Sovereign credit ratings and financial markets linkages: application to European data

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Abstract

We use EU sovereign bond yield and CDS spreads daily data to carry out an event study analysis on the reaction of government yield spreads before and after announcements from rating agencies (Standard & Poor's, Moody's, Fitch). Our results show significant responses of government bond yield spreads to changes in rating notations and outlook, particularly in the case of negative announcements. Announcements are not anticipated at 1-2 months horizon but there is bi-directional causality between ratings and spreads within 1-2 weeks; spillover effects especially among EMU countries and from lower rated countries to higher rated countries; and persistence effects for recently downgraded countries.

Highlights

► Event study analysis of the reaction of government yield spreads to rating announcements. ► We find significant responses of yield spreads particularly for negative announcements. ► The reaction of CDS spreads to negative announcements increased after the Lehman bankruptcy. ► There is evidence of rating announcement spillovers from lower to higher rated countries. ► Countries downgraded less than six months ago face higher spreads than countries with similar rating not downgraded.

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1. Introduction

After the 2008-2009 financial and economic crisis sovereign bond yield spreads increased markedly in several European Union (EU) countries, notably in the euro area,

and above what one would expect from the sum of inflation, real economic growth, and fiscal developments. The main cause of such developments has to be found in the increased awareness of capital markets towards the different macro and fiscal fundamentals of each country, notably the increase in fiscal imbalances in the aftermath of the crisis. Not surprisingly, several downgrades also occurred at the sovereign rating level, both impinging and reinforcing the upward movements in sovereign spreads.

Given that government debt crises have been less common in developed countries (Reinhart, 2010), previous work in the literature has focused on the relation between rating and yield and Credit Default Swap (CDS) spreads for emerging and developing economies. However, little work exists regarding the response of yields (CDS) spreads to rating announcements for a large group of advanced economies.

This paper tries to fill this gap. We carry out an event study analysis to examine the effects of sovereign credit rating announcements of upgrades and downgrades (as well as changes in rating outlooks) on sovereign bond yield (CDS) spreads in EU countries. We use daily data from January 1995 until October 2010.

Our contribution is twofold. First, we conduct an event study analysis looking at the reaction of yield spreads (and CDS spreads) within two days of the announcements from the rating agencies: Standard & Poor's, Moody's and Fitch. We make a distinction between the three main rating agencies to assess whether some agencies have bigger or more lagged impacts on the sovereign bond markets. We also look whether spread developments anticipate, to some extent, rating movements.

Second, with the ratings converted into a numerical scale, we run a causality test between the transformed ratings and the yield (CDS) spreads. We look at whether sovereign yields and CDS spreads in a given country react to rating announcements of other countries, and whether there are asymmetries in the transmission of these spillover effects. In addition, we also examine whether downgrades and upgrades carry more information to the market, beyond the information contained in the rating notation.

According to our analysis, the main findings include: i) a significant response of government bond yield spreads to changes in both the rating notations and the rating outlook, particularly important for the case of negative announcements; ii) rating announcements are essentially not anticipated in the previous 1 or 2 months but; iii) there is bi-directional causality between ratings and spreads in a 1-2 week window; iv) there is evidence of contagion, specially from lower rated countries to higher rated countries; and v) countries that have been downgraded less than six months ago face higher spreads than

countries with the same rating but that have not been downgraded within the last six months.

The remainder of the paper is organised as follows. Section two briefly reviews the related literature. Section three describes the data and some stylised facts. Section four conducts the empirical analysis and discusses the results. Section five concludes.

2. Related literature

There are several papers analysing the behaviour of credit rating agencies (see, for instance, the survey by de Haan and Amtenbrink, 2011). More specifically, the existing studies dealing with sovereign debt ratings can be broadly grouped into two areas. First, we find papers that try to uncover the determinants of sovereign debt rating notations, notably via the estimation of both linear estimation methods and ordered response models (see, for instance, Afonso, 2003; Bissoondoyal-Bheenick, 2005 and Afonso, Gomes and Rother, 2011, for both developed and developing countries). These studies conclude that the rating scale is mainly explained by the level of GDP per capita, real GDP growth, external debt, the public debt level and the government budget balance. Some other papers document other predictors of rating migrations such as: the outlook status, past rating changes, the rating duration or the existing rating (see Al-Sakka and Gwilym, 2009 and Hill, Brooks and Faff, 2010).

Second, there are studies that address the explanatory power of sovereign ratings for the development of government bond spreads, which is closer to the event study analysis that we undertake here. For instance, Afonso and Strauch (2007) evaluate to which extent policy events taking place in the course of 2002, when the Stability and Growth Pact was put to a test, impinged on sovereign spreads. They find some mitigated effects of policy events on the euro interest rate swap spreads, the difference between the 10-year rate for the inter-bank swap market, and the 10-year government bond yield.

Kräussl (2005) conducts an event study analysis using daily sovereign ratings of long-term foreign currency debt from Standard & Poor's and Moody's. For the period under analysis, 1 January 1997 and 31 December 2000, they construct a so-called index of speculative market pressure to determine the ratings effect on financial markets. They report that sovereign rating changes and credit outlooks have a relevant effect on the size and volatility of lending in emerging markets, notably for the case of ratings' downgrades and negative outlooks.

