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REVIEW

Unpacking the impact of CRA's watch announcement on EU sovereign bond yields: empirical examination of *Ex Ante* and post ante effects of the CRAII regulation

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The study aims to analyze whether there is a correlation between credit rating agencies' (CRAs) watch announcements on EU sovereign bond yields and EU sovereign bond yields after the implementation of the CRA II Regulation. In theory, the role of rating agencies is to provide key information to investors regarding the risk associated with investing in sovereign bonds. However, it remains unclear whether CRAs influence EU sovereign bond yields. Sovereign bond yields are collected for Austria, Germany, Belgium, Finland, France, the Netherlands, Ireland, Italy, Spain, and Portugal. These countries' samples represent the empirical analysis of our study. Data used for this analysis include information on European sovereign bond yields, credit watch announcements from Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings, and interest rate volatility are all extrapolated from the Bloomberg database. European sovereign bond yields are collected from 1940 to 2015. Our study conducted multiple linear regression tests to determine whether there is evidence that a change in yield is determined by a watch announcement made by the big three credit rating agencies before and after the introduction of the CRA II Regulation and hence, whether CRAs do influence yields with their watch announcements. According to the *F*-test and *p*-value results, the study of sovereign bonds with 10 and 5-year maturities shows statistical significance in both situations at 95 and 99% confidence levels. With 0 for all regression analyses, interest rate volatility is also statistically significant.

Keywords: credit rating agencies, sovereign bond yields, contagion effect, risk, sovereign debt

1. Introduction

By the highest ratings to dangerous financial instruments during the U.S. subprime mortgage crisis, the key companies in the credit rating sector Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings significantly contributed to the collapse of capital markets. As the real estate bubble collapsed and the crisis spread into a global recession, European economies were battered. Credit rating agencies (CRAs) downgraded governments, and yields on sovereign bonds rose to a record high. Governments could no longer meet their debt obligations, which subsequently led to the intervention of the European Union (EU). Following those events, the EU introduced several regulations to prevent future crises. As CRAs played a major role in the development of the financial crisis, the EU introduced the CRA II Regulation for making credit rating agencies less influential to investors.

The role of CRAs as gatekeepers of the debt market has triggered a plethora of research interests in the past, and in particular, rating agencies were under the spotlight during the global financial meltdown due to their failure to properly rate financial products (1). Further studies (2–4) have attempted to examine CRAs' rating actions on economies and financial markets, raising some concern about how ratings

are conducted. In Europe, the sovereign rating actions have been consistent and insightful because of the influence of the "sovereign ceiling." However, sovereign rating and sovereign ceiling are interrelated because sovereign rating addressed the likelihood of how the government will commit to its debt obligations, whereas the later indicates the possible tendency of the government to interfere with the private sector debt service. Historically, the CRAs have come under intense scrutiny and regulatory debate about whether their rating actions do have the propensity to increase the dynamics of crises. Research critics have continuously viewed that CRAs tend to assign inflated ratings (5). This means that the CRAs assess the possible probability that will result in issuers defaulting on bonds. Kraussl (6) conducted a rigorous event study whereby he focused on the emerging market during the Asian financial meltdown of 1997–1998. His study aimed to evaluate the extent and impact of sovereign credit ratings on these economies. In his findings, he concluded that the regression results showed that CRAs have a significant influence on "the size and volatility" when it comes to lending within emerging markets. Evidently, Kraussl (6) also showed within his empirical findings that results were far much stronger when it comes to government downgrades.

It is paramount to note that the risk assessment conducted and assigned by CRAs under the directive of individual central governments has increased significantly, which means investor uncertainty is greatly reduced due to risk exposure. Thus, CRAs have brought the contagion risk to the fore.

In our study, we attempt to analyze whether there is a relationship between CRAs' watch announcements on EU sovereign bond yields and EU sovereign bond yields after the implementation of CRA II Regulation credit rating watch announcement effects on EU sovereign bond yields before *(ex ante*) and after (*post-ante*) the CRA II Regulation. In our study, we focus on the CRA II Regulation, as this was the first regulation implemented in the EU for supervising and regulating CRAs uniformly on a European-wide level.

Furthermore, the issue of sovereign credit ratings has enabled a significant number of national governments to access the international bond markets, even though a number of these governments have historically suffered from debt defaults, which subsequently led to downgrading.

In Europe, during the sovereign debt crisis, the rating agencies' actions spotlighted the potential for spillover effects or broadly termed contagion. Caselli et al. (7) contend that because of their current holdings of sovereign debt, collateral, and implicit government guarantees, banks are significantly impacted by sovereign rating actions both domestically and globally.

The following empirical research seeks to quantify the degree to which the main three credit rating agencies continue to influence European sovereign bond yields following the implementation of the CRA II Regulation. The key focus here is the *impact* and *influence* of credit watch announcements on foreign currency in the *long term*. For the analysis, the authors rely on the statistical analysis conducted by Cantor and Packer (8) and Bradley and Gulati (9) to build a robust statistical analysis tool.

The remainder of the essay is structured as follows: The research goals section of the study provides a clear explanation of the study's goals and objectives. Section "Data and methodology" gives an overview discussion of the related literature pertaining to the topic under study. Section "Discussion and conclusion" discusses the methodology adopted for this study, followed by the main research findings, and Section 5 concludes the study.

2. Literature review

The unleashing of the European sovereign debt crisis in 2009 contributed to a significant level of research interest because of factors related to the sovereign rating outcomes as well as actions upon capital markets and institutions. A spectrum of studies has focused on two areas such as own country effects and spillover effects on banks (10) as well as bond markets (11). Using the information on the yield on EU sovereign bonds and the spread between credit default swaps (CDS), Afonso et al. (11) conducted an event study analysis to examine how governments react to yield spread before and after the rating announcements from the rating agencies (Standard & Poor's, Moody's, and Fitch). Using an event study methodology, Afonso et al. (11) discovered that changes in rating notations as well as future outlooks significantly affected government bond yield spreads, especially when the announcements were seen as being unfavorable. This means that when examining the impact of domestic micro factors on their influence on bond yield spread, the findings showed that there was a significant increase during periods of the financial crisis, in particular with reference to international investors who discriminate between countries with the unfavorable economic climate.

This is primarily caused by a confluence of strong risk aversion and significant current account deficits, which tend to amplify the impact of deteriorating public finances on the yield spread on government bonds.

When examining credit watch announcements, previous studies [e.g., (6)] indicate that they are not anticipated at a 1–2 month horizon, but they find a bidirectional causality between ratings and spreads within 1–2 weeks. Moreover, according to the analysis by Afonso et al. (11), there is a spillover effect, especially from those countries that have a lower rating to those that have a higher rating and it is also observed that a persistence effect is present for those countries that may have been recently downgraded. By analyzing the effect of CRAs' announcement on the value of the euro currency as well as yields from the following nations, Baum et al. (12) provided consistent evidence in their study: Germany, Italy, Spain, and France. Their findings revealed

interesting findings whereby a common pattern existed in long-term sovereign bonds during the eurozone debt crisis between 2011 and 2012. Baum et al. (12) adopted an event study by employing a GARCH model for their analysis. The choice of the GARCH model is fundamental because it allows the authors to deal with the most common financial data time series, which can reveal characteristics such as thick tails.

Using GARCH, modeling is a sound technique because it is considered a relatively more sensitive approach when measuring risk in a normal distribution. However, such a technique allows the researcher to capture both heavy tails of return series as well as factors related to volatility clustering.

In their study, the researchers apply a combination of an event study methodology, which employs two types of analysis, namely, univariate and multivariate, and further employs Granger causality tests using a panel framework supported by impulse response tests. Interestingly, their findings showed no evidence for Granger causality from bond yields to CRAs' rating announcements. There was also further evidence of inference because the CRAs' announcements evidently influenced "crisis-time capital allocation" within the eurozone markets. Symbolically, this means that when there are downgrade events, the currency value of the euro subsequently reduces, hence affecting sovereign bond yields.

The three main rating agencies use rating scales, with the best quality issuers receiving a triple-A notation (AAA). Agiakloglou and Deligiannakis (13) used Granger causality techniques to examine both the short-run and long-run relationship between government bond yields as revealed by CDS for eight European countries. By encapsulating a wide range of factors, these credit risk assessments have been identified in the literature as critical tools essential for defining and evaluating a rigorous investment assessment designed to identify opportunities, particularly in the rising emerging markets. However, these emerging markets show a tendency to have problems related to asymmetric information, which can be very high.

