Rating Changes and Sovereign Bond Yields

by

Tyler Huber

Advisor: Mario J. Crucini

Economics Honors Thesis

Apr 2014

DEPARTMENT OF ECONOMICS
VANDERBILT UNIVERSITY
NASHVILLE, TN 37235

www.vanderbilt.edu/econ

Rating Changes and Sovereign Bond Yields During the European Debt Crisis*

Tyler Huber

Advisor: Mario J. Crucini

Apr. 11, 2014

Abstract

Rating agencies who assess sovereign debt have garnered much attention during and following the recent European debt crisis. Previous papers have attempted to study these agencies' effect on a variety of different markets, within and outside of the country being rated, over a range of time periods. Here, we focus on the effect of sovereign credit rating changes by the S&P on the debt market of that sovereign during the European debt crisis, with comparisons to rating changes by other agencies. We implement an event study where the event is a rating or outlook change, and the variable of interest is the yield spread on 10-year bonds indices. We find that rating changes significantly increased yield spreads in Greece, Ireland and Portugal during the European Debt Crisis, although these findings are not consistent across agencies.

*I would like to thank Professor Mario Crucini, who generously agreed to serve as my advisor and has guided me throughout the process. Thanks as well go to Professor David Parsley for helping me acquire the data necessary for this study. Finally I would like to thank my fellow honors students, friends and family who have offered support and advice along the way.

I. Introduction

The importance of sovereign creditworthiness has come to light in the past 30 years as a result of the Latin American debt crisis of the 1980s, the Asian financial crisis, and the recent European debt crises. Following these downturns increasing scrutiny has been placed on the riskiness of sovereign debt, or the probability of default. The most widespread measure of such risk is the rating assigned to a country by each of the "Big Three" rating agencies; Standard & Poors, Moody's Investors Services, and Fitch Ratings. These three agencies together hold nearly 90% of the market share in sovereign ratings (ESMA 2013). Certain Mutual and Pension funds, along with other types of investments, have mandates that their investments in sovereign bonds must hold a certain level of "investment grade" credit rating from these agencies. Therefore although these agencies may be independently influential, they also have the ability to move investments in these markets in a concrete way outside of pure investor speculation on the accuracy of such ratings (Sylla 2001).

As economic booms and (more importantly) busts in countries and their associated ratings have evolved, the credit agencies have come under attack with accusations that their ratings do not accurately predict crises, and may instead exacerbate them. The hypothetical argument is as follows. A downgrade of a sovereign by an agency may influence the public to demand a higher risk premium, increases the borrowing costs of that sovereign. This increase in borrowing costs increases the sovereign's debt burden moving them further toward insolvency and leading the agency to downgrade the sovereign further. This could lead to a self-fulfilling prophecy whereby the sovereign actually enters default. In this scenario the sovereign has been induced into default not by its original inherent lack of creditworthiness, but by the agency's

influence on investor expectations and the asymmetries in assessment of default risk between the agency and investors.

This question of prediction vs. exacerbation is a complex one, requiring an understanding of whether rating changes actually convey new information to the marketplace. Furthermore, since sovereign bonds comprise 40% of the stock of global bonds, the effect of these agencies ratings on bond yields is an important question (Hill 2002). The remainder of this paper is organized as follows. Section II gives a brief history of the credit rating agencies and outlines the related literature that has studied various effects of rating changes. Section III describes the credit rating and bond yield data. Section IV presents the methodology and preliminary empirical results associated with the study. Section V offers additional commentary on the rating agencies' behavior as it relates to our study. Section VI compares our initial results to similar analyses. Section VII Concludes and discusses future improvements and potential extensions to the analysis.

II. Brief History and Related Literature

The history of credit rating agencies dates back to the turn of the 20th century when John Moody began publishing ratings on bonds of U.S. railroad companies. While the bond market had existed for at least three centuries before rating agencies came about, the advent of such agencies, as detailed by Richard Sylla in his historical paper on credit agencies, is due to investors' demand for wider and more accessible information on corporations of unprecedented size and capital demands, which at the time were railroad companies.

The agencies initially charged subscribers (investors), but changed their business model and started charging issuers in the early 1970s. This was shortly followed by the advent of "Nationally Recognized Statistical Ratings Organizations" (NRSROs) a name for the rating agencies designated by the Securities and Exchange Commission, which mandated that certain types of investments have a certain rating grade or higher (Sylla 2001). In the late 1970s, the rating agencies began to rate sovereigns as a whole by their probability of default.

Rating agencies assign an alphabetical rating to sovereigns taken from a scale based on certain metrics surrounding the country's political and economic environment. Each agency has its own scale; however there is a clear equivalence for each rating from one scale to the next (Appendix I). For instance, a rating by the S&P of AAA (the highest possible rating defined as an "extremely strong capacity to meet financial commitments") is equivalent to an Aaa rating by Moody's. Furthermore, these agencies give credit outlook and watches on ratings. A positive/ negative "outlook" indicates a potential positive/negative rating change in the intermediate term, while a similar "watch" indicates heightened probability of a change in the near term.

The number of sovereigns rated by these agencies has expanded through the 21st century as more and more countries and companies within their borders sought access to international capital markets (Cantor 1996). As of 12/31/2012, the big three rating agencies assign ratings to a combined 148 Sovereigns. As sovereign ratings increased, so did the scrutiny placed on the agencies. In 1996 Cantor and Packer published the first systematic analysis of the "determinants and impact of sovereign credit ratings." They applied an event study similar to what we use over the period 1987-1994 for all ratings made over that time period by Moody's and the S&P. Necessary to such a study is the conversion of the alphabetical rating from an

agency to a numerical one to be employed in empirical analysis. Appendix I offers a rating conversion similar to the one used by Cantor and Packer. With a two-day event window, they found statistically significant evidence that yield spreads on Eurodollar bonds are affected by rating changes for non-investment grade issues, positive announcements (including outlook/watch) and explicit rating changes (versus outlook/watch changes).

