The Contagion Effects of Sovereign Downgrades: Evidence from the European Financial Crisis

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ABSTRACT: This research examines the effects of sovereign downgrades on European financial markets between 2005 and 2012. Vector Autoregression (VAR) techniques are used to investigate the presence of contagion effects after a sovereign downgrade across equity indices, five year Credit Default Swaps (CDS) and ten year government bonds of the investigated European states. Sovereign downgrades are found to be associated with an increase in equity returns, and cause significant increases in the cost of insuring debt through CDS and the yield of government debt. The Greek and Irish downgrades are to found to have significant reverberations throughout European financial markets. German CDS spreads are found to increase when a European state is downgraded, signalling their use by investors as a barometer of European-wide defaults. Though credit rating agencies clearly missed the European sovereign crisis prior to 2007, their rating downgrades are still found to cause significant effects within European financial markets.

Keywords: Sovereign ratings; VAR; contagion; financial crisis; stock markets.
JEL Classifications: G01; G15

1. Introduction

Since 2010, international credit rating agencies have downgraded numerous European states, with the outlook for all being placed firmly under the microscope. This has raised many doubts about the credibility of credit rating agencies as to why they have implemented these downgrades in the midst of crisis, rather than during its evolution. The downgrades implemented were centralised on the main problematic states of Greece, Ireland, Spain, Italy and Portugal. But other states, perceived to be more economically stable such as France, Belgium and Austria have also been subjected to similar fates.

This research specifically investigates the contagion effects of these individual downgrades across European financial markets, through the main financial inter-linkages provided by equity markets, five year credit default swaps (CDS) and ten year government debt. The credit rating agencies under investigation are Moody's, Fitch and Standard and Poors. Vector autoregression (VAR) techniques are used to test for the presence of contagion through the implementation of dummy variables denoting the announcement of a sovereign downgrade.

The channels in which contagion may spread have increased in Europe since the establishment of the Euro currency in 1999. Fratzscher (2002) found that the aggregation of numerous states into this currency union has increased the correlation of equity returns across Europe. Sy (2009) found that credit rating agency announcements could cause contagion effects in Europe as a result of rating-based triggers such as banking regulation changes, ECB collateral rules, CDS contracts and other investment mandates. Areski et al. (2011) found that the holdings of foreign debt by domestic banks and European-wide debt within European banks could enhance contagion effects. The authors focused on the effects of ratings announcements for European countries between 2007 and 2010 to find significant spillover effects. Ehrmann et al. (2010) uncovered evidence of substantial international spillover effects across numerous international asset classes during the recent crisis, while Kiff et al. (2012) found evidence supporting rating agency failure during the European crisis and conclude that ratings should incorporate obligor's resilience to stress scenarios in their methodology.

Bissoondoyal-Bheenick (2012) argued that there are more significant spillover effects after a rating change when links in financial markets are analysed in comparison to similar trade links, and

that there appears to be a contamination effect in terms of contagion present for both upgrades and downgrades. Alsakka and ap Gwilym (2012) investigated pre and post-crisis rating agency decisions for countries in Europe and Central Asia to find strong spillover effects through currency markets, with the magnitude of these spillover effects more pronounced in crisis periods rather than periods of relative financial calm. De Santis (2012) investigated the influence of rating agencies in spreading crisis to Europe from Greece, Ireland and Portugal. This research finds that three factors can explain the recorded developments in sovereign spreads: an aggregate regional risk factor, the country-specific credit risk and the spillover effect from Greece. Gande and Parsley (2005) found that a country's rating downgrade has a significant negative effect on the sovereign bond spreads of other countries.

Li et al. (2008) investigated contagion effects from rating announcements in Asia from 1990-2003 to find that the contagion effect caused a rating announcement in one country to affect stock market returns in other crisis-influenced countries. Alternatively, El-Shagi (2010) could not find evidence supporting the same hypothesis, finding that the accusations against credit rating agencies were unconvincing given that most downgrades of sovereign debt occurred towards the end of a crisis. Afonso et al. (2011) investigated financial market inter-linkages in the time period before and after a ratings announcement. The authors find significant responses of government bond yield spreads to changes in rating notations and outlook, with announcements not anticipated at the one to two month horizon but there is bi-directional causality between ratings and spreads within two weeks after the announcement. The spillover effects are also found to run from lower ranked countries to those with a higher ranking and there are persistent effects present for recently downgraded countries.

To effectively model the European crisis and the effects of rating agencies' announcements, event studies were found to be inappropriate in capturing the spillover effects between markets. Thus in light of the models used by Arezki et al. (2011) inspired by the previous work of Favero and Giavazzi (2002), a VAR (Vector Autoregression) framework is found to be most appropriate, with dummy variables implemented to capture the effect of sovereign rating news on the included equity, five year CDS (Credit Default Swap) and ten year sovereign bond markets. This enables the capture of the dynamics spillover effects of rating agency announcements on these specific financial markets by controlling for the lagged effects of fluctuations in these asset classes.