Theoretically, rating agencies play a pivotal role whereby they disseminate valuable information to potential investors by conducting in-depth risk evaluations of sovereign bonds. But it is still not quite obvious how CRAs affect risk pricing so widely (14). The minimal information value of credit rating announcements on the market pricing of sovereign bonds is evaluated in their study. Empirically, they employ a dynamic macroeconomic model with a sample of 56 countries using monthly data. The findings revealed that watch or the outlook status plays a key role in ensuring accuracy related to determining of the information provided by CRAs is credible and henceforth, the information value of credit rating changes is presented.

Previous literature (8, 15–18) found evidence that CRAs influence bond yields, specifically when a downgrade is announced. The CRA II Regulation is expected to decrease the influence and impact on credit watch announcements of the major players in the credit rating industry. The adoption of the CRA II Regulation in May 2011 is anticipated to have an impact on sovereign bond rates, according to the authors. Regulations on credit rating agencies adopted in 2013 and 2015 are not considered due to a lack of data on watch announcements. Hence, the focus of this empirical analysis is the CRA II Regulation introduced in May 2011.

Thus, factors that affect sovereign bond yields are typically associated with aggregate risk. It is fundamental to note that this aggregate risk is typically influenced by government actions on monetary policy changes, geopolitical dynamics and uncertainty, factors related to risk aversion, and more country-specific risks as well as the contagion effect risk.

Broadly speaking, contagion is one of the mechanisms by which financial instability becomes so widespread that a crisis reaches systematic dimensions. The other two mechanisms that constitute sources of systematic risk are the unwinding of financial imbalances and the occurrence of severe macroshocks. However, there are two ideas underlining the definition of contagion risk. First, the wider spreading of instability would usually not happen without an initial shock. Second, the transmission of the initial instability goes beyond what could be expected from the normal relationship between markets or intermediaries, for example, in terms of speed, strength, or scope.

In his study, de Santis (19) empirically correlated that contagion effects within the euro area are closely linked to stocktickerCRA rating and adopted a framework of a structural vector error correction model. He contended that the evolution of spreads for nations like Portugal, Ireland, Greece, and Spain was significantly influenced by country-specific credit ratings (PIGS). This means that any downgrade can be able to generate a portfolio shift, resulting in a significant impact on bond yields. Eijfinger (15) echoed this sentiment by explicitly declaring, "Downgrading sovereigns or even the announcements of a possible future downgrade may jeopardize the achievement of implemented austerity measures." This has increased the momentum of debate surrounding the methods, timing, and measures employed by these rating agencies, resulting in the EU adopting new regulatory measures under the European Securities and Markets Authority (ESMA), but the controversy remains unabated. Further criticism has also been associated with the use of market power dominance by the big three rating agencies as well as entry barriers for prospective new rating agencies entering the market.

In their study, Silvapulle et al. (20) investigated the contagion effect on the daily bond yield spread of five peripheral EU countries as a result of the euro-debt crisis. The authors utilized a robust semiparametric copula method, which enabled them to detect and capture the contagion effects when observing the daily sovereign yield spread. Their research findings showed that there was a contagion effect, which was shown by a significant increase in tail dependence

during two events, namely, the pre-crisis (1999–2008) and the post-crisis, from 2008 to 2013.

However, it is imperative to note that the sovereign debt market has shortcomings when it comes to rating sovereign debt. The common denominator of indicators includes general proxies like GDP per capita, GDP growth rate, debt history, government debt, and external debt, although the top three agencies very frequently disagree on grading sovereign debt due to the disparities in rating indicators (15).

For instance, when Greece's rating was lowered from BAA1 to BA2 on July 5, 2005, this precipitated changes in spreads for nations with poorer fiscal fundamentals, such as Ireland, Portugal, Italy, Spain, Belgium, and France. This spillover effect meant a negative outlook, which in turn implied a rise in risk whereby the "private sector participation could become a precondition for additional rounds of official lending to Portugal as well" (19). As Greece was the epicenter of the sovereign debt crisis, other countries were also impacted with different rating degrading.

Since the subprime mortgage crisis, literature on how CRAs' announcements influence sovereign bond yields has emerged. Recently, in their study, Kenourgios et al. (17) examined the effect of credit rating announcements on 10-year sovereign bond yields using samples from "traditional" and "new" global emerging economies as well as the developing countries that were severely impacted by the global financial crisis. By adopting panel regression as an instrument and conducting several robustness tests, they concluded that heterogeneous effects existed across different types of credit events, different country groups, and the CRAs. This showed that the downgrades and negative outlooks by the big three rating agencies were more informative, thus resulting in the increase in bond yields of the group of countries both during the time of announcement and after. However, it is crucial to recognize the importance of rating agencies due to their substantial influence on funding costs and institutional investors' desire to hold particular types of financial instruments (17). The other study from Baum et al. (21) highlighted the impact of CRA announcements on sovereign bond yields of France, Italy, Germany, and Spain and how this affected the euro currency reaction against major trading currencies. By employing an event study using 2010–2012 as a time parameter, Baum et al. (21) used GARCH models to analyze the yield behavior post-announcement. Evidently, they concluded that announcements of CRA downgrades, watch lists, and outlooks did not affect the value of the euro, although they did see a rise in exchange rate volatility. Baum et al. (21) found evidence about the impact of CRAs' announcements on the value of the euro and the yields of French, Italian, German, and Spanish long-term sovereign bonds during the culmination of the eurozone sovereign debt. Specifically, their estimates revealed that there were effects from those downgraded yields and other volatilities of French, Italian, and Spanish yield bonds. However, the strongest effect was observed for the negative outlook announcements that showed an increase in the yields of German bonds.

Results show that CRAs' downgrade announcements had negative effects on the value of the euro currency and, subsequently, its volatility. This is because sovereign ratings provide financial markets with new information, which might trigger market panics and overreactions, in particular when the announcement is negative. Moreover, Baum et al. (21) demonstrated that downgrading from CRAs increased the yields of French, Italian, and Spanish bonds but lowered the German bond yield. No evidence of Granger causality from bond yields to rating announcements could be proven. The authors conclude that credit rating announcements significantly influenced crisis-time capital allocation in the eurozone.

The effect of credit rating releases from Moody's Investors Service on government bond rates was examined by Liu et al. (22) using an event study. Their overall findings illustrate that bond markets respond to the announcement of downgrading. This tends to have a greater impact on security prices than upgrading. Barron et al. (23) analyzed the impact of new ratings, credit rating changes, and commercial paper ratings on UKUK*United Kingdom* common stock returns. By adopting a market model such as the capital asset pricing model (CAPM) and a panel approach, the following conclusions were reached: First, credit rating agencies provide information to the capital market in the United Kingdom (UK). Second, significant excess stock returns are associated with bond rating downgrades and positive credit watch announcements. Third, rating changes affecting short-term debt have no statistically significant impact, as is the case for new long-term debt ratings.

Abad et al. (24), in their empirical study, analyzed liquidity shocks in the US corporate bond market induced by the information content of the changes in credit ratings and regulatory market constraints. Interestingly, the analysis revealed an interesting pattern whereby the market anticipates rating changes because trading activity sows down days before an event occurs.

During the 2 weeks after the event, they found that there is price pressure and the volume of trading is significantly high. Furthermore, the price converges to the fundamental values, which is followed by high trading activity rising too, especially during the fortnight. Finally, the migration movement of investment as well as the different speculative grade categories results in further liquidity shocks.

Concerning the econometric approach related to the topic under study, there are two strands in the literature (25). In the first one, researchers employ linear regression models on a numerical representation of the ratings. With the statistical techniques of multiple regression analysis, Cantor and Packer (8) conducted a rigorous systematic analysis by observing the determinants as well as impact factors on sovereign credit ratings. This analysis focused on a cross-section study with a sample of 45 countries, assigned by Standard &

Poor's Financial Services and Moody's Investors Service. The authors discover that rating releases, in particular, have an immediate impact on the market price for issuers that are below investment grade. Afonso et al. (25) made additional attempts by utilizing the ordinary least squares (OLS) approach for the numerical depiction of credit ratings. The second strand of literature on the econometric approach uses ordered response models such as Hu et al. (26), Bissoondoyal-Bheenick (27), and Depken et al. (28).