There have been a number of event studies that have been conducted since the Cantor & Packer paper that study the effect of rating changes. However, certain characteristics differentiate such papers. The most significant of these is the study of rating change spillovers into the yield spreads of the countries not being rated, as opposed to the study of rating change effects on own-country spreads. Parsley and Gande presented the first paper using this methodology in 2005 in an attempt to provide a more robust estimation of the effect of rating changes by taking out the possible contamination of events in other countries. Necessary to the analysis is the definition of Common and Differential information spillovers that the authors make in the paper. Common information spillover is when a positive (negative) rating change for a country results in an all-around decrease (increase) in credit spreads abroad. This implies that countries' credit spreads move in tandem. By contrast, a positive (negative) rating change in a country could increase (decrease) that country's attractiveness relative to other countries, and therefore increase (decrease) credit spreads abroad. Parsley and Gande refer to this as a differential effect.

The authors find that rating changes have a significant effect on spreads that is asymmetrical: positive rating changes have no substantial impact on credit spreads in other countries, while negative rating changes result in an increase in all around credit spreads. This

means that for negative rating changes, common information spillovers dominate differential ones, yet for positive changes, neither tend to dominate (if any effect whatsoever). While these findings are interesting and shed light on global credit spreads, they do not provide information on a rating change's effect on domestic spreads, and whether a rating change significantly alters the public's view on sovereign creditworthiness possibly leading to a self-fulfilling prophecy scenario leading to default.

The realm of empirical studies on the effects of rating changes can be separated into three more categories beyond the study of domestic versus spillover spreads. The time horizon for an event study naturally will vary from paper to paper, but there have also been papers that explicitly study the effects of rating changes during crisis periods. This paper clearly falls in that category. Studies can further be categorized by market assessed and geography assessed. An increasing number of papers have studied the effects of rating changes on the stock and credit default markets (among others). Studies on these markets attempt to analyze the effects of rating changes on other aspects of the economy. Finally, studies have naturally focused on different geographies such as emerging markets or the Eurozone as interest in differing geographies has increased over time and during crisis periods. Appendix II presents a full summary of the existing literature on the effects of rating changes, separated by methodology (domestic vs. spillover study).

Roberto De Santis (2012) and Afonso, Furceri and Gomes (2011) provide two papers that are most closely related to this study. De Santis studies the effect of the downgrades of Greece during the European Debt crisis on other countries in the Eurozone. He finds that these

downgrades significantly increased spreads for other countries with weak fiscal fundamentals; namely Ireland, Portugal, Italy, Spain, Belgium and France. Afonso, Furceri and Gomes employ a longer time horizon (1995-2010) on the European Union. They also find significant responses to rating changes as well as outlook changes, particularly in the case of negative changes. This paper distinguishes itself from the two former in two ways. First, we study the effect of rating changes on own country spreads versus spillover effects. Second, we limit our time horizon to the start of the European debt crisis (2009) to present day. In essence, this paper in concerned with the effects of downgrades during the European debt crises on the bond market of the country where the rating change occurs. While the bulk of related literature on the effects of rating changes finds that they do convey new information to various markets, the extent to which these agencies played a role in the evolution of the European Debt crisis gives further indication to their potential to sway markets during economic downturns and the negative implications that could come with such influence.

III. Data

As a preliminary study the primary dataset we use is the rating and outlook changes by the S&P from 1/1/2009 to 4/1/2014 (present day at the time of this draft). Rating changes from Moody's and Fitch have been initially excluded for this study. Differences among these agencies and analyses including the other agencies are discussed in section V and VI. The bond series data was compiled by Bloomberg and (when not available through Bloomberg) DataStream, and reflect daily market-closing observations of 10-year bond index yields for each country. For a country to be included in this study, it must have at least one rating change by the S&P over

the time period studied, have a Bloomberg or DataStream 10-year bond index, and be on the Euro. Seven sovereigns meet these criteria, namely; Belgium, France, Greece, Ireland, Italy, Portugal and Spain. Ireland is the sole country whose bond yield data was compiled from DataStream, as its Bloomberg index was disbanded in late 2011. For our purposes, any explicit rating change or outlook change constitutes a rating event. Over this time horizon we view a total of 56 events, distributed among countries as shown below. The vast majority of these events are negative (rating downgrades) and account for 50 of the 56 total events.

Table 1 ***S&P Events Distribution***

(2009-2014)	Downgrades	Upgrades	Total
Belgium	3	1	4
France	3	0	3
Greece	13	3	16
Ireland	8	0	8
Italy	5	0	5
Portugal	9	2	11
Spain	9	0	9
Total	***50***	***6***	***56***

IV. Methodology & Empirical Results

Our analysis begins by computing the yield spread for the bond series data for each country in our Eurozone subset. We implement a market model event study, and use Germany's Bloomberg composite 10-year bond index yields as a proxy for the market return (Germany had no rating changes by S&P over our estimation window). Yield spreads are calculated as Domestic Yield minus German yield. For each country, we estimate the following regression over our time horizon for normal returns where θ is the yield spread and R is the Market (German) returns.

$$\Theta_{i,t} = \alpha_i + \beta_i R_t + \varepsilon_{i,t}$$

We then calculate abnormal returns as the difference between the actual return, and our estimated market return.