The remainder of the paper is organised as follows. Section 2 discusses the credit rating agencies reaction to the sovereign debt crisis. Section 3 introduces the data, methodology and structure of the models. Section 4 summarises the results of the research and section 5 concludes.

2. The Reaction of Credit Rating Agencies to the European Financial Crisis

Credit rating announcements are based on rating changes (upgrades or downgrades), revisions of previous outlooks and reviews for future ratings changes. These differing types of rating changes can occur simultaneously, even differing between the three companies investigated. There has been a large increase in the number of European downgrades since 2007. There has also been a significant increase in the number of 'negative outlook' changes which indicates potential downgrades within the next two years, and an increase in the number of 'negative watch' announcements which indicates an impending downgrade within ninety days.

2.1. Types of credit rating announcements

There were ninety rating announcements between the period January 2005 and January 2012 for the main European sovereign states investigated in this research. The main downgrades and negative outlook changes are included in table 1. Table 2 summarises the announcements based on the issuing credit agency. It shows that of the ninety announcements, there were thirty-five downgrades, thirty-three outlook revisions and seventeen combined announcements, with five countries being placed on review for downgrade in the next ninety days.

Standard and Poor is the most frequent announcer (thirty-six) and most frequent down-grader (fifteen). There was only one upgrade (Belgium in May 2006) for the countries investigated in the sample. Since then, up to January 2012, only two other European countries investigated in this research received a positive announcement from the three rating agencies. Table 2 also presents the announcements based on the outlook portrayed (either positive or negative), of which there are only three positive announcements in total between 2005 and 2012.

Table 1. Rating Agency actions for investigated European countries January 2005 to January 2012

Number	Country	Agency	Date change	Action	Grade
1	Belgium	Fitch	02/05/2006	Upgrade and stable outlook	AA+
2	Italy	Fitch	25/05/2006	Negative watch	AA
3	Italy	Fitch	19/10/2006	Downgrade and stable outlook	AA-
4	Italy	S&P	19/10/2006	Downgrade	A+
5	Greece	S&P	14/01/2009	Downgrade	A-
6	Ireland	Fitch	06/03/2009	Negative watch	AAA
7	Ireland	S&P	30/03/2009	Downgrade	AA+
8	Ireland	Fitch	08/04/2009	Downgrade and negative outlook	AA+
9	Ireland	S&P	08/06/2009	Downgrade	AA
10	Ireland	Moody's	19/07/2009	Downgrade	Aa2
11	Greece	Fitch	22/10/2009	Downgrade and negative outlook	A-
12	Ireland	Fitch	04/11/2009	Downgrade	AA-
13	Greece	Fitch	08/12/2009	Downgrade and negative outlook	BBB+
14	Greece	S&P	16/12/2009	Downgrade	BBB+
15	Greece	Moody's	22/12/2009	Downgrade	A2
16	Greece	Fitch	09/04/2010	Downgrade and negative outlook	BBB-
17	Greece	Moody's	22/04/2010	Downgrade	A3
18	Greece	S&P	27/04/2010	Downgrade	BB+
19	Spain	S&P	28/04/2010	Downgrade	AA
20	Spain	Fitch	28/05/2010	Downgrade and stable outlook	AA+
21	Greece	Moody's	14/06/2010	Downgrade	Ba1
22	Ireland	S&P	24/08/2010	Downgrade	AA-
23	Spain	Moody's	30/09/2010	Downgrade	Aa1
24	Ireland	Fitch	06/10/2010	Downgrade and negative outlook	A+
25	Ireland	S&P	23/11/2010	Downgrade	A
26	Ireland	Fitch	09/12/2010	Downgrade and stable outlook	BBB+
27	Ireland	Moody's	17/12/2010	Downgrade	Baa1
28	Greece	Fitch	21/12/2010	Negative watch	BBB-
29	Greece	Fitch	14/01/2011	Downgrade and negative outlook	BB+
30	Ireland	S&P	02/02/2011	Downgrade	A-
31	Greece	Moody's	07/03/2011	Downgrade	B1
32	Spain	Moody's	10/03/2011	Downgrade	Aa2
33	Greece	S&P	29/03/2011	Downgrade	BB-
34	Ireland	S&P	01/04/2011	Downgrade	BBB+
35	Ireland	Moody's	15/04/2011	Downgrade	Baa3
36	Greece	S&P	09/05/2011	Downgrade	B
37	Greece	Fitch	20/05/2011	Downgrade and negative outlook	B+
38	Belgium	Fitch	23/05/2011	Negative watch	AA+
39	Greece	Moody's	01/06/2011	Downgrade	Caa1
40	Greece	S&P	13/06/2011	Downgrade	CCC
41	Ireland	Moody's	12/07/2011	Downgrade	Ba1
42	Greece	Fitch	13/07/2011	Downgrade	CCC
43	Greece	Moody's	25/07/2011	Downgrade	Ca
44	Greece	S&P	27/07/2011	Downgrade	CC
45	Italy	S&P	19/09/2011	Downgrade	A
46	Italy	Moody's	04/10/2011	Downgrade	A2
47	Italy, Spain	Fitch	07/10/2011	Downgrade	A+
48	Spain	S&P	13/10/2011	Downgrade	AA-
49	Spain	Moody's	18/10/2011	Downgrade	A1
50	Belgium	S&P	26/11/2011	Downgrade and negative outlook	AA
51	Austria, France, Germany, Spain, Ireland, Italy,	S&P	05/12/2011	Negative watch	
52	Austria	Fitch	16/12/2011	Downgrade	AA+
53	Belgium	Moody's	16/12/2011	Downgrade	Aa3
54	Ireland, Italy,	Fitch	16/12/2011	Negative watch	