The statistical methods used to analyze sovereign bond yields differ greatly. Hand et al. (16) examined the correlation between daily excess bond and stock returns and S&P watch list announcements, as well as actual S&P and Moody's rating changes. Using regression analysis and panel analysis, they found evidence that common stock prices do respond to credit watch announcements and bond rating changes. The evidence from the findings reflects a consistency with responses from stock prices from all the credit rating announcements, with the exception of the actual rating upgrades. Moreover, the evidence is consistent with price effects for both upgrades and downgrades in determining the effect of preferred stock rating changes on preferred stock returns. Alsakka and ap Gwilym (29) investigated the behavior of sovereign watch lists and outlook signals by the big three credit rating agencies by employing an ordered probit modeling approach. Their results show that the actions of different credit rating agencies imply different policies. In addition, the authors found evidence of a negative outlook momentum, but neither watch list momentum nor positive momentum could be validated. In addition, their analysis shows that there is interdependence among the three major players, S&P, Moody's, and Fitch Ratings, regarding the sovereign outlook and watch list actions.

Evidently, it is observed that the impact shows a stronger effect in particular to the multiple-notch sovereign rating downgrades and are more visibly within the PIIGSPIIGS*Portugal, Italy, Ireland, Greece, Spain*[1] states. Furthermore, the authors find differences in rating policies across the big three, and they show evidence of interdependence in bank rating actions. S&P tends to be the more independent, and Moody's appears to be more cautious but is by far the most likely to assign multiple-notch downgrades.

Katz (30) provides evidence on the price adjustment process of bonds to rating reclassifications using regression analysis. The author finds that there is no anticipation at all of a rating reclassification. Also, there appears to be a lag of between 6 and 10 weeks after a rating reclassification before a 100% adjustment to the new rating class prevails. With a panel model and a spline regression, Aizenman et al. (31) analyzed by examining how the impact of credit rating changes influences sovereign bond yields within the EU. Their study also looked at macroeconomic and financial variables that account for the different effects over time whenever there is a change in credit rating.

The authors find that evidence for changes in ratings is informative, economically important, and highly statistically significant in fixed asset panel models. In their 2011 study, Candelon et al. (32) examined the effects of news about sovereign ratings on European financial markets between 2007 and 2010. Using an event study, it is proved that sovereign rating downgrades have statistically and economically significant spillover effects across countries as well as financial markets. However, this depends on the type of announcement; the source the country is experiencing the downgrade and the rating agency.

Reduced to nearly speculative economies (like Greece), other eurozone nations have systematic spillover effects. Treepongkaruna et al. (33) also reviewed realized volatility in the stock and currency markets. During times of financial crisis, they analyzed the asymmetric effects of different types of sovereign rating announcements on stocks and currency movement, degree of skewness, and correlation relationships.

The findings provide interesting insights into how the currency and stock markets tend to respond in a heterogeneous way to credit rating announcements, and they concluded that, actually, the stock markets showed a more tendency of responsiveness in comparison to the currency market. Evidence suggests that rating events have significant and asymmetric impacts on higher moments of both asset market returns. Using an event study, Norden and Weber (34) analyzed the response of stock and CDS markets to rating announcements by the three major players in the credit rating industry during 2000–2002. Moreover, the authors conducted a study by examining the degree of how strongly these markets respond to a credit rating announcement by observing abnormal returns, as well as the CDS, spreads that have been adjusted. Norden and Weber (34) found that both markets not only anticipate rating outcomes as a result of a downgrade but also reviews for downgrade by the big three credit rating agencies. It is imperative that a combination of different trading events within the different agencies that are reviewed for downgrade by S&P and Moody's exhibit the largest impact on both markets. Furthermore, the analysis shows that the magnitude of abnormal performance in both markets is influenced by the level of the old rating, previous rating events, and, only in the CDS market, by the pre-event average rating level by all agencies. Kraussl (6) researched with a specific focus on the event study and panel regression,

TABLE 1 | Bond characteristics of European sovereign bonds used in the analysis.

Bonds before CRA II Regulation	Bonds after CRA II Regulation
Issue date starting from 2006	Issue date starting after May 2011
Bonds issued in euro	Bonds issued in euro
Coupon type: fixed	Coupon type: fixed
10- and 5-year sovereign bonds	10- and 5-year sovereign bonds

Source: Authors.

the role played by credit rating agencies when examining the impact on an international financial market platform, particularly whether sovereign credit ratings have an impact on the financial stability in emerging market economies. Due to their significant effect on the two important aspects of lending to developing markets, i.e., size and market volatility, his findings demonstrate the trustworthiness of CRAs. Additionally, the findings demonstrate a notable degree of strength in the case of government downgrades as well as adverse sovereign credit rating actions, including credit watches and rating outlooks. Comparatively speaking, the projected changes in sovereign credit ratings made by market participants have less of an influence on the financial markets of emerging nations. Chung et al. (35) analyzed credit watch and rating actions during the credit rating process. They concluded that watch actions are frequently triggered by very specific, well-known events, unlike rating actions.

Christopher et al. (36) made further attempts by investigating the permanent and transitory effects of sovereign credit ratings by examining the effects of time-varying stock and bond market correlations. They used a sample of nineteen emerging countries from January 1994 to July 2007. They concluded that stock and bond market co-movements within a region tend heterogeneity when there is information dissemination on the sovereign rating. In contrast, sovereign rating outlooks were found to be negatively related to regional bond market co-movements, reflecting the existence of contagion effects.

Ory et al. (37) used a case-by-case study, also called the binary-logit model, to focus on downgradings and negative watches. The main goal was to characterize series that react to rating changes and to quantify as well as explain the importance of reactions. They found that in 50% of cases, downgrades and negative watches have no impact but lead to financial market reactions only for industrial and commercial corporate issuers. The reaction of a negative rating action depends on the economic climate, in particular when the economy slows down. In addition, there are reactions when the initial rating is low (less or equal to BBB-/Baa3). Finally, reactions are stronger when there are negative announcements from S&P and Fitch Ratings when compared to Moody's.

Previous research on how CRAs' announcements have an impact on government bond yields shows that, especially when there is a negative announcement, yields do respond. Our empirical analysis brings new evidence to the scientific literature in investigating the impact of CRAs' watch announcements before and after the introduction of the CRA II Regulation in Europe. As this regulation first tried to reduce CRAs' influence in the European Union on the capital market, the study aims to illustrate whether there is still a relationship between European sovereign bond yields and watch announcements from S&P, Moody's, and Fitch Ratings. In finding evidence on whether the CRA II Regulation did reduce or not the influence of CRAs' watch announcement, the authors make an important contribution to the empirical analysis of sovereign debt and the impact of the big three credit rating agencies after the first regulations on CRAs came into force within the EU.

Hence, the authors set up the hypothesis that there is a relationship between sovereign bond yields, the introduction of the CRA II Regulation, before or after an announcement, watch announcements, and the rating grade of a government.

3. Data and methodology

A majority of studies that examine and analyze the determinants of bond yield spreads employ simple linear regression models because these models assume that there is a constant relationship between a set of explanatory variables and bond yield spreads. For this reason, our study follows this logic.

Data used for the analysis, such as information on European sovereign bond yields, credit watch announcements from Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings, and interest rate volatility, are all obtained from the Bloomberg database. Interest rate volatility refers to the variance of changes in the level of yield curves. This means interest rate volatility has a significant effect on bond prices.

3.1. Country sample selection

Sovereign bond yields are collected for Austria, Germany, Belgium, Finland, France, the Netherlands, Ireland, Italy, Spain, and Portugal. All these countries are part of the empirical analysis. Other European countries are not included in the analysis due to a lack of data at the time of the analysis on credit watch announcements by Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings (**Table 1**).

TABLE 2 | Frequency credit watch announcements of Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings.

	Watch announcement	Year	Right	Wrong
Standard & Poor's	17	2009, 2011, 2012, 2013	13	4
Moody's	18	1992, 1993, 1996, 1997, 1998, 2001, 2009, 2010, 2011, 2014	16	2
Fitch Ratings	10	2006, 2011, 2009, 2014	9	1

Source: Authors based on the Bloomberg database.

As a first step, the authors search for evidence of whether there is a positive or negative change in the watch announcement. For this purpose, all countries named above are analyzed individually for sovereign bonds with a maturity of 10 and 5 years. For each country, the dates and directions[2] of watch announcements are collected. Later, the corresponding bonds are determined for the time of the watch announcement. Finally, the difference in yield before and after the announcement was made is calculated to find evidence on whether yields and watch announcements follow the same directions; therefore, the variables "yields before a watch announcement" are subtracted from the variables "yield at the time of a watch announcement" to get the searched variable "change in yield." The following formula shows how the change in yield is calculated for each country:

In the appendices, the tables for 5- and 10-year sovereign bonds can be found, which show the first results concerning the change in yield after a credit watch announcement was made.