$$AR_{i,t} = \Theta_{i,t} - \alpha_i - \beta_i R_t = \varepsilon_{i,t}$$

For our event study we use a two-day event window (0,1], in an attempt to gauge the market's immediate reaction to the rating event while incorporating potential lags in trading hours and the possibility of the rating announcement occurring after trading hours. For each country we then separate events into two categories; positive events (rating or outlook upgrades) and negative events (rating or outlook downgrades). Aggregating across events and over the event window for each country gives a measure of whether rating events have significantly altered spreads. Finally, we perform a pooled analysis and aggregate across countries to see whether positive or negative events by the S&P over our time horizon have had an overall effect on the countries in our sample. We find highly statistically significant evidence for Greece, Ireland and Portugal that negative events increased yield spreads over our time horizon. We also find some evidence that positive events decreased yields for Greece and Portugal, with significance at the .05 and .1 level respectively. For all other countries there is no significant effect. A summary of the results is given below in Tables 2 and 3, separated by negative and positive events. Average abnormal return (AAR) is our aggregated value of abnormal returns, where AAR/St Dev ~ N(0,1). N is the number of observed events, and t is the number of days used in computing the market regression.

Table 2 2009-2014

Negative Events by S&P

	Belgium	France	Greece	Ireland	Italy	Portugal	Spain	Pooled across Countries
AAR	*-0.11*	*0.00*	*0.04*	*0.06*	*0.02*	*0.10*	*0.01*	*0.04*
St Dev	*0.05*	*0.06*	*0.02*	*0.02*	*0.04*	*0.02*	*0.03*	*0.20*
N	*3*	*3*	*13*	*8*	*5*	*9*	*9*	*50*
t	*1,369*	*1,369*	*1,358*	*1,367*	*1,369*	*1,364*	*1,369*	*9,565*
Stat	*-1.94*	*-0.03*	*2.69*	*2.89*	*0.60*	*4.41*	*0.26*	*0.18*
P-Value	*0.97*	*0.51*	*0.00*	*0.00*	*0.28*	*0.00*	*0.40*	*0.43*

Table 3 2009-2014

Positive Events by S&P

	Belgium	France	Greece	Ireland	Italy	Portugal	Spain	Pooled across Countries
AAR	*0.08*		*-0.06*			*-0.07*		*-0.04*
St Dev	*0.09*		*0.03*			*0.05*		*0.58*
N	*1*	*0*	*3*	*0*	*0*	*2*	*0*	*6*
t	*1,369*		*1,358*			*1,364*		*4,091*
Stat	*0.87*		*-1.74*			*-1.38*		*-0.07*
P-Value	*0.81*		*0.04*			*0.08*		*0.47*

It is important to point out that the three countries that showed a response to rating events were all downgraded to speculative grade at some point over our time horizon, with the exception of Ireland which was downgraded to two notches above speculative grade. This supports the findings of other papers that speculative grade rated sovereigns are more sensitive to rating or outlook changes than investment grade rated sovereigns (Cantor & Packer 1996, Arezki, Bertrand and Amadou 2011).

V. Rating Agency Behavior

As explained in the Data section, our preliminary analyses uses only one of the big three agencies' ratings. A primary motivation for this is that the S&P was the most active agency

during our time period (56 rating events versus 47 for Moody's and 43 for Fitch). Additionally, the S&P is one of the largest of the three agencies, with around 35% of the market share in ratings. Moody's also has around 35%, whereas Fitch holds around 18% (ESMA 2013). Finally, the distribution of rating events is not neatly clustered among agencies (see appendix VI). That is, a rating event by one agency does not tend to evoke a rating event by the other two in the short term. There are a number of occasions, however, where a rating event by one agency is closely followed by another. In these cases, the primary event may have a greater impact, as the secondary event may simply serve to reaffirm the information already conveyed to the marketplace and therefore have a diminished effect. We found that both Moody's and S&P had the greatest portion of leading ratings over our time horizon, as shown in Table 4 below.

Table 4 2009-2014

Numer of leads by less than 7 days			
	S&P	**Moodys**	**Fitch**
Belgium	0	0	0
France	0	0	0
Greece	3	3	1
Ireland	0	1	0
Italy	0	1	0
Portugal	1	1	1
Spain	2	0	3
Total	**6**	**6**	**5**
%	35.3%	35.3%	29.4%

Using one agency, however, has the possibility to introduce biases resulting from clustering. Clustering in our study happens when two or more rating events occur on the same day or within one day of each other, which would lead to event window overlap if we were to expand the rating data to other agencies. Additionally, if there are events by agencies other than the one being studied that fall into our event windows, then we are essentially

understating the number of events taking place, skewing our p-values upward. This occurs four times for rating events by the S&P, twice for Greek ratings and once each for Ireland and Portugal. While the magnitude of our test statistics for these countries in our initial study is great enough that events in these countries still have a statistically significant effect, clustering may have skewed our results to some extent.

On the other hand, using only one agency may still give an accurate representation of all agencies' effect, since they act in much the same way as one another. As previously stated, agencies tend to rate sovereigns very similarly. Expanding our analysis to other agencies may therefore not give much more information than only including one. To analyze this, we calculated the pairwise difference in numerical rating between agencies, averaged across each country over our time horizon for the European subset, the results of which are shown below in table 5 (conversion to numerical ratings can be found in appendix 1).