	Spain				
55	Austria, France, Spain	S&P	13/01/2012	Downgrade	AA+, AA, A
56	Belgium, Italy, Spain	Fitch	27/01/2012	Downgrade	AA. AA-, A
57	Italy	S&P	31/01/2012	Downgrade	BBB+

Note: The above table represents the main credit announcements in terms of downgrades from January 2005 to January 2012 for the rating agencies S&P, Fitch and Moody's.

Table 2. Segregated rating agency actions for investigated European countries January 2005 to January 2012

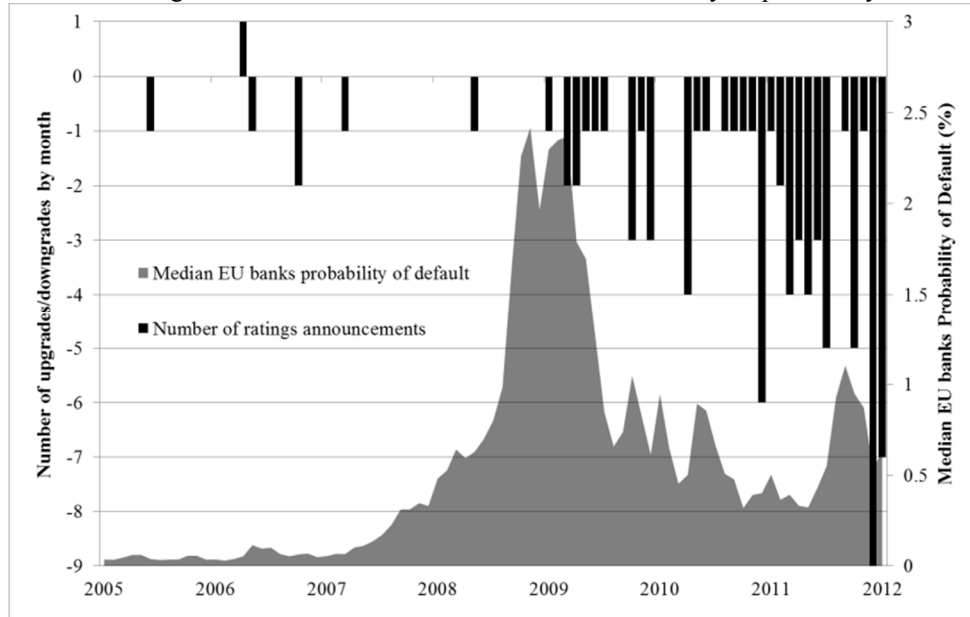|	Fitch	Moody's	S&P	Total
Rating changes				
Upgrades	1	0	0	1
Downgrades	7	13	15	35
Outlook revision				
Positive	1	0	0	1
Negative	10	9	12	31
Maintained	0	0	1	1
Combined announcements				
Outlook revisions with an upgrade	1	0	0	1
Outlook revisions with an downgrade	11	2	3	16
Country under immediate review	0	0	5	5
Totals	31	24	36	91

Note: The above table represents the total number of rating agency announcements segregated by rating announcement type and the rating agency making the announcement.

2.2. Sequencing of the European credit rating announcements

The rating agencies presented in tables 1 and 2 were concentrated from January 2005 until January 2012. Table 1 shows that prior to January 2009, there were only four major announcements for European countries. This is clear evidence that the three rating agencies investigated in this research did not anticipate the economic problems in Europe. Figure 1 echoes this sentiment, presenting the monthly number of sovereign upgrades and downgrades compared to the median EBA banks (European Banking Authority) five year probability of default. The European sovereign crisis stemmed from an international banking crisis, but the lag between the implementation of negative announcements and downgrades from the three rating agencies and the peak of the European banking crisis is indisputable.