Nevertheless, this is the case, particularly for sovereign bonds issued from countries with the worst ratings, such as Portugal and Ireland. Notably, the change in yield is also positive for Germany, Finland, and the Netherlands, which are rated with the best ratings. Countries such as Belgium, France, Italy, and Spain have a negative change in yield, even though the watch announcements made are negative as well. These tables might show first results that yields do not always respond in the same way as credit watch announcements are made. The impression is that, in some cases, investors trust credit rating watch announcements as sovereign bond yields do respond to watch announcements. In the next step, linear regression will follow to obtain evidence of whether yields are related to credit watch announcements. Particularly, whether there is evidence of response of sovereign bond yields on credit watch announcements before and after the CRA II Regulation came into force.

In the next steps, two multiple linear regressions are conducted. To find evidence about whether (there is a relationship between the change in yield and watch announcements) a change in yield is determined by a watch announcement made by the big three CRAs before and after the introduction of the CRA II Regulation, a regression analysis is applied. In the first step, a separate simple linear regression is undertaken to control interest rate volatility during the period of credit watch announcements. Illustrations of interest rate volatility for Germany, Belgium, Finland, France, the Netherlands, Italy, Spain, Portugal, Ireland, and Austria for 5- and 10-year government bonds are shown in the appendices. As can be seen in the diagrams, there are daily fluctuations. This analysis aims to find evidence of whether the yields of sovereign bonds are affected by interest rate volatility. In doing so, the authors aim to control the result of the main regression analysis, which then needs to be considered for interpreting the results of the main multiple linear regression. Interest rate volatility could bias the results, as this is a major fact, which has an impact on government bond yields. Hence, a separate regression analysis is realized to find evidence on whether interest rate volatility influences the yields on sovereign bonds. For this, two individual analyses are executed for 5- and 10-year government bonds. The daily yields at the time a watch announcement is made are used as a dependent variable. The independent variable is the daily volatility of 5- and 10-year government bonds. Data on interest rate volatility are extrapolated from the Bloomberg database for

TABLE 3 | Coding variable announcement grade.

Rating	Before announcement	After negative announcement	After positive announcement
AAA/Aaa	1	2	1
AA + /Aa1	2	3	1
AA/Aa2	3	4	2
AA-/Aa3	4	5	3
A + /A1	5	6	4
A/A2	6	7	5
A-/A3	7	8	6
BBB + /Baa1	8	9	7
BBB/Baa2	9	10	8
BBB-/Baa3	10	11	9
BB + /Ba1	11	12	10
BB/Ba2	12	13	11
BB-/Ba3	13	14	12

Source: Authors.

TABLE 4 | Summary statistics of interest rate volatility.

	Five-year sovereign bonds	Ten-year sovereign bonds
F-test	2,614.57* 2,614.57**	3,934* 3,934.41**
p-value	0* 0**	0* 0**
Interest rate volatility	0* 0**	0* 0**

Source: Authors.

TABLE 5 | Summary statistics multiple linear regression on credit rating agencies.

	Five-year sovereign bonds	Ten-year sovereign bonds
F-test	694.89* 694.887**	1,209.45* 1,209.45**
p-value	0* 0**	0* 0**
CRA II	1.8662E-05* 1.8662E-05**	0.0024* 0.0024**
Before/after announcement	1.0012E-34* 1.0012E-34**	0.00013* 0.00013**
Watch	0.003* 0.003**	0.041* 0.041**
Announcement grade	4.955E-262* 4.955E-262**	0* 0**

Source: Authors.

10–15 days before and after watch, announcements are made. Governments included in the analysis are Germany, Belgium, Finland, France, the Netherlands, Spain, Italy, and Portugal for 5-year sovereign bonds and Germany, Belgium, Finland, France, the Netherlands, Spain, Italy, Portugal, Ireland, and Austria for 10-year sovereign bonds. There is a lack of data at the time of the analysis for Ireland and Austria for 5-year sovereign bonds, which is the reason why they are not used in the first analysis. Data on sovereign bonds are denominated in euros, have a fixed coupon type, and are issued between 2009 and 2014, which is consistent with the main multiple linear regression and data on watch announcements. The analysis was conducted at 95 and 99% confidence levels for each 5- and 10-year sovereign bonds. The simple linear regression contains a data sample of 1,499 data for 5-year sovereign bonds and 3,762 data for 10-year sovereign bonds. Hence, for each of the 5- and 10-year sovereign bonds, the following formulas can be built:

For this, the multiple linear regression is divided into two separate analyses. The main analysis is carried out separately for 5- and 10-year sovereign bonds, respectively. The dependent variable Y represents the daily yields of European sovereign bond yields each 20 days before[3] and after a watch announcement was made. Data for the watch announcements are taken from the watch lists for each country from the Bloomberg database, as well as data on European sovereign bond yields. Bond characteristics are the same as explained before, with a fixed coupon type and denominated in euros. For bonds issued before May 2011, when the CRA II Regulation was implemented, the year 2006 was chosen as the issue date, for having a comparable timeframe for the analysis. Bonds issued after the CRA II Regulation was introduced are gathered from May 2011 on. The multiple linear regression is done for European sovereign bonds with a maturity of 5 and 10 years separately. Data on 5-year sovereign bonds are available[4] for Germany, Belgium, Spain, Finland, France, the Netherlands, Italy, and Portugal. The sample contains 1,499 daily sovereign bond yields. For 10-year sovereign bonds, data are obtained for Germany, Belgium, Spain, Finland, France, the Netherlands, Italy, Portugal, Ireland, and Austria. The data sample includes 3,762 daily sovereign bond yields. The multiple linear regressions are calculated at 95 and 99% confidence levels for each regression analysis.

Data on credit watch announcements are obtained from the Bloomberg database, which ranges from 1993 to 2014. As the CRA II Regulation was implemented in May 2011, data on watch announcements are used from 2006 to 2014 for having a comparable timeframe before and after the introduction of the CRA II Regulation. Credit watch announcements on foreign currency long-term debt from Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings are used. This is because an issuer's foreign currency rating will differ from its local currency rating when the obligor has a different capacity to meet its obligations denominated in its local currency vs. obligations denominated in a foreign currency (38). A first overview of the credit watch announcement frequency made by Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings is shown in **Table 2**.

Table 2 shows how many watch announcements were recently made by the big three CRAs. Furthermore, the years of the announcements are listed. The last two columns show how often a credit watch announcement was followed by an actual rating, which represented the direction of the watch announcement (right) and which did not represent the direction of the watch announcement (wrong). Moody's Investors Service was the rating agency with the most watch announcements, but mainly during the time before the European sovereign debt crisis hit and the CRA II Regulation was introduced. Standard & Poor's Financial Services follows Moody's Investors Service in terms of the number of watch announcements made. Moreover, Standard & Poor's Financial Services is the credit rating agency with the most wrong announcements, particularly during the European sovereign debt crisis. This shows that the CRA put countries on watch, but the actual rating given by the company went in the other direction. Fitch Ratings announced fewer credit watches but with a trend of the least wrong announcements. During the European sovereign debt crisis, Standard & Poor's Financial Services and Fitch Ratings were the most active CRAs in terms of watch announcements. After the CRA II Regulation came into force, further credit watch announcements were made by all three credit rating agencies, with Standard & Poor's Financial Services being the most active. Moody's Investors Service watch announcements after the CRA II Regulation was introduced, which mainly concentrated on struggling economies such as Portugal.

Data on the country, the rating before the watch announcement, and the direction of the watch announcements are collected. Countries included in the analysis and for which data are available are Germany, Belgium, Spain, Finland, France, the Netherlands, Italy, Portugal, Ireland, and Austria, with all data containing negative watch announcements, except for Portugal in 2014, which is positive.