Table 5

	Pairwise differences in numerical ratings						
	Belgium	**France**	**Greece**	**Ireland**	**Italy**	**Portugal**	**Spain**
S&P - Moodys	0.00	-0.38	1.39	2.49	-1.77	0.47	-1.54
S&P - Fitch	0.20	-0.25	-1.32	-0.19	-1.12	-1.74	-1.13
Moodys - Fitch	-0.35	0.13	-2.71	-2.67	0.65	-2.21	0.41
Average Variation	*0.18*	*0.26*	*1.81*	*1.78*	*1.18*	*1.47*	*1.02*

Pooled Differences

	S&P	Moodys	Fitch
S&P	0	0.09	-0.79
Moodys	-0.09	0	-0.97
Fitch	0.79	0.97	0

As an example, for France, over our time horizon, the S&P's numerical rating is on average 0.38 points lower than that of Moody's (a one point difference would equate to a one notch difference on the rating scale). As we can see in the Pooled Differences section, over our time period for the countries included Fitch tends to be the most optimistic (0.79 points above

S&P and 0.97 points above Moody's) followed by the S&P (0.09 points above Moody's) then Moody's, who tends to be the least optimistic of the three. These differences, however, are mostly trivial and may instead reflect minute differences in the rating scales of each agency.

The fact that agencies are generally in agreement as to a sovereign's rating and that rating events across agencies are not neatly clustered in groups provide evidence that using rating events by the S&P may be a sufficient study of rating events' effect on bond yields. Results from similar analyses using the other agencies are provided in the following section to add robustness.

VI. Comparison to Similar Analyses

Using the same bond yield data, we perform similar analyses using the rating data by both Moody's and Fitch, as well as a pooled analysis using the rating data by all three firms. The results are somewhat consistent with the findings of our initial study, although there is less evidence of effects of rating events for each of the other two agencies. For negative rating events, events by Moody's only have a substantial impact on Portugal's yields, whereas Fitch's events only show evidence of an effect on the yields of Greece. The impact of S&P's negative events along with the increase in observations do carry over, however, as a pooled analysis across agencies for negative rating events shows significant effects for Greece, Ireland and Portugal. The results of the event studies using the other two agencies and the pooled analysis for negative events is shown in tables 6, 7 and 8 below.

Table 6 2009-2014

Negative Events by Fitch

	Belgium	France	Greece	Ireland	Italy	Portugal	Spain	Pooled across Countries
AAR	*0.02*	*0.09*	*0.03*	*0.01*	*0.02*	*0.03*	*-0.01*	*0.02*
St Dev	*0.05*	*0.07*	*0.02*	*0.02*	*0.04*	*0.03*	*0.03*	*0.23*
N	*3*	*2*	*11*	*7*	*4*	*6*	*6*	*39*
t	*1,369*	*1,369*	*1,358*	*1,367*	*1,369*	*1,364*	*1,369*	*9,565*
Stat	*0.45*	*1.22*	*1.83*	*0.63*	*0.48*	*1.02*	*-0.31*	*0.10*
P-Value	*0.33*	*0.11*	*0.03*	*0.27*	*0.31*	*0.15*	*0.62*	*0.46*

Table 7 2009-2014

Negative Events by Moody's

	Belgium	France	Greece	Ireland	Italy	Portugal	Spain	Pooled across Countries
AAR	*0.02*	*-0.08*	*0.02*	*0.02*	*0.00*	*0.08*	*0.01*	*0.02*
St Dev	*0.05*	*0.10*	*0.02*	*0.02*	*0.04*	*0.02*	*0.03*	*0.22*
N	*3*	*1*	*11*	*8*	*4*	*8*	*8*	*43*
t	*1,369*	*1,369*	*1,358*	*1,367*	*1,369*	*1,364*	*1,369*	*9,565*
Stat	*0.31*	*-0.80*	*1.00*	*0.96*	*0.01*	*3.37*	*0.29*	*0.11*
P-Value	*0.38*	*0.79*	*0.16*	*0.17*	*0.49*	*0.00*	*0.39*	*0.45*

Table 8 2009-2014

Negative Events Pooled Across Agencies

	Belgium	France	Greece	Ireland	Italy	Portugal	Spain	Pooled Across Countries & Agencies
AAR	*-0.02*	*0.01*	*0.03*	*0.03*	*0.01*	*0.08*	*0.00*	*0.03*
St Dev	*0.03*	*0.04*	*0.01*	*0.01*	*0.02*	*0.01*	*0.02*	*0.12*
N	*9*	*6*	*35*	*23*	*13*	*23*	*23*	*132*
t	*1,369*	*1,369*	*1,358*	*1,367*	*1,369*	*1,364*	*1,369*	*9,565*
Stat	*-0.68*	*0.36*	*3.23*	*2.61*	*0.65*	*5.27*	*0.17*	*0.23*
P-Value	*0.75*	*0.36*	*0.00*	*0.00*	*0.26*	*0.00*	*0.43*	*0.41*

For positive events, we see results that are more consistent with our results using only the S&P's rating data. Positive events for Fitch confirm that influence of rating events on Greece, and while there is some evidence of a decrease in spreads in response to Moody's positive events, it is not statistically significant. The two Moody's upgrades of Spain (the only positive events for the country) do prove to have a substantial impact, however, at the .05 level. Findings for Ireland by both Moody's and Fitch, on the other hand, are counter intuitive since spreads rose on average in response to positive events by each agency. This may be due to the small number of event observations in each case. A summary of the results for positive events by Moody's, Fitch and the pooled positive events is given in the tables below.