Credit rating announcements are not only concentrated over time, but are also concentrated geographically. Table 3 describes the geographical division of rating announcements from January 2005 until January 2012 for the European countries investigated. Greece, Ireland, Spain, Italy and Portugal account for over 83% of total rating agency actions. Greece has the highest number of downgrades, while Germany, The Netherlands and The United Kingdom had no downgrades during the investigated period, but were all placed under review as the crisis escalated.

Figure 1. Number of rating announcements and the median EBA banks five year probability of default

Note: Figure 1 shows the downgrade of sovereign states and the peak of the European banking crisis (Q3 2008) as measured by the median EU banks probability of defaults as measured through Kamakura.

Table 3. Geographical segregation of rating agency actions from January 2005 to January 2012

Country	Rating change	Outlook change	Combined	Under review	Totals
Austria	2	1	0	0	3
Belgium	2	1	2	0	5
France	1	1	0	1	3
Germany	0	1	0	1	2
Greece	9	5	14	0	28
Ireland	7	4	9	0	20
Italy	5	4	3	1	13
Netherlands	0	0	0	1	1
Spain	8	5	1	0	14
United Kingdom	0	0	0	1	1
Totals	**34**	**22**	**29**	**5**	**90**

Note: The above table represents the style and geographical segregation of the rating announcements in the investigated period.

3. Data, Methodology and Structure of the Models

The VAR model comprises of three equations each representing a facet of a given financial market, namely the main equity market index, the sovereign CDS spread and the ten year government bond yield. Data for the ten largest European countries are used (Austria, Belgium, France, Germany, Greece, Ireland, Italy, Netherlands, Spain and The United Kingdom). The data spans from January 2005 until January 2012, representing 1,879 observations. To obtain robust estimators to possible remaining heteroskedasticity and autocorrelation in the residuals, a White correction is performed on the standard deviation of the estimated coefficient.

A sequence of impulse dummy variables D_t, are used to indicate the release date or a particular announcement. VAR techniques are used to measure the return impact r^i, of these ratings announcements on market i at time t. Formally, the relationship with the market return and the rating announcement news of a series of L rating announcements where j=1,......, L is expressed as:

$$r_t^i = a^i + \sum_j b^{ij} D_t^i + e_t^i \qquad (1)$$

where e_t^i is i.i.d and represents the white noise residual. If the coefficient associated with D_t is significant, it indicates that the ratings announcement D leads to abnormal returns for the market i at time t. This specification relies on two assumptions. The first is that market i is assumed to be efficient as the return does not depend on past variables. Second, the specification above relies on the assumption that financial markets are not interrelated. Thus the model in this paper is of the form:

$$Z_i^t = \phi(L)Z_t^i + v_t^i \qquad (2)$$

where Z_i^t is a N-dimension vector of asset prices that are taken in logarithms on market i, $\phi(L)$ is a NxN lag polynomial with $L^k y_t = y_{t-k}$, v_t are reduced-form disturbances with zero means and constant covariance matrix with variances given by E$[v_t^i]=\sigma^i$ and E$[v_t^i, v_t^j]=0$ for i not equal to j. As the model is specified in levels, the impulse dummies D_t^j are deemed to be inappropriate. To be consistent with the specification in difference as in the equations above, we use step dummies that are represented as SD_t^i, where $SD_t = \sum_{i=1}^{j} D_i$. Hence the specification of the estimation becomes:

$$Z_t^i = \phi(L)Z_t^i + \sum_j b^{ij} SD_t^j + v_t^i \qquad (3)$$

where b^{ij} is a matrix of NxK lag polynomial, with K representing the number of credit rating announcements included in the estimation model. Using such a specification will allow us to obtain unbiased estimates of the effect of the rating announcements on the markets prices of the investigated indices to extract the effects of the announcements b^{ij}, from that of the natural structural linkages that exist between markets $\phi(L)$. The effects of a change in outlook or indeed the impact of multiple announcements are also included in the model. In the case of the effects of a rating announcement on a particular sovereign jurisdiction, the specification is now expressed as:

$$Z_t^i = \phi(L)Z_t^i + b^{i1}SD_t^{DG} + b^{i2}SD_t^{OC} + b^{i3}SD_t^{MA} + v_t^i \qquad (4)$$

In equation (*4*), DG represents downgrades, OC is the coefficient on the dummy variable for rating agency outlook changes and MA is based on multiple announcements. Further the specification for an investigation based on the source of the rating agency announcement is expressed as:

$$Z_t^i = \phi(L)Z_t^i + b^{i1}SD_t^{Fitch} + b^{i2}SD_t^{S\&P} + b^{i3}SD_t^{Moody's} + v_t^i \qquad (5)$$