For the analysis, the credit watch announcements of the big three CRAs are coded 0 for a negative watch announcement and 1 for a positive watch announcement for each CRA:

0 = negative watch announcement

Credit watch announcement = 1 = positive watch announcement

The data sample on watch announcements covers the European sovereign debt crisis and includes struggling countries, with watch announcements ranging between speculative and investment grade. As previous literature such as Afonso et al. (11) and Cantor and Packer (8) found evidence that watch announcements, especially negative ones, do have a major impact when the country is put on

watch from investment grade to speculative grade, this will be considered in the analysis as well. This is done with the help of two independent variables. First, a variable called before/after the announcement is coded with 0 for data concerning the period before an announcement is made and 1 for covering the period after the announcement is made:

0 = before watch announcement

Before/after announcement =

1 = after watch announcement

The second independent variable is called "announcement grade." Announcement grades covering the period before an announcement is made represent the rating of the government before a watch announcement. Data on these ratings are taken from the watch announcement lists from the Bloomberg database. Announcement grades covering the period after watch announcements are calculated by taking the previous ratings and adding or subtracting 1, depending on which direction the watch is announced. For the ratings, an ordinal scale is used, as Bradley and Gulati (9) did in their analysis. In addition, Cantor and Packer (8) used a numerical scale for coding the ratings in their analysis. This is why we made use of a numerical scale to code the ratings, as well. **Table 3** summarizes the coding for the variable announcement grade.

3.2. Statistical results

3.2.1. Simple linear regression on interest rate volatility

In the appendices, a detailed simple linear regression on interest rate volatility can be found. In this study, the main findings are presented in **Table 4** below.

The independent variable for dependent variable yields of sovereign bonds is interest rate volatility at the time of watch announcements. Results are shown for 10- and 5-year sovereign bonds. A 95% confidence level is reported as * and a 99% confidence level as **.

Overall analysis for 10- and 5-year sovereign bonds shows statistical significance in both cases at 95 and 99% confidence levels, reported in the *F*-test and *p*-value. Interest rate volatility is also statistically significant, with 0 for all regression analyses. This result indicates that interest rate volatility has a statistically significant influence on each sovereign bond maturing after 5 or 10 years. Due to high fluctuations during the European sovereign debt crisis, which is the timeframe of the analysis, this needs to be considered in interpreting the results of the main multiple linear regression.

3.2.2. Multiple linear regression on CRAs

The full statistical results of the multiple linear regressions for each 5- and 10-year sovereign bond can be found in the appendices. In this section, the most important findings are explained in **Table 5**.

3.2.3. Multiple linear regression on CRAs

The full statistical results of the multiple linear regressions for each 5- and 10-year sovereign bond can be found in the appendices. In this section, the most important findings are explained in **Table 5**.

Independent variables for dependent variable yield are 0 for no CRA II Regulation and 1 if there is one; before/after the announcement is coded 0 for before and 1 for after; watch is coded 0 if it is negative and 1 if it is positive; announcement grade ranges from 1 for the best rating and 14 for the worst. Results are shown for 10- and 5-year sovereign bonds. A 95% confidence level is reported as * and a 99% confidence level as **.

For 5-year sovereign bonds, at both confidence levels, the overall multiple regression analysis is statistically significant as reflected in the *F*-test with 694.89 and the *p*-value with 0 for each confidence level. The results for the single variables at both confidence levels show that the only variable being statistically significant is watch with 0.003 smaller than 0.05 and 0.003 smaller than 0.01. The remaining variables within the multiple linear regression for 5-year sovereign bonds are all not statistically significant, with results all being greater than 0.05 or greater than 0.01, the confidence levels. Hence, the variable watch is the only variable within the statistical analysis having a relationship to the dependent variable yield. The result shows that there is a relationship between credit watch announcements and European sovereign bond yields. Thus, evidence shows that bond yields do respond to watch announcements.

Overall analysis for 10-year sovereign bonds is statistically significant with an *F*-test of 1,209.45 at 95 and 99% confidence levels. All independent variables at a 95% confidence level are statistically significant, with each result being smaller than 0.05. At a 99% confidence level, each variable except watch (0.041 greater than 0.01) is statistically significant as well, in presenting results smaller than 0.01. The results indicate that, at a 95% confidence level, each variable does have a statistically significant relationship to the dependent variable yield. Hence, sovereign bond yields are influenced by all variables: the CRA II Regulation, before or after an announcement is made, the watch announcement, and the rating grade. At a 99% confidence level, the same result is obtained, with the exception, that the variable watch is not statistically significant. Nevertheless, as explained before, the variables announcement grade and before/after announcement do reflect the watch announcement indirectly, including the rating a government might obtain after a watch announcement was made. As these two variables are statistically significant, the authors conclude that even at a 99% confidence level, the 10-year sovereign bond yields do respond to watch announcements made by Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings. The null hypothesis cannot be rejected as yields are impacted by credit rating

agencies' watch announcements before and after the CRA II Regulation came into force.

Independent variables for dependent variable yield are 0 for no CRA II Regulation and 1 if there is one; before/after the announcement is coded 0 for before and 1 for after; watch is coded 0 if it is negative and 1 if it is positive; announcement grade ranges from 1 for the best rating and 14 for the worst. Results are shown for 10- and 5-year sovereign bonds. A 95% confidence level is reported as * and a 99% confidence level as **.

For 5-year sovereign bonds, at both confidence levels, the overall multiple regression analysis is statistically significant as reflected in the *F*-test with 694.89 and the *p*-value with 0 for each confidence level. The results for the single variables at both confidence levels show that the only variable being statistically significant is watch with 0.003 smaller than 0.05 and 0.003 smaller than 0.01. The remaining variables within the multiple linear regression for 5-year sovereign bonds are all not statistically significant, with results all being greater than 0.05 or greater than 0.01, the confidence levels. Hence, the variable watch is the only variable within the statistical analysis having a relationship to the dependent variable yield. The result shows that there is a relationship between credit watch announcements and European sovereign bond yields. Thus, evidence shows that bond yields do respond to watch announcements.

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3.3. Results empirical analyses of credit rating agencies

Results obtained indicate a relationship between European sovereign bond yields and credit rating watch announcements are consistent with previous literature such as Afonso et al. (11) and Cantor and Packer (8). The reason why results obtained for 5-year sovereign bonds, which show a statistical significance only for the variable watch is 2-fold: First, as mentioned before, data on 5-year sovereign bonds with the chosen bond characteristics and the independent variables include a data sample of half of the size compared to data used for 10-year sovereign bonds. The number of data included in an empirical analysis could have a great impact on the results. For future analysis, it is recommended to undertake a similar empirical analysis in some years when more data are available.

Second, interest rate volatility is statistically significant for both 5- and 10-year sovereign bonds. Longstaff and Schwartz (39) found evidence that interest rate volatility is higher for 10-year sovereign bonds than for 5-year government bonds. There are several reasons for interest rate volatility, such as actions undertaken by central banks, economic conditions, or inflation. One of these reasons is the economic conditions are also reflected in CRAs' watch announcements as this represents the main part of the evaluation of a rating made by the big three CRAs: Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings. Hence, the authors conclude that watch announcements influence yields and, thus, could trigger some interest rate volatility. As the findings of the main multiple linear regression on credit rating agencies indicate, watch announcements, yields before/after an announcement, and the changing announcement grade do impact yields of 10-year sovereign bonds. This could be seen as a picture of the economic conditions within governments and hence, as a reason for interest rate volatility. which explains the statistical significance for 10-year sovereign bonds as well. Kraussl (6) found evidence that CRAs have a substantial influence on the size and volatility of emerging market lending, particularly when there is a downgrade or a negative watch announcement. This is consistent with the findings that found a higher statistical significance for 10-year sovereign bonds, which also include more data on watch announcements than the analysis for 5-year sovereign bonds.

Another fact that needs to be mentioned for the different results is that watch announcement made by Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings are made for a long-term time horizon due to the focus on foreign currency long-term debt obligations. Hence, as 10-year sovereign bonds cover a long-term period, yields on 10-year sovereign bonds do respond to watch announcements made by the big three credit rating agencies more strongly, as the results of the empirical analysis indicate.

4. Discussion and conclusion

In this study, the authors assessed the impact of CRAs' watch announcements on European government bonds as a regulatory result of the European sovereign debt crisis.

The research aimed to find evidence on whether the introduction of the new regulation does have an impact on European sovereign bond yields up to date. Thus, whether there is still a relationship between credit rating watch announcements and EU sovereign bond yields after the introduction of the CRA II Regulation. In other words, evidence can be found that credit rating agencies' watch announcements no longer impact yields after having introduced the CRA II Regulation. The following analysis and findings are documented in the study:

- There is a change in sovereign bond yields after watch announcements are announced and after the introduction of the CRA II Regulation in May 2011.
- Analysis for controlling interest rate volatility shows statistical significance for 5- and 10-year sovereign bonds.
- Analysis for finding evidence on whether sovereign bond yields do still respond to CRAs' watch announcements after the inclusion of the CRA II Regulation.