Table 9 2009-2014

Positive Events by Fitch

	Belgium	France	Greece	Ireland	Italy	Portugal	Spain	Pooled across Countries
AAR			*-0.34*	*0.07*				*-0.13*
St Dev			*0.04*	*0.04*				*0.71*
N	*0*	*0*	*2*	*2*	*0*	*0*	*0*	*4*
t			*1,358*	*1,367*				*2,725*
Stat			*-8.35*	*1.78*				*-0.19*
P-Value			*0.00*	*0.96*				*0.42*

Table 10 2009-2014

Positive Events by Moody's

	Belgium	France	Greece	Ireland	Italy	Portugal	Spain	Pooled across Countries
AAR			*-0.03*	*0.05*			*-0.11*	*-0.05*
St Dev			*0.06*	*0.06*			*0.06*	*0.71*
N	*0*	*0*	*1*	*1*	*0*	*0*	*2*	*4*
t			*1,358*	*1,367*			*1,369*	*4,094*
Stat			*-0.53*	*0.93*			*-2.03*	*-0.07*
P-Value			*0.30*	*0.83*			*0.02*	*0.47*

Table 11 2009-2014

Positive Events Pooled Across Agencies

	Belgium	France	Greece	Ireland	Italy	Portugal	Spain	Pooled Across Countries & Agencies
AAR	*0.08*		*-0.15*	*0.07*		*-0.07*	*-0.11*	*-0.07*
St Dev	*0.09*		*0.02*	*0.03*		*0.05*	*0.06*	*0.38*
N	*1*	*0*	*6*	*3*	*0*	*2*	*2*	*14*
t	*1,369*		*1,358*	*1,367*		*1,364*	*1,369*	*6,827*
Stat	*0.87*		*-6.27*	*1.99*		*-1.38*	*-2.03*	*-0.18*
P-Value	*0.81*		*0.00*	*0.98*		*0.08*	*0.02*	*0.43*

VII. Conclusion

The differences in results among the three rating agencies are curios given that rating events do appear to occur independently and not in clusters. Fitch had the fewest ratings, has a much smaller market share, and followed the other two agencies in close succession more frequently than it led, which all have the potential to dilute its effect on the marketplace. However, while many of the results from Fitch and Moody's are not statistically significant, nearly all countries show an average increase in yield spreads in response to negative rating events by each agency (and a similar decrease in spreads in response to positive events). This consistency in the correct sign supports the hypothesis that rating events during the European debt crisis did add new information to the marketplace, especially in the case of the more troubled economies like Greece, Ireland and Portugal. The fact that these three countries were most affected also supports the hypothesis that countries rated speculative grade or nearby are

more sensitive to rating events. This, to some extent, supports the view that rating agencies have the potential to exacerbate the debt burden of a country during crises periods.

Finally, while our findings show significance, there are a number of areas where our model may be improved to add robustness. First is the issue of external events to which the rating agencies may be changing their ratings in response. This is likely the case in the upgrade of Greece by Fitch on March 13, 2012. The upgrade happened on the same day the IMF agreed to $8.2 billion in bailout funds (Trotman 2012). The market's response to the external event is almost surely captured in the event window, as yield spreads fell by 50% the day of announcement. Our results, however, imply that this swing in the marketplace is a reaction to the rating event, where in reality it is the rating agency that is reacting to external events. While removing this event from our dataset still shows a significant response to Fitch's upgrades, similar scenarios where the rating agency immediately reacts to "big news" may have skewed our results. Some additional research would be necessary to compile a list of rating events that appear to be independent as opposed to reactionary events.

Second, our model does not disassociate events from one another in any way. That is, in our model's view, a change in rating outlook from stable to positive in one of the highest ratings is that same as a change in rating from speculative to investment grade. Our results must therefore be interpreted as the effect of any type of rating or outlook change whatsoever. This may have diluted the effect of explicit rating changes, or rating events that occurred lower on the rating scale.

Finally, as previously stated, when pooling across agencies our event study succumbs to event window overlap. This and the possibility of rating events in countries outside our country

set have the potential to bias our results further. While there are some drawbacks to our model, the magnitude of our test statistics still imply that rating events did play a role in the evolution of the European debt crisis. This is especially apparent in the cases of negative events for Greece and Portugal, and for the S&P. Adding robustness to this analysis as described above may provide additional insight into why the S&P seem to have a greater impact on the marketplace during this period.

In late 2013 the European Securities and Market Authority (ESMA) issued a statement indicating that they might pursue regulatory action following investigations of the big three rating agencies. The statement added that the investigation revealed issues in the sovereign rating process which "could pose risks to the quality, independence and integrity of ratings." Chairman of the ESMA Steven Maijoor was quoted as saying "The impact which changes in these ratings can have on financial markets and sovereign states can be significant" (ESMA 2013). The need for regulatory action necessitates a confirmation of the validity of this statement. While there is absolutely room for discussion and continued research on the topic, these results do tend to support the chairman's statement that the rating agencies can have a significant impact on the marketplace and therefore may warrant regulatory action.