The results of this VAR model generate estimates of the effects on each market investigated based on the source of the announcement. This offers evidence as to whether one rating agency was viewed by the market to be more or less influential than its counterparties. The next model investigates whether there is a difference in the impact on the investigated markets based on the initial sovereign rating present at the time of the announcement. In theory, the downgrade of a high investment grade product by one grade may have a large impact, or indeed the downgrading of a sovereign state to default status. The rating announcements are then segregated into high and low investment grade and then high and low junk grade based on the individual rating agencies grading mandates. The VAR models are then run to analyse any specific differences and are expressed as:

$$Z_t^i = \phi(L)Z_t^i + b^{i1}SD_t^{high\ inv.} + b^{i2}SD_t^{low\ inv.} + b^{i3}SD_t^{high\ junk} + b^{i4}SD_t^{low\ junk} + v_t^i \qquad (6)$$

The final VAR specification is based on the impact of a specific sovereign downgrade on the individual major European financial markets investigated. In this case, the specification changes to include the seven separate step dummies representing the European jurisdictions that have been subjected to downgrades and the VAR model investigates the effects on equity, CDS and sovereign bond markets separately. The models are expressed as:

$$Z_t^i = \phi(L)Z_t^i + b^{i1}SD_t^{Aus} + b^{i2}SD_t^{Bel} + b^{i3}SD_t^{Fra} + b^{i4}SD_t^{Gre}$$
$$+ b^{i5}SD_t^{Ita} + b^{i6}SD_t^{Spa} + b^{i7}SD_t^{Ire} + + v_t^i \qquad (7)$$

4. Results

In a preliminary analysis, the Augmented Dickey Fuller Test confirms that each series contains a stochastic trend. Similarly, Johansen's cointegration testing leads to the acceptance of the presence of at least one cointegration relationship within the equations. It is therefore important to separate the direct impact of the rating news from the diffusion process that exists between the investigated financial markets. The results of the Hausman test lead us to rejects the equality of the coefficients associated with the dummy variable at a minimum of the 5 per cent level. This suggests that there is heterogeneity of coefficients associated with the different dummy variables across the investigated countries. This highlights the transmission heterogeneity of rating news across European countries, preventing the use of panel data techniques, thus the analysis is completed on a country by country level.

To test for interdependence between markets, the model is first estimated without considering any exogenous variables. The results are reported in table 4. Each equation includes a lagged exogenous variable and the estimated coefficient is statistically significant and not different from one.

This result adds further confirmation to the findings of the unit root in the cointegration tests. The investigation highlights the existence of a transmission mechanism between the investigated markets and countries. Not taking such interdependence into account would not allow for discrimination between the impacts of rating news and the natural diffusion process that already exists in the investigated markets due to structural relationships.

Table 4. Interdependence between the markets under investigation

	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Nether.	Spain	UK
Variable 1: Equities										
Equities	1.062***	1.025***	0.951***	1.002***	1.022***	1.032***	0.977***	0.974***	0.984***	0.964***
CDS	-0.012**	0.001	-0.004	-0.003	-0.02***	0.001	-0.017**	-0.001	-0.02***	-0.007
Bonds	0.091***	0.009	0.047	-0.007	0.033	0.015	-0.023	0.041	0.018	-0.002
Variable 2: CDS										
Equities	-0.742	-0.71***	-0.68***	-0.397**	-0.49***	-0.299	-0.28***	-0.692	-0.45***	-0.111
CDS	0.862	0.791***	0.686***	0.753***	0.771***	0.748***	0.909***	0.818***	0.834***	0.882***
Bonds	-0.053	0.214*	-0.173	-0.073	0.303***	0.561	0.348***	-0.019	0.014	-0.136*
Variable 3: Bonds										
Equities	-0.121	-0.12***	-0.09***	-0.012	-0.09***	-0.07***	-0.07***	-0.07***	-0.018	0.001
CDS	-0.011	0.006	-0.001	-0.002	0.015**	0.001	-0.002	0.000	0.027***	-0.012
Bonds	1.161	1.203***	1.096***	1.151***	1.093***	1.194***	1.128***	1.149***	1.013***	1.035***

Notes: Robust standard errors are in parentheses, where ***p<0.01, **p<0.05 and *p<0.10.

Table 5. Impact of downgrades and downgrade by agency on the sovereign state investigated