Evidence is found that European sovereign bond yields do still respond to CRAs' watch announcements made by the big three CRAs. Evidence is found that CRAs still influence European Union government bond yields even though the European Union aims to control this through regulations on CRAs, such as the CRA II Regulation, which means, according to our analysis, the CRA II Regulation does not fulfill its main goal of reducing the power of credit rating agencies. Since the CRA II Regulation was implemented in the European Union, several new and stricter regulations on CRAs came into force. These are known as CRA III and CRA IV Regulations. These do concentrate more on reducing the influence and importance of CRAs on capital markets and, hence, on European sovereign bond yields as well. To find evidence on whether the regulations do reduce the power of CRAs in the European Union, it is recommended to undertake a similar empirical analysis in the future when more data are available for analyzing the impact of the following stricter rules on CRAs. As evidence is found, the CRA II Regulation did not have an impact on the influence of the major CRAs Standard & Poor's Financial Services, Moody's Investors Service, and Fitch Ratings.

Still, through the research, the authors bring an empirical contribution to the scientific literature by finding evidence that even after the implementation of the CRA II Regulation, CRAs do still influence sovereign bond yields is indeed recognized and priced in capital markets.

Author contributions

SE and LN: conceptualization, data curation, formal analysis, investigation, methodology, validation, visualization, and roles/writing—original draft. SE: project administration, supervision, writing–review, and editing. LN: resources and software.

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Appendix A

TABLE A1 | Change in Yield after Watch Announcements for five and ten year Sovereign Bonds.

	Watch	Yield at watch announcement	Yield before watch announcement	Change in yield 5 year
DE	negative	0,68	0,629	0,051
DE	negative	0,926	0,879	0,047
DE	negative	−0,29	−0,276	−0,014
DE	negative	1,416	1,359	0,057
DE	negative	0,195	0,182	0,013
DE	negative	1,951	1,876	0,075
BE	negative	3,111	3,283	−0,172
BE	negative	3,211	3,375	−0,164
BE	negative	3,306	3,463	−0,157
BE	negative	3,386	3,532	−0,146
BE	negative	3,465	3,604	−0,139
BE	negative	3,55	3,682	−0,132
BE	negative	3,62	3,746	−0,126
BE	negative	3,595	3,875	−0,28
BE	negative	3,657	3,931	−0,274
BE	negative	3,723	3,983	−0,26
BE	negative	3,76	4,027	−0,267
BE	negative	3,812	4,076	−0,264
BE	negative	3,866	4,127	−0,261
BE	negative	3,911	4,169	−0,258
BE	negative	3,169	3,271	−0,102
BE	negative	3,273	3,376	−0,103
BE	negative	3,343	3,449	−0,106
BE	negative	3,365	3,474	−0,109
BE	negative	3,487	3,598	−0,111
BE	negative	3,567	3,679	−0,112
ES	negative	4,206	4,346	−0,14
ES	negative	5,037	5,212	−0,175
ES	negative	4,432	4,565	−0,133
ES	negative	4,369	4,908	−0,539
ES	negative	5,152	5,617	−0,465
ES	negative	4,527	5,071	−0,544
FI	negative	1,258	1,237	0,021
FI	negative	1,619	1,587	0,032
FR	negative	0,036	0,044	−0,008
FR	negative	0,072	0,077	−0,005
FR	negative	0,243	0,278	−0,035
FR	negative	2,822	2,943	−0,121
NL	negative	0,832	0,79	0,042
IT	negative	6,162	6,194	−0,032
IT	negative	6,614	6,604	0,01
IT	negative	5,93	6,491	−0,561
IT	negative	6,15	6,922	−0,772
IT	negative	2,522	2,511	0,011
IT	negative	4,463	4,504	−0,041
PT	negative	9,645	9,448	0,197
PT	negative	8,032	7,871	0,161
PT	negative	8,06	8,032	0,028
PT	negative	6,064	6,195	−0,131
PT	negative	16,607	16,827	−0,22
PT	positive	11,624	11,297	0,327
PT	positive	11,624	11,297	0,327
DE	negative	2,003	1,928	0,075
BE	negative	3,106	3,286	−0,18
BE	negative	3,679	3,808	−0,129
BE	negative	3,779	3,888	−0,109
BE	negative	3,906	3,972	−0,066
BE	negative	3,482	3,773	−0,291
BE	negative	3,892	4,152	−0,26
BE	negative	3,975	4,27	−0,295
BE	negative	4,038	4,324	−0,286
BE	negative	3,07	3,112	−0,042
BE	negative	3,506	3,586	−0,08
BE	negative	3,581	3,663	−0,082
BE	negative	3,679	3,764	−0,085
ES	negative	4,035	4,186	−0,151
ES	negative	4,452	4,571	−0,119
ES	negative	4,659	4,762	−0,103
ES	negative	4,801	4,938	−0,137
ES	negative	4,839	4,96	−0,121
ES	negative	4,936	5,059	−0,123
ES	negative	5,06	5,182	−0,122
ES	negative	6,045	6,166	−0,121
ES	negative	5,264	5,392	−0,128
ES	negative	5,605	5,724	−0,119
ES	negative	4,17	4,736	−0,566
ES	negative	4,526	5,044	−0,518
ES	negative	4,588	5,152	−0,564
ES	negative	4,721	5,241	−0,52
ES	negative	4,752	5,261	−0,509
ES	negative	4,764	5,275	−0,511
ES	negative	4,897	5,425	−0,528
ES	negative	5,869	6,36	−0,491
ES	negative	5,09	5,626	−0,536
ES	negative	5,433	6,003	−0,57
FI	negative	2,627	2,57	0,057
FI	negative	2,71	2,648	0,062
FR	negative	−0,03	−0,014	−0,016
FR	negative	0,056	0,08	−0,024
FR	negative	0,817	0,88	−0,063
FR	negative	0,928	0,995	−0,067
FR	negative	1,949	2,108	−0,159
NL	negative	0,217	0,197	0,02
NL	negative	0,389	0,362	0,027
NL	negative	0,67	0,631	0,039
NL	negative	0,949	0,897	0,052

TABLE A1 | Continued

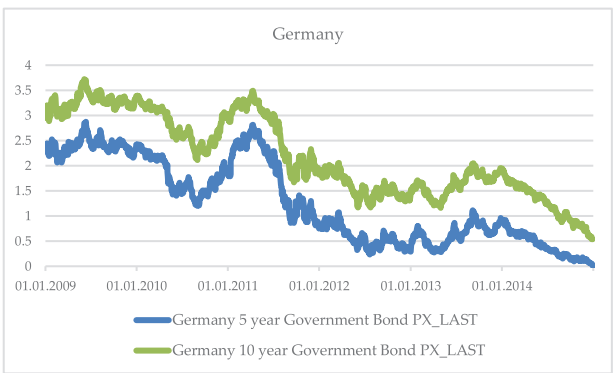
	Watch	Yield at watch announcement	Yield before watch announcement	Change in yield 5 year
NL	negative	1,211	1,156	0,055
NL	negative	1,456	1,403	0,053
NL	negative	1,715	1,667	0,048
NL	negative	1,947	1,9	0,047
NL	negative	2,16	2,115	0,045
IT	negative	6,164	6,221	−0,057
IT	negative	6,469	6,489	−0,02
IT	negative	7,002	6,999	0,003
IT	negative	7,491	7,547	−0,056
IT	negative	5,916	6,746	−0,83
IT	negative	6,097	6,919	−0,822
IT	negative	6,422	7,075	−0,653
IT	negative	7,103	7,712	−0,609
IT	negative	3,879	3,937	−0,058
IT	negative	4,14	4,194	−0,054
IT	negative	4,869	4,899	−0,03
IT	negative	5,313	5,311	0,002
PT	negative	8,769	8,787	−0,018
PT	negative	8,925	8,926	−0,001
PT	negative	8,892	8,817	0,075
PT	negative	8,953	8,917	0,036
PT	negative	8,726	8,561	0,165
PT	negative	8,552	8,499	0,053
PT	negative	7,602	7,415	0,187
PT	negative	7,616	7,451	0,165
PT	negative	7,79	7,617	0,173
PT	negative	7,645	7,508	0,137
PT	negative	7,585	7,448	0,137
PT	negative	7,626	7,506	0,12
PT	negative	7,671	7,602	0,069
PT	negative	7,693	7,616	0,077
PT	negative	7,836	7,79	0,046
PT	negative	7,758	7,645	0,113
PT	negative	7,625	7,585	0,04
PT	negative	7,67	7,626	0,044
PT	negative	5,489	5,557	−0,068
PT	negative	6,114	6,09	0,024
PT	negative	6,396	6,45	−0,054
PT	negative	6,508	6,586	−0,078
PT	negative	8,087	8,084	0,003
PT	negative	6,846	6,858	−0,012
PT	negative	8,448	8,446	0,002
PT	negative	7,01	7,019	−0,009
PT	negative	14,045	14,995	−0,95
PT	negative	15,828	16,55	−0,722
PT	negative	16,02	16,749	−0,729
PT	negative	15,73	16,183	−0,453
PT	negative	16,861	16,857	0,004
PT	negative	15,229	15,673	−0,444
PT	negative	16,025	16,022	0,003
PT	negative	14,823	15,162	−0,339
PT	positive	10,508	10,284	0,224
PT	positive	10,705	10,439	0,266
PT	positive	10,71	10,482	0,228
PT	positive	10,625	10,472	0,153
PT	positive	11,757	11,756	0,001
PT	positive	10,369	10,188	0,181
PT	positive	9,944	9,942	0,002
PT	positive	10,051	9,875	0,176
IE	negative	10,062	10,177	−0,115
IE	negative	8,295	8,542	−0,247
IE	negative	8,954	8,888	0,066
IE	negative	7,394	7,439	−0,045
AT	negative	1,863	2,014	−0,151
AT	negative	2,159	2,29	−0,131
AT	negative	2,603	2,744	−0,141

