bank debts will now have to accept losses. This position was initially telegraphed by ECB President Draghi on 9 July.
2012.07.23	Mario Draghi, president of the ECB, states that the euro is not in danger from a Eurozone breakup.
2012.08.02	ECB President Draghi says that the central bank is ready to buy bonds from troubled banks again.
2012.08.21	BdB German Banking Association announces that it wants the ECB to have sole regulatory responsibility for all euro-region banks. It recommends the creation of a legally independent body within the ECB to oversee bank supervision.
2012.08.28	It is reported, though not officially confirmed, that the ECB is pressuring the Basel Committee on Banking Supervision to relax the language of a drafted liquidity rule.

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### Credit Rating Agencies

Date	Event
2009.12.08	Fitch Ratings cuts Greece's sovereign credit rating to BBB+ from A-. The outlook is "negative."
2009.12.16	Standard & Poor's cuts Greece's sovereign credit rating to BBB+ from A-.
2009.12.22	Moody's cuts Greece's sovereign credit rating to A2 from A1.
2010.04.27	Standard & Poor's downgrades Greece's sovereign credit rating below investment-grade status. Standard & Poor's also downgrades the sovereign debt of Portugal by two notches.
2010.04.28	Standard & Poor's downgrades Spain's sovereign credit rating from AAA to AA-.
2010.05.29	Fitch Ratings downgrades Spain's sovereign credit rating from AAA to AA+.
2010.06.14	Moody's cuts the sovereign debt rating of Greece to Ba1, junk status.
2010.07.13	Moody's cuts the sovereign debt rating of Portugal to A1.
2010.08.24	Standard & Poor's cuts the sovereign debt rating of Ireland to AA-.
2011.01.14	Fitch Ratings downgrades Greek sovereign debt to BB+, or junk status.
2011.09.18	Standard & Poor's downgrades its credit ratings of 24 Italian banks, 7 of which are major institutions.
2011.09.19	Standard & Poor's downgrades Italy's sovereign debt rating from A+ to A-, outlook negative.
2011.10.07	Fitch Ratings cuts the sovereign debt rating of Italy from AA- to A+; it also cuts the sovereign debt rating of Spain to AA- from AA+.
2011.10.13	Standard & Poor's cuts the sovereign debt rating of Spain to AA- from AA, outlook negative.
2011.12.05	Standard & Poor's places the debt of 15 of the 17 Eurozone nations on credit watch: negative. This means that there is a 50:50 chance of a downgrade in the next 30 days.
2011.12.09	Moody's credit ratings agency downgrades of three major French banks — BNP Paribas, Crédit Agricole (down to Aa3), and Société Générale (to A1) — due to a lack of investor appetite for their debt.
2012.01.13	Standard & Poor's cuts the rating of nine Eurozone nations, including the AAA-rated nations of France and Austria. Furthermore, the ratings agency changes the outlook to "negative" for 13 Eurozone nations.
2012.01.16	Standard & Poor's downgrades the credit rating of the EFSF from AAA to Aa+. Deteriorating economics of the EFSF's contributors is stated as the reason for the downgrade.
2012.02.28	Standard and Poor's (S&P) announces that it considers Greece to be in default on its sovereign debt obligations.
2012.04.19	Denmark's largest banks fire Moody's Investors Service in rating the nation's debts due to the volatile nature of the ratings.
2012.04.27	Standard & Poor's downgrades Spain two notches to BBB+ because of the increased severity of its recession.
2012.06.07	Spain's credit rating is lowered three notches by Fitch from A to BBB.
2012.06.25	Spain formally requests €100 billion in aid for its banks from the Eurogroup — details about the plan are scant. Moody's downgrades 28 of the 33 banks in its coverage universe.
2012.10.10	Spain credit rating cut by S&P to BBB-

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