	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Nether.	Spain	UK
Variable 1: Impact of a downgrade										
Equities	0.0012	0.0011	0.0013	0.0029*	0.0004	0.0023	0.0035*	0.0015	0.0013	0.0016
CDS	0.0071	0.0078	0.0059	0.0096	0.0030	0.0067	0.0073	0.0084	0.0063	0.0020
Bonds	0.0018	0.0017	0.0023	0.0029*	0.0055**	0.0038***	0.0014	0.0004	0.0013	0.0021
Variable 2: Impact of a Fitch downgrade										
Equities	-0.0049	-0.0021	-0.002	-0.0003	0.0023	-0.0096	-0.0014	-0.0015	-0.0022	-0.0013
CDS	0.0096	0.0075	0.0069	0.0141	0.0024	0.0023	0.0135	0.0071	0.0082	0.0053
Bonds	0.0022	0.0067***	0.0033	0.0004	0.0026	0.0028	0.0073***	0.0002	0.0003	-0.0019
Variable 3: Impact of a S&P downgrade										
Equities	0.0046*	0.0042*	0.0039	0.0056**	0.0027	0.0054*	0.0061**	0.0041	0.0031	0.0036
CDS	0.0131	0.0114	0.0044	0.0109	0.0039	0.0069	0.0102	0.0138	0.0099	0.0047
Bonds	0.0016	-0.0017	0.0012	0.0037	0.0083**	0.0037	-0.0004	0.0000	0.0029	0.0037
Variable 4: Impact of a Moody's downgrade										
Equities	0.0037	0.0005	0.0009	0.0029	-0.0075*	0.0227	0.0064*	0.0010	0.0034	0.0026
CDS	-0.0085	0.0018	0.0089	0.0019	0.0041	0.2037	-0.0075	0.0101	-0.0033	-0.0089
Bonds	0.0016	0.0006	0.0027	0.0051	0.0074	0.0063*	-0.0044	0.0010	0.0003	0.0049

Notes: Robust standard errors are in parentheses, where ***p<0.01, **p<0.05 and *p<0.10.

Table 6. Impact of negative reviews and multiple announcements on the sovereign state investigated

	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Nether.	Spain	UK
Variable 1: Impact of a negative review										
Equities	-0.001	-0.0017	-0.0019	-0.0027	-0.001	-0.0019	-0.0029	-0.0007	-0.0012	-0.0007
CDS	0.0019	0.0058	0.0032	0.0049	-0.012	0.0069	0.0043	0.0084	0.0016	0.0038
Bonds	0.0021	0.0006	0.0033**	0.0000	-0.001	0.0000	-0.0005	0.0006	-0.0007	-0.004*
Variable 2: Impact a multiple rating agency announcement										
Equities	0.0014	0.0001	0.0001	0.0014	0.0009	0.0011	0.0008	0.0007	-0.0000	0.0014
CDS	0.0076	0.0118	0.0059	0.0106	0.0033	0.1597	0.0089	0.0133	0.0073	0.0035
Bonds	0.0013	0.0006	0.0021	0.0033*	0.0034	0.0037	0.0009	0.0011	0.0013	0.0023

Notes: Robust standard errors are in parentheses, where ***p<0.01, **p<0.05 and *p<0.10.

4.1. The effects of rating agency decisions on European financial markets

The models are segregated to investigate the direct impact of a downgrade on the selected European financial markets. Table 5 displays the VAR results based on an included dummy variable signalling a downgrade and indeed, the rating agency that made the downgrade. Table 6 displays the VAR results by country when a negative outlook or negative review was issued. These results are also adopted to include simultaneous announcements, thus include downgrades with attached negative

outlooks and reviews (which signal consideration for further downgrades in the short to medium term).

Investigating the impact of sovereign downgrades and the origin rating agency offers some interesting results. First, there are uniform reactions to a downgrade, through increases in equity market returns and the yield demanded by investors for sovereign debt. German CFD spreads also showed significant reactions, indicating that insurers required a higher premium for risk. This may be explained through the German position as a central strength of the Eurozone; therefore, the German CDS would have been viewed as an alternative measure of perceived European-wide risk.

Fitch and Standard and Poors appear to have the largest impacts across the European nations investigated. There was a large reaction of Irish equity, CDS and bond markets to Moody's downgrades. Negative reviews are associated with decreased returns across all equity markets, with the deepest falls in Germany, Portugal, Italy, Ireland and Spain. Greece consistently possessed the highest risk of default in terms of five year CDS and ten year government bond yields, but actually showed alleviation in pressure based on these CDS and bond yields at the time of a downgrade. When multiple announcements were made simultaneously, there was a sharp increase in CDS spreads, indicative of increased perceptions of risk and default throughout the financial community.

Table 7. Impact of downgrade based on whether investment or junk grade sovereign status