Appendices

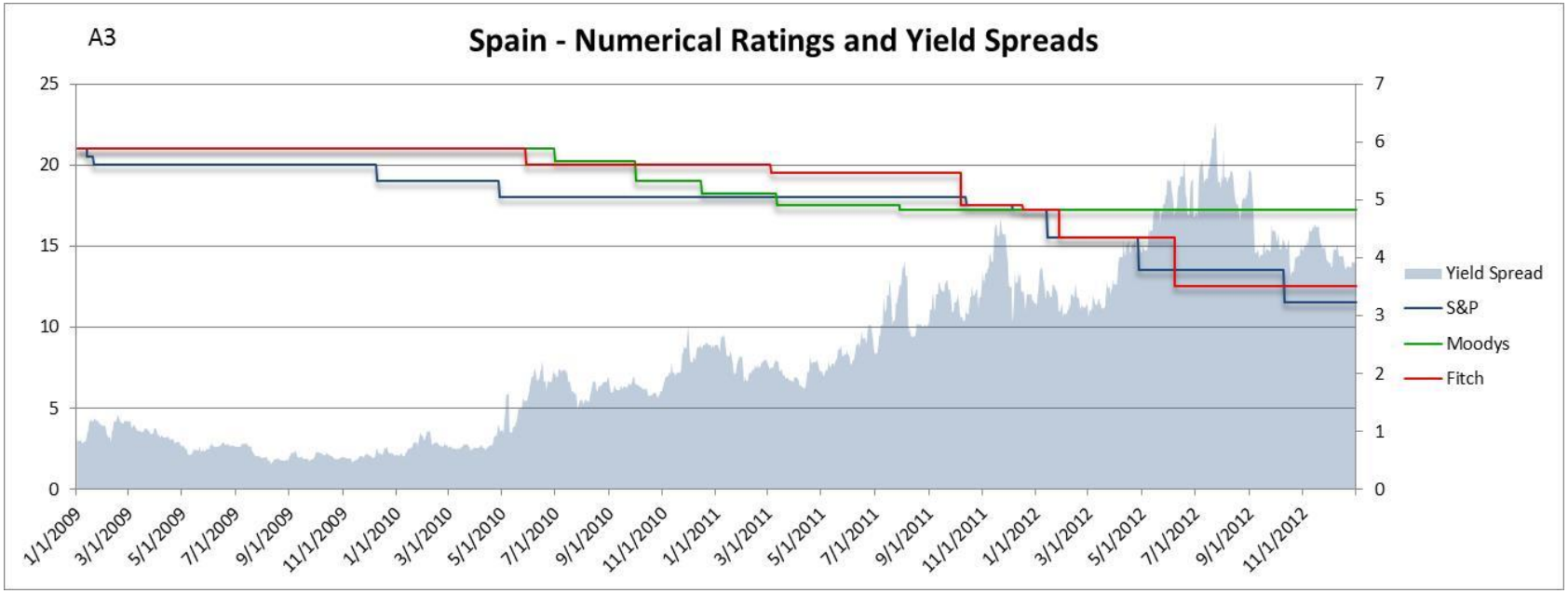
A1

Rating Conversion				
Numerical	Fitch	S&P	Moodys	
21	AAA	AAA	Aaa	
20	AA+	AA+	Aa	
19	AA	AA	Aa1	
18	AA-	AA-	Aa2	
17	A+	A+	Aa3	Investment
16	A	A	A	Grade
15	A-	A-	A1	
14	BBB+	BBB+	A2	
13	BBB	BBB	A3	
12	BBB-	BBB-	Baa	
11	BB+	BB+	Baa1	
10	BB	BB	Baa2	
9	BB-	BB-	Baa3	
8	B+	B+	Ba1	Non
7	B	B	Ba2	Investment
6	B-	B-	Ba3	Grade
5	CCC+	CCC+	B1	
4	CCC	CCC	B2	
3	CCC-	CCC-	B3	
2	CC	CC	Caa1	
1	C	C	Caa2	
0	DDD	DDD	Caa3	
0	DD	DD	Ca	
0	D	D	C	
0	RD	SD	WR	
NA		NR		

A2

	Date Published	Author(s)	Journal Published	Methodology	Time Horizon	Market Assessed	Geography Assessed
Domestic							
1	Oct-96	Richard Cantor and Frank Packer	FRBNY Economic Policy Review	Domestic Spread Event Study	1987-1994	Bond	Worldwide
2	Mar-99	Reisen and von Maltzan	OECD Development Centre (Working Paper)	Domestic Spread Event Study	1997-1998	Bond	Worldwide
3	Aug-02	Brooks, Faff, D. Hillier and J. Hillier	The World Bank Economic Review	Domestic Spread Event Study	1973-2000	Stock	Worldwide & Emerging Markets
4	Aug-04	Norden and Weber	Journal of Banking and Finance	Domestic Spread Event Study	2000-2002	Stock and Credit Default Swap	Worldwide
5	Oct-06	Pukthuanthong-Le, Elayan and Rose	Global Finance Journal	Domestic Spread Event Study	1990-2000	Bond and Stock	Worldwide
6	Jun-08	Hooper, Hume and Kim	University of New South Wales (Prof)	Domestic Spread Event Study	1995-2003	Stock	Worldwide & Emerging Markets
7	Jun-11	Afonso, Furceri and Gomes	ECB (Working Paper)	Domestic Spread Event Study	1995-2010	Bond and Credit Default Swap	European Union
Spillover							
1	May-02	Kaminsky and Schmukler	Journal of Banking and Finance	Spillovers Event Study	1990-2000	Bond	Emerging Markets
2	Feb-03	Roman Kraussl	University of Crete (Professor)	Spillovers Event Study	1977-2000	Bond	Emerging Markets
3	Oct-04	Gande and Parsley	Journal of Financial Economics	Spillovers Event Study	1991-2000	Bond	Worldwide
4	Jan-07	Ferreira and Gama	Journal of Banking and Finance	Spillovers Event Study	1989-2003	Stock	Worldwide
5	Oct-10	Arezki, Candelon and Sy	IMF, University of Maastricht	Spillovers Event Study	2007-2010	Stock and Credit Default Swap	Europe
6	Mar-11	Arezki, Candelon and Sy	IMF, University of Maastricht	Spillovers Event Study	2007-2010	Stock and Credit Default Swap	Europe
7	May-12	Claeys and Vasicek	Universitat de Barcelona, Czech National Bank	Spillovers Event Study	2000-2012	Bond	Europe
8	May-12	Michaelelides and Milidonis	University of Cyprus (Professors)	Spillovers Event Study	1988-2011	Stock	Worldwide
9	Jul-13	Hwang and Park	Korea University (Assistant Prof)	Spillovers Event Study	1988-2012	Stock	Europe
10	Aug-13	Boninghausen and Zabel	University of Munich (Grad Student)	Spillovers Event Study	1994-2011	Bond	Worldwide
Domestic & Spillover							
1	May-10	Miroslav Mateev	American University in Bulgaria (Professor)	Domestic & Spillover Event Study	1998-2007	Bond and Stock	Emerging Markets
2	May-10	Estevan Flores	Stanford University (Undergrad)	Domestic & Spillover Event Study	1997-2010	Bond, Stock, VIX	Emerging Markets
3	Dec-10	Ismailescu and Kazemi	Journal of Banking and Finance	Domestic & Spillover Event Study	2001-2009	Credit Default Swap	Emerging Markets
4	Dec-11	Alsakka dn Gwilym	Elsevier	Domestic & Spillover Event Study	2000-2010	Foreign Exchange	Europe and Central Asia
5	Feb-12	Roberto A. De Santis	ECB (Working Paper)	Domestic & Spillover Event Study	2008-2011	Bond and Credit Default Swap	Europe
6	Jun-13	Aizenman, Binici and Hutchison	NBER (Working Paper)	Domestic & Spillover Event Study	2005-2012	Credit Default Swap	European Union
Domestic & Spillover							
1	Dec-08	Alsakka and ap Gwilym	Elsevier	Ordered Probit Model	2000-2006	Rating Heterogeneity	Emerging Markets
2	Oct-12	Williams, Alsakka, and Gwilym	Elsevier	Ordered Probit Model	1999-2009	Bank Ratings	Emerging Markets
3	Apr-13	Alsakka and ap Gwilym	Elsevier	Ordered Probit Model	2006-2012	Bank Ratings	Europe