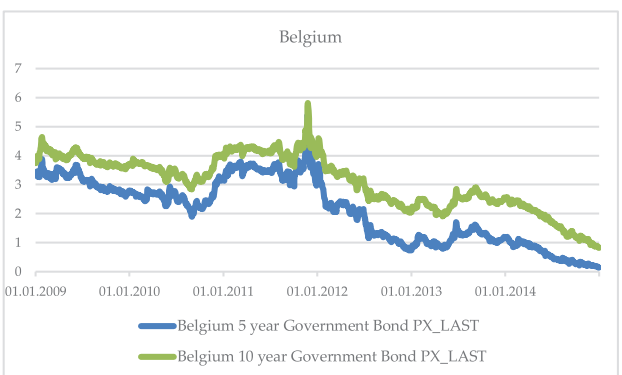
Continued

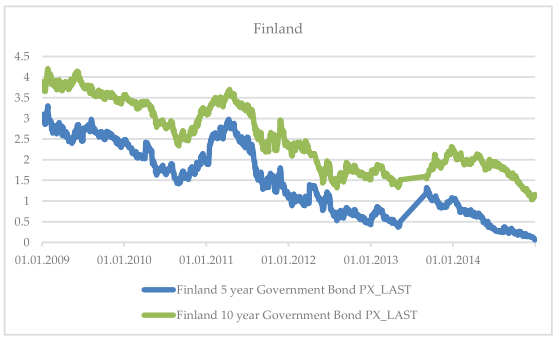
Change in yield and watch announcements from Standard & Poor's Financial Services, Moody's Investors Service and Fitch Ratings for 10- and 5-year sovereign bonds. Source: Bloomberg –Authors' own analysis.

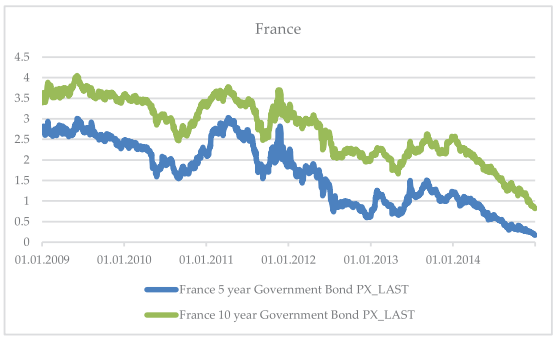
Appendix B

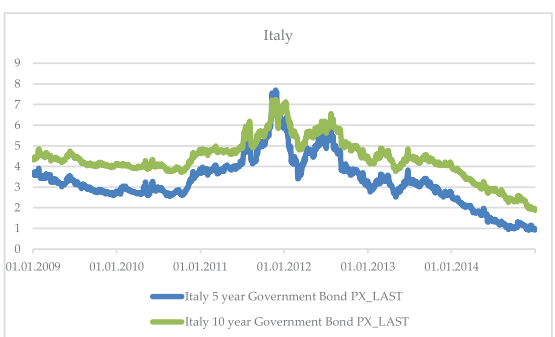
Daily Interest Rate Volatility

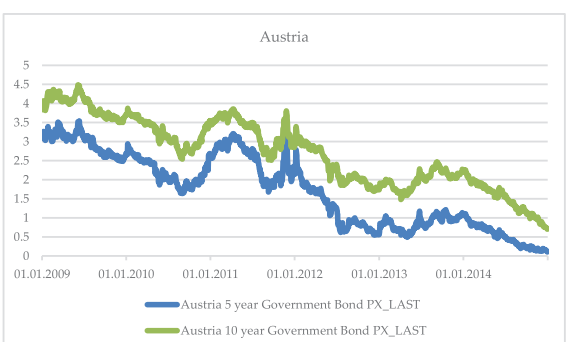


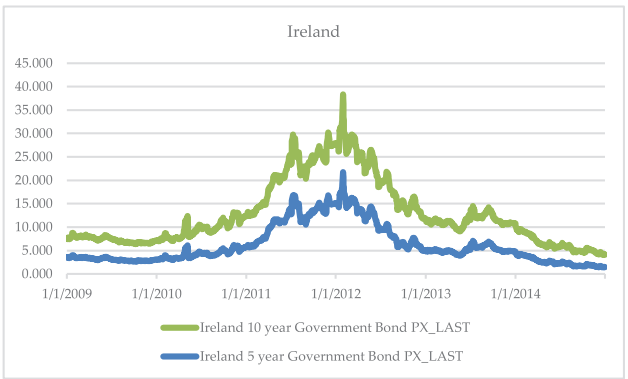


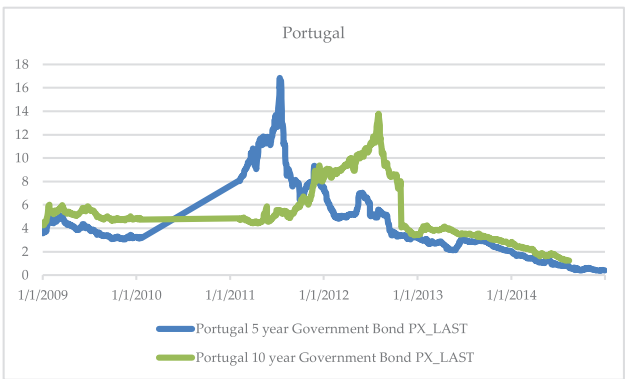


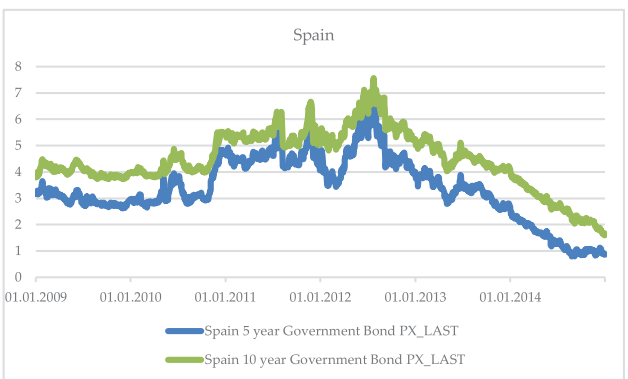












Source: Bloomberg – Authors' own analysis

Simple Linear Regression Daily Yields at Watch Announcement and Interest Rate Volatility

TABLE B1 | Simple linear regression daily yields at watch announcements and interest rate volatility of 5-year sovereign bonds at 95% confidence level.