	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Nether.	Spain	UK
Variable 1: Impact of high investment grade downgrade										
Equities	0.0023	0.0029*	0.0029	0.0033	0.0039	0.0034	0.0048**	0.0029	0.0031	0.0025
CDS	-0.0049	-0.0021	-0.0009	0.0031	-0.0029	-0.0001	-0.0015	-0.003	-0.0082	-0.0012
Bonds	0.0041**	0.0018	0.0047***	0.0049**	0.0003	0.0031*	-0.0019	0.0027	-0.0002	0.0036*
Variable 2: Impact of low investment grade downgrade										
Equities	0.0005	0.0001	0.0004	0.0041	-0.0029	0.0034	0.0022	0.0013	-0.0004	0.0018
CDS	0.0142	0.0205	0.0125	0.0158	0.0069	0.0154	0.0171*	0.0289	0.0228*	0.0073
Bonds	0.0012	0.0038	0.0027	-0.0006	0.0047	0.0036	0.0056**	-0.002	-0.0006	0.0014
Variable 3: Impact of high junk grade downgrade										
Equities	-0.0035	-0.0029	-0.0021	0.0001	-0.0085	-0.0039	-0.0025	-0.002	-0.0039	-0.0016
CDS	0.0081	0.0085	0.0100	0.0194	0.0018	0.0293	0.0143	0.0253	0.0081	0.0025
Bonds	0.0009	0.0014	0.0001	0.0026	0.0219***	0.0131***	-0.0007	0.0008	0.0072	-0.0009
Variable 4: Impact of low junk grade downgrade										
Equities	-0.0023	-0.0028	-0.0052	-0.0031	-0.0069	-0.0045	0.0006	-0.004	0.0007	-0.0025
CDS	-0.0101	-0.0029	0.0063	0.0035	0.0033	-0.0051	-0.0094	0.0024	-0.0034	-0.0041
Bonds	-0.0018	0.0013	-0.0021	-0.0022	0.0034	-0.1093*	0.0024	-0.000	0.0037	0.0019

Notes: Robust standard errors are in parentheses, where ***p<0.01, **p<0.05 and *p<0.10. High investment grade is denoted as AAA to A+ for Fitch and S&P, and Aaa to A1 for Moody's. Low investment grade is denoted at A to BBB- for Fitch and S&P and A2 to Baa3 for Moody's. High junk grade is ranked as BB+ to B for Fitch and S&P and Ba1 to B2 for Moody's and finally low junk grade is ranked as B- to SD/Default for Fitch and S&P and B3 to D for Moody's.

4.2. The impact of downgrades based on rating agency grading

Between 2005 and 2012, Greece was the only European country identified by rating agencies to be in a state of default. Table 7 shows the VAR results based in the spillover effects within the European markets at the time of a downgrade segregated by their investment status. Variables 3 and 4 in table 7 are based solely on the Greek downgrade. Seven states in total were downgraded. For high investment grade ratings, equity market returns increased initially after a downgrade, but sovereign debt markets showed substantial stress. This may be caused by the shock of an investment grade asset being identified as being in trouble. When a state has fallen to junk status, the effects of a downgrade are amplified, as seen in the dramatic widening of CDS spreads. This effect was evident during the downgrades of Portugal, Spain, Greece, Ireland and Italy.

Once a state was downgraded to junk status, the scenario was accompanied by a fall in European equity markets. The PIIGS showed tremendous pressures in CDS and bond markets as the possibility of a European default was deemed increasingly credible. Contagion effects are also significant throughout European markets. Germany shows increasing stress levels through increasing 10 year bund yields and 5 year senior CDS spreads, providing evidence that the German markets were indeed being used by investors as a barometer of European-wide financial health. This is particularly interesting as German markets were not downgraded throughout the period investigated. This investigation clearly shows that the effects of contagion within the Eurozone had been effectively

priced in by investors, who were planning for what would happen after a default rather than the primary question of who was going to default.