A3



A4

Total Numer of Rating Events				
Country	*S&P*	*Moodys*	*Fitch*	*Total*
Belgium	4	3	3	*10*
France	3	1	2	*6*
Greece	16	12	13	*41*
Ireland	8	9	9	*26*
Italy	5	4	4	*13*
Portugal	11	8	6	*25*
Spain	9	10	6	*25*
Total	*56*	*47*	*43*	*146*

Number of Downgrades				
Country	*S&P*	*Moodys*	*Fitch*	*Total*
Belgium	3	3	3	*9*
France	3	1	2	*6*
Greece	15	11	11	*37*
Ireland	8	8	7	*23*
Italy	5	4	4	*13*
Portugal	9	8	6	*23*
Spain	9	8	6	*23*
Total	*52*	*43*	*39*	*134*

Number of Upgrades				
Country	*S&P*	*Moodys*	*Fitch*	*Total*
Belgium	1	0	0	*1*
France	0	0	0	*0*
Greece	3	1	2	*6*
Ireland	0	1	2	*3*
Italy	0	0	0	*0*
Portugal	2	0	0	*2*
Spain	0	2	0	*2*
Total	*6*	*4*	*4*	*14*

Source: Author's Calculations

A5

Average days until next rating event by each Agency

=

Belgium

	S	M	F
S	0	110	64
M	375	0	310
F	186	69	0

Italy

	S	M	F
S	0	37	46
M	257	0	185
F	185	68	0

France

	S	M	F
S	0	331	279
M	357	0	235
F	75	339	0

Portugal

	S	M	F
S	0	96	119
M	127	0	132
F	80	46	0

Greece

	S	M	F
S	0	46	85
M	91	0	91
F	66	41	0

Spain

	S	M	F
S	0	61	55
M	210	0	134
F	163	22	0

Ireland

	S	M	F
S	0	32	47
M	139	0	118
F	73	68	0

Works Cited

Afonso, Antonio, Davide Furceri, and Pedro Gomes. "Sovereign Credit Ratings and Financial Markets Linkages." *ECB Working Paper Series* 1347th ser. (2011)

Aizenman, Joshua, Mahir Binici, and Michael M. Hutchison. "Credit Ratings and the Pricing of Sovereign Debt during the Euro Crisis." *NBER Working Paper Series* (2013): n. pag. Print.

Al-Sakka, Rasha, and Owain Ap Gwilym. "Heterogeneity of Sovereign Rating Migrations in Emergin Countries." *Elsevier* (2008): n. pag. Web.

Alsakka, Rasha, and Owain Ap Gwilym. "Rating Agencies' Signals during the European Soveregin Debt Crisis: Market Impact and Spillovers." *Journal of Economic Behavior and Organization* (2011): n. pag. Print.

Alsakka, Rasha, Owain Ap Gwilym, and Tuyet Nhung Vu. *Bank and Sovereign Credit Ratings during the European Debt Crisis*. Bangor Business School, Bangor University, 30 Apr. 2013. Web.

Arezki, Rabah, Bertrand Candelon, and Amadou Sy. "Sovereign Rating News and Financial Markets Spillovers: Evidence from the European Debt Crisis." *IMF Working Paper* 11.68 (2011): n. pag. Print.

Arezki, Rabah, Bertrand Candelon, and Amadou Sy. "Sovereign Ratings News and FInancial Markets Spillovers: Evidence from the European Debt Crises." *IMF Working Paper* (2010): n. pag. Web.

Bloomberg L.P. (2013) Bond Yields on various bond indices. Retrieved Oct, 2013 from Bloomberg database.

Boninghausen, Benjamin, and Michael Zabel. *Credit Ratings and Cross-Border Bond Market Spillovers*. Munich Graduate School of Economics, 12 Aug. 2013. Web.

Borensztein, Eduardo, Kevin Cowan, and Patricio Valenzuela. "Sovereign Ceilings "Lite"? The Impact of Sovereign Ratings on Corporate Ratings in Emerging Market Economies." *IMF Working Paper* (2007): n. pag. Web.

Brooks, Robert, Robert Faff, David Hillier, and Joseph Hillier. "The National Market Impact of Sovereign Rating Changes." *Journal of Banking and Finance* (2004): n. pag. Web.

Claeys, Peter, and Borek Vasicek. *Measuring Sovereign Bond Spillover in Europe and the Impact of Rating News*. Universitat De Barcelona and Czech National Bank, May 2012. Web.