Overall fit	
Multiple R	0.7974369
R Square	0.6359056
Adjusted R Square	0.6356624
Standard Error	1.7475712
Observations	1,499

ANOVA

TABLE B2 | Alpha 0.05.

	df	SS	MS	F	*p*-value	sig
Regression	1	7,984.9129	7,984.9129	2,614.5708	0	yes
Residual	1,497	4,571.8459	3.0540053			
Total	1,498	12,556.759				

	coeff	Std err	t stat	*p*-value	lower	upper
Intercept	0.5665916	0.0807399	7.0174942	3.412E-12	0.4082163	0.7249669
Interest rate volatility	0.8175541	0.0159888	51.132874	0	0.7861913	0.848917

Simple linear regression daily yields at watch announcements and interest rate volatility of 5-year sovereign bonds at 99% confidence level.

TABLE B3 |

Overall fit	
Multiple R	0.7974369
R Square	0.6359056
Adjusted R Square	0.6356624
Standard Error	1.7475712
Observations	1,499

ANOVA

TABLE B4 | Alpha 0.01.

	df	SS	MS	F	*p*-value	sig
Regression	1	7,984.9129	7,984.9129	2,614.5708	0	yes
Residual	1,497	4,571.8459	3.0540053			
Total	1,498	12556.759				

	coeff	Std err	t stat	*p*-value	lower	upper
Intercept	0.5665916	0.0807399	7.0174942	3.412E-12	0.358354	0.7748293
Interest rate volatility	0.8175541	0.0159888	51.132874	0	0.7763171	0.8587912

Regression analysis daily yields at credit watch announcement and 5-year sovereign bond volatility. Data obtained from Bloomberg Database; author's own work.

TABLE B5 | Simple linear regression daily yields at watch announcements and interest rate volatility of 10-year sovereign bonds at 95% confidence level.

Overall fit	
Multiple R	0.7150761
R Square	0.5113339
Adjusted R Square	0.5112039
Standard Error	2.3875528
Observations	3,762

ANOVA

TABLE B6 | Alpha 0.05.

	df	SS	MS	F	*p*-value	sig
Regression	1	22,427.774	22,427.774	3,934.4155	0	yes
Residual	3,760	21,433.535	5.7004082			
Total	3,761	4,3861.309				

	coeff	Std err	t stat	*p*-value	lower	upper
Intercept	0.2254389	0.1013239	2.2249329	0.0261449	0.0267837	0.4240941
Interest rate volatility	1.0256712	0.0163519	62.724919	0	0.9936118	1.0577307

Simple linear regression daily yields at watch announcements and interest rate volatility of 10-year sovereign bonds at 99% confidence level.

TABLE B7 |

Overall fit	
Multiple R	0.7150761
R Square	0.5113339
Adjusted R Square	0.5112039
Standard Error	2.3875528
Observations	3762

ANOVA

TABLE B8 | Alpha 0.01.

	df	SS	MS	F	*p*-value	sig
Regression	1	22,427.774	22,427.774	3,934.4155	0	yes
Residual	3,760	21,433.535	5.7004082			
Total	3,761	43,861.309				

	coeff	Std err	t stat	*p*-value	lower	upper
Intercept	0.2254389	0.1013239	2.2249329	0.0261449	–0.035687	0.4865646
Interest rate volatility	1.0256712	0.0163519	62.724919	0	0.9835301	1.0678123

Regression analysis daily yields at credit watch announcement and 10-year sovereign bond volatility.
Source: Bloomberg – Authors' own analysis.

TABLE B9 | Multiple linear regression credit rating agencies of 5-year sovereign bonds at 95% confidence level.

Overall fit	
Multiple R	0.806478581
R Square	0.650407702
Adjusted R Square	0.649471712
Standard Error	1.714132564
Observations	1,499

ANOVA

TABLE B10 | Alpha 0.05.

	df	SS	MS	F	*p*-value	sig
Regression	4	8,167.012648	2,041.753162	694.887382	0	yes
Residual	1,494	4,389.74617	2.938250449			
Total	1,498	12,556.75882				
	coeff	**Std err**	**t stat**	***p*-value**	**lower**	**upper**
Intercept	2.279190433	0.227166879	10.03311065	5.70869E-23	1.833590534	2.7247903
CRA II	–0.865475138	0.20154497	–4.294203613	1.8662E-05	–1.260816301	–0.470134
before/after announcement	–1.138573621	0.090280402	–12.61152578	1.00122E-34	–1.315663425	–0.961484
Watch	1.09095087	0.368664407	2.959197713	0.003132969	0.367796054	1.81410567
announcement grade	0.843266855	0.019695417	42.81538382	4.9548E-262	0.804633248	0.8819005

TABLE B11 | Multiple linear regression credit rating agencies of 5-year sovereign bonds at 99% confidence level.

Overall fit	
Multiple R	0.806478581
R Square	0.650407702
Adjusted R Square	0.649471712
Standard Error	1.714132564
Observations	1,499

TABLE B12 | ANOVA Alpha 0.01

	df	SS	MS	F	*p*-value	sig
Regression	4	8,167.012648	2,041.753162	694.887382	0	yes
Residual	1,494	4,389.74617	2.938250449			
Total	1,498	12,556.75882				
	coeff	**Std err**	**t stat**	***p*-value**	**lower**	**upper**
Intercept	2.279190433	0.227166879	10.03311065	5.70869E-23	1.693298855	2.865082
CRA II	–0.865475138	0.20154497	–4.294203613	1.8662E-05	–1.385284632	–0.345666
before/after announcement	–1.138573621	0.090280402	–12.61152578	1.00122E-34	–1.371417985	–0.905729
Watch	1.09095087	0.368664407	2.959197713	0.003132969	0.140119603	2.0417821
announcement grade	0.843266855	0.019695417	42.81538382	4.9548E-262	0.792469929	0.8940638

Regression analysis yield of European sovereign bonds 20 days before and after a credit watch announcement as dependent variable. Independent variables are CRA II (0 = before; 1 = after), before/after announcement (0 = before; 1 = after), watch announcement (0 = down; 1 = up) and the rating grade coded from 1–14 (1 represents best rating, 14 the worst rating). Data obtained from Bloomberg Database; author's own work.

TABLE B13 | Multiple linear regression credit rating agencies of 10-year sovereign bonds at 95% confidence level.

Overall fit	
Multiple R	0.750250642
R Square	0.562876025
Adjusted R Square	0.562410629
Standard Error	2.259032667
Observations	3762

ANOVA

TABLE B14 | Alpha 0.05.

	df	SS	MS	F	*p*-value	sig
Regression	4	24,688.47941	6,172.1199	1,209.4539	0	yes
Residual	3,757	19,172.82982	5.1032286			
Total	3,761	43,861.30923				
	coeff	**Std err**	**t stat**	***p*-value**	**lower**	**upper**
Intercept	2.77307937	0.114068035	24.310794	2.28E-121	2.5494381	2.9967207
CRA II	–0.289747388	0.095531919	–3.03299	0.002438	–0.477047	–0.102448
before/after announcement	–0.33826698	0.08827827	–3.831826	0.0001293	–0.511345	–0.165189
Watch	0.353885903	0.173132646	2.044016	0.0410215	0.0144428	0.693329
announcement grade	0.65766966	0.011127238	59.104482		0.6358536	0.6794857

TABLE B15 | Multiple linear regression credit rating agencies of 10-year sovereign bonds at 99% confidence level.

Overall fit	
Multiple R	0.750250642
R Square	0.562876025
Adjusted R Square	0.562410629
Standard Error	2.259032667
Observations	3,762

ANOVA

TABLE B16 | Alpha 0.01.

	df	SS	MS	F	*p*-value	sig
Regression	4	24,688.47941	6,172.1199	1,209.4539	0	yes
Residual	3,757	19,172.82982	5.1032286			
Total	3,761	43861.30923				
	coeff	**Std err**	**t stat**	***p*-value**	**lower**	**upper**
Intercept	2.77307937	0.114068035	24.310794	2.28E-121	2.4791102	3.0670485
CRA II	–0.289747388	0.095531919	–3.03299	0.002438	–0.535946	–0.043548
before/after announcement	–0.33826698	0.08827827	–3.831826	0.0001293	–0.565772	–0.110762
Watch	0.353885903	0.173132646	2.044016	0.0410215	–0.092301	0.8000727
announcement grade	0.65766966	0.011127238	59.104482		0.6289932	0.6863461

Regression analysis yield of European sovereign bonds 20 days before and after a credit watch announcement as dependent variable. Independent variables are CRA II (0 = before; 1 = after), before/after announcement (0 = before; 1 = after), watch announcement (0 = down; 1 = up) and the rating grade coded from 1–14 (1 represents best rating, 14 the worst rating). Source: Bloomberg–Authors' own analysis.