Table 8. Impact of country-specific downgrade on sovereign financial market

	Austria	Belgium	France	Germany	Greece	Ireland	Italy	Nether.	Spain	UK
Variable 1: Austrian downgrade										
Equities	0.0002	0.0036	0.0012	0.0043	0.0010	0.0027	0.0051	0.0076	-0.0038	0.0062
CDS	0.0153	-0.0033	0.0289	0.0125	-0.0405	0.0143	0.0226	0.0043	0.0002	-0.0087
Bonds	-0.0044	-0.0088	-0.0050	0.0028	-0.0097	0.0025	0.0059	-0.017*	-0.0044	0.0064
Variable 2: Belgian downgrade										
Equities	-0.0096	-0.0027	-0.0049	-0.0037	-0.0023	-0.0009	-0.0043	-0.0025	-0.0039	-0.0041
CDS	0.0042	-0.0047	0.0012	0.0149	0.0273	0.0028	0.0116	0.0056	0.0008	0.0067
Bonds	0.0011	0.0006	0.0011	-0.0069	-0.0024	-0.0034	0.0073	-0.0032	-0.0133	-0.0123*
Variable 3: French downgrade										
Equities	0.0002	-0.0037	0.0079	0.0125	0.0088	0.0023	0.0141	0.0099	-0.0011	0.0034
CDS	-0.0099	0.0246	0.0056	0.0073	-0.0089	0.0163	0.0315	0.0421	0.0069	-0.0053
Bonds	-0.0045	0.0033	-0.0074	0.0002	0.0157	-0.0011	-0.0037	-0.025*	0.0194	-0.0005
Variable 4: Greek downgrade										
Equities	-0.0029	0.0073*	-0.0033	-0.0019	-0.0043	-0.0023	-0.0019	-0.0028	-0.0024	-0.0019
CDS	0.0094	0.0246	0.0067	0.0018	0.0112	0.0190	0.0066	0.0307	0.0012*	0.0012
Bonds	0.0009	0.0033	0.0063	0.0011	0.0085*	0.0038	0.0033	0.0027	0.0039	0.0025
Variable 5: Italian downgrade										
Equities	0.0060	0.0073*	0.0092	0.0138***	0.0034	0.0064	0.0125**	0.0077*	0.0086*	0.0079*
CDS	-0.0082	-0.0046	-0.0035	0.0200	-0.0019	-0.1207	0.0042	-0.0188	-0.0037	-0.0063
Bonds	0.0035	0.0048	0.0063	0.0111**	0.0106*	-0.0013	0.0027	0.0054	-0.0072	0.0126***
Variable 6: Spanish downgrade										
Equities	-0.0023	0.0026	0.0023	0.0045	0.0118*	0.0052	0.0092*	0.0044	0.0015	0.0038
CDS	-0.0186	0.0019	0.0036	-0.0069	-0.0233	-0.0113	-0.0033	0.0005	-0.0098	-0.0045
Bonds	0.0071*	-0.0014	0.0105**	0.0141***	-0.0079	0.0049	0.0007	0.0044	-0.0001	0.0062
Variable 7: Irish downgrade										
Equities	0.0066*	0.0028	0.0032	0.0059*	-0.0049	0.0071*	0.0064*	0.0029	0.0041	0.0037
CDS	0.0075	0.0002	0.0114	0.0062	-0.0007	0.0331	0.0126	0.0239	0.0066	0.0084
Bonds	0.0010	0.0025	0.0003	0.0010	0.0035	0.0124***	0.0019	-0.0012	0.0055	-0.0001

Notes: Robust standard errors are in parentheses, where ***p<0.01, **p<0.05 and *p<0.10.

4.3. Contagion effect on European financial markets due to a sovereign downgrade

The contagion effects of downgrades are shown in table 8. The size-adjusted inter-country connections, which are found to be in the worst economic health, should theoretically cause the largest reactions. The Austrian and Belgian downgrades were associated with simultaneous large increases in other states' CDS spreads offering evidence of spill-over effects. But most interestingly the Austrian and French downgrades appear to relieve pressure from the Greek situation, perhaps as investor's re-evaluated the potential recapitalisation and quantitative easing actions of the ECB and indeed the imposed restrictions of the IMF, given the clear evidence of contagion being already present. Greek CDS spreads also show pressure reduction when their struggling counterparts Italy, Spain and Ireland were downgraded. This may be evidence of the shifting focus of international financial markets as different states were placed under the spotlight. At the time of these rating decisions, the sheer turmoil and panic across states was so immense that nobody could be certain of whom was next to be in focus. The interactions between the struggling states are clearly obvious, with a downgrade of one being priced by the market as a faltering of the Eurozone as a whole.

Also of note are the German CDS and bond reactions to the Italian and Spanish downgrades. There is a sharp widening of CDS spreads and increase in the European benchmark German bund-rates, signifying the stresses present as larger-nations became victim to the negative sentiment offered by the rating agencies.

5. Conclusions

This paper investigates the contagion effects of sovereign rating agency announcements across the main European financial markets using daily data on the investigated countries' domestic equity indices, five year senior credit default swaps (CDS) and ten year sovereign government-issued bonds during the period 2005-2012. It finds that downgrades were associated with an increase in equity

returns with a simultaneous increase in the yields demanded for sovereign debt. German CDS spreads show a large increase, indicative of their use as a European-wide barometer of default based on the widespread potential for contagion effects to escalate and spread given the market expectations throughout of a default of a European state.

In terms of the individual rating agencies, both Fitch and S&P were associated with the largest impacts on financial markets. Negative reviews were also found to have a negative impact on the investigated markets, with the outlook of this announcement indicating a downgrade in the next ninety days. Simultaneous announcements are found to have a much more pronounced negative effect, dampening investor aspirations as the announcements are associated with a downgrade of a European state with an outlook of further downgrades on the horizon. There is also a correlation between the starting point of the credit rating of a country being downgraded and the depth of the spillover effects found using the VAR methodology, again with the focus of negative investors shifting to Germany as the centre-piece European state. The growth of the European Union has enabled this phenomenon, as investors now clearly see the contagion trail between all the interconnected European states and Germany as the largest sovereign state in the conglomerate.

Overall, credit rating agencies are found to have a significant influence in terms of initiating contagion effects on the European financial markets examined in this paper. The methodology and modelling of the sovereign states they monitor must be called into question, as if they see fit to downgrade European nations emphatically since 2010, why is it that they did not do so in the escalation of the crisis. The rating agencies must now learn from their mistakes, primarily to regain credibility with the financial community, but also given the important role through the significant effects that they have been found to possess on financial markets.

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