Cantor, R., Packer, F., 1996. Determinants and impact of sovereign credit ratings. Federal Reserve Bank of New York Economic Policy Review 2 (2), 37–53.

Cavanaugh, Marie. Sovereign Rating And Country T&C Assessment Histories. 31 Dec. 2012. Raw data.

CRAs' Market Share Calculation According to Article 8d of the CRA Regulation. Publication. European Securities and Markets Authority, 16 Dec. 2013. Web. 1 Apr. 2014. <http://www.esma.europa.eu/system/files/esma_cra_market_share_calculation.pdf>.

Datastream International. (November 14, 2013). Available: Datastream International.

De Santis, Roberto A. "The Euro Area Sovereign Debt Crisis: Safe Haven, Credit Rating Agencies and the Spread of the Fever from Greece, Ireland and Portugal." *ECB Working Paper Series* 1419th ser. (2012): n. pag. Print.

Dimitrijevic, Alexandra. *How We Rate Sovereigns*. New York: Standard & Poor's, 13 Mar. 2012. PDF.

The European Securities and Markets Authority. *ESMA Identifies Deficiencies in CRAs Sovereign Ratings Processes*. ESMA, 2 Dec. 2013. Web. 1 Apr. 2014. <http://www.esma.europa.eu/content/ESMA-identifies-deficiencies-CRAs-sovereign-ratings-processes>.

Ferreira, Miguel A., and Paulo M. Gama. "Does Sovereign Debt Rating News Spill Over to International Stock Markets?" *Journal of Banking and Finance* (n.d.): n. pag. Web.

Fitch Ratings." *Fitch Ratings*. <http://www.fitchratings.com/web/en/dynamic/fitch-home.jsp>. PDF Document, New York.

Fitch Ratings. Historical Sovereign Credit Ratings. 24 Aug. 2012. Raw data. Microsoft Excel Document, London.

Flores, Estevan. *Do Sovereign Credit Rating Changes Have Spillover Effects on Other Countries?* Economics Department, Stanford University, 9 May 2010. Web.

Ho Hwang, Joon, and Sangwon Park. *National Spillover Effects of Sovereign Credit Rating Changes: The Case of the European Union and the Eurozon*. Korea University, 7 July 2013. Web.

Hooper, Vince, Timothy Hume, and Suk-Joong Kim. "Sovereign Rating Changes - Do They Provide New Information for Stock Markets?" *Economic Systems* 32.2 (2008): n. pag. Web.

Hill, Claire A. (2002), "Rating Agencies Behaving Badly: The Case of Enron", *Conn. L. Rev.* 35, 1145

Ismailescu, Iuliana, and Hossein Kazemi. "The Reaction of Emerging Market Credit Default Swap Spreads to Sovereign Credit Rating Chagnes." *Journal of Banking and Finance* 34.12 (2010): n. pag. Print.

Kaminsky, Graciela, and Sergio Schmukler. "Emerging Market Instability: Do Sovereign Ratings Affect Country Risk and Stock Returns?" *The World Bank Economic Review* 16.2 (2002): n. pag. Web.

Klein, Alec (23 November 2004). “Smoothing the Way for Debt Markets”. *The Washington Post*.

Kraussl, Roman. *Do Changes in Sovereign Credit Ratings Contribute Ot Financial Contagion in Emerging Market Crises?* Department of Economics, University of Crete, n.d. Web.

MacKinlay, Craig A. *Event Studies in Economics and Finance*. Nashville: American Economic Association, Mar. 1997. PDF.

Mateev, Miroslav. *The Effect of Sovereign Credit Rating Announcements on Emergin Bond and Stock Markets: New Evidences*. American University in Bulgaria, 2010. Web.

Michaelides, Alexander, and Andreas Milidonis. *Sovereign Debt Rating Changes and the Stock Market*. University of Cyprus, 2012. Web.

"Moody's Investor Service." *Moody's Corporation*. <https://www.moodys.com/Pages/atc002.aspx>.

Norden, Lars, and Martin Weber. "Informational Efficiency of Credit Default Swap and Stock Markets: The Impact of Credit Rating Announcements." *Journal of Banking and Finance* (2004): n. pag. Web.

Parsley, David C, and Gande, Amar. "News Spillovers in the Sovereign Debt Market."*Journal of Financial Economics* 75 (2005): 691-734. PDF.

Pukthuanthong-Le, Kuntara, Fayez A. Elayan, and Lawrence Rose. "Equity and Debt Market Responses to Sovereign Credit Ratings Announcement." *Global Finance Journal* (2006): n. pag. Web.

Reisen, H., von Maltzan, J., 1999. Boom and bust and sovereign ratings. International Finance 2 (2), 273–293.

Reisen, Helmut, and Julia Von Maltzan. "Boom and Bust and Sovereign Ratings." *OECD Development Centre* (1999): n. pag. Web. 1 Dec. 2013.

"Standard & Poor's Rating Service." *S&P* Web <http://www.standardandpoors.com/ratings/en/us/>.

Sylla, Richard. *A Historical Primer on the Business of Credit Ratings*. Technical Report. Department of Economics: Stern School of Business, New York, 2001.

Trotman, Andrew, and Amy Wilson. "Debt Crisis: As It Happened - March 13, 2012." *The Telegraph*. Telegraph Media Group, 13 Mar. 2012. Web. 17 Mar. 2014.

Williams, Gwion, Rasha Alsakka, and Owain Ap Gwilym. "The Impace of Sovereign Rating Actions on Bank Ratings in Emergin Markets." *Journal of Banking and Finance* 37 (2013): 563-77. 8 Oct. 2012. Web.