Using also an event study for the period 1989–1997, with sovereign credit rating data from Standard & Poor's, Moody's, and Fitch, Reisen and von Maltzan (1999) find a significant rating effect on the government bond yield spread when a country was put on review for a downgrade. They also report the existence of two-way causality between sovereign credit ratings and government bond yield spreads for the set of 29 emerging markets in their study.

Ismailescu and Hossein (2010) assess the effect of sovereign credit rating announcements on sovereign CDS spreads, and their possible spillover effects. According to their results, for daily observations from January 2, 2001 to April 22, 2009 for 22 emerging markets, positive events have a greater impact on CDS markets in the two-day period surrounding the event, being then more likely to spill over to other countries. Moreover, a positive credit rating event is more relevant for emerging markets. On the other hand, markets tend to anticipate negative events.

Gande and Parsley (2005) report that the existence of spillover effects across sovereign ratings, in a study for the period 1991-2000, for a set of 34 developed and developing economies. This implies that contagion effects are present when a rating event occurs and are, therefore, worthwhile being assessed as well. In addition, Arezki, Candelon and Sy (2011), studying the European financial markets during the period 2007-2010, also find evidence of contagion, of sovereign downgrades of countries near speculative grade, on other euro area countries.

3. Data and stylized facts

3.1. Sovereign ratings

A rating notation is an assessment of the issuer's ability to pay back in the future both capital and interests. The three main rating agencies use similar rating scales, with the best quality issuers receiving a triple-A notation.

Our data for the credit rating developments are from the three main credit rating agencies: Standard and Poor's (S&P), Moody's (M) and Fitch (F). We transform the sovereign credit rating information into a discrete variable that codifies the decision of the rating agencies as depicted in Table 1. In practice, we use a linear scale to group the ratings in 17 categories, where the triple-A is attributed the level 17, and where we put together in the same bucket the few observations below B-, which all receive a level of one in the

scale.[1] Usually, notations at and below BB+ and Ba1 tend to be seen as relating to speculative grade debt.

[Table 1]

On a given date, the dummy variables *upM* and *downM*, as an example for Moody's, assume the following values:

$$upM_{it} = \begin{cases} 1, \text{ if an upgrade occurs} \\ 0, \text{ otherwise} \end{cases} \quad downM_{it} = \begin{cases} 1, \text{ if a downgrade occurs} \\ 0, \text{ otherwise} \end{cases} \tag{1.1}$$

. .

A similar set of discrete variables were constructed for S&P and for Fitch. Alternatively, to the credit rating announcements, we also consider the changes in the rating outlooks and we construct analogous discrete variables

$$posM_{it} = \begin{cases} 1, \text{ a positive outlook occurs} \\ 0, \text{ otherwise} \end{cases} \quad negM_{it} = \begin{cases} 1, \text{ a negative outlook occurs} \\ 0, \text{ otherwise} \end{cases} \tag{1.2}$$

,

Given that changes in the outlook tend to anticipate movements in the rating notation, the information content of the outlook is in itself valuable for explaining the movements of the yield spreads.

3.2. Data set

In the analysis, we cover twenty-four EU countries: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom. No data were available for Cyprus, Estonia and Luxembourg.

The daily dataset starts as early as 2 January 1995 for some countries and ends on 10 October 2010.[2] The data for the sovereign rating announcements and rating outlook changes were provided by the three rating agencies: Standard and Poor's, Moody's and Fitch. It covers between 96000 and 99000 observations.

The data for the sovereign bond yields, which is for the 10-year government bond, end-of-day data, comes from Reuters (68376 observations).The data for the CDS spreads is for

[1] For instance, Reisen and Maltzan (1999) apply a logistic transformation and Afonso (2003) applies both a logistic and an exponential transformation, but Afonso, Gomes and Rother (2011) confirm that such tranformations provide little improvement over the linear one, therefore, not finding evidence of so-called "cliff effects" (when investors shift portfolio composition to encompass only investment grade paper).

[2] This covers the period of the euro debt crisis, when some sovereign bond markets were distorted or not functioning, and were also helped via the ECB's Securities Market Programme.

5-year senior debt, and comes from DataStream (historical close - Euro). Regarding the CDS spreads daily dataset, in some cases it starts as early as 1 January 2003, implying the availability of a maximum of 36713 observations. Additionally, we also use an equity index, as reported in Datastream, which starts as early as of 1 January 2002 (57272 observations).[3]

3.3. Stylised facts

In total, since 1995, there were 394 rating announcements from the three agencies. S&P and Fitch were the most active agencies with 150 and 138 announcements, whereas Moody's only had 108. Out of these announcements, mostly of them were upgrades (167) and positive outlook announcements (88) rather than downgrades and negative outlooks (79 and 60, respectively).[4]

However, and because we only have data on sovereign yields and CDS spreads starting at a later period, we cannot use the full set of rating announcements. Therefore, in our study we have 191 announcements overlapping with sovereign yield data, 167 overlapping with CDS spreads data and 252 overlapping with stock market returns.

The sovereign yield data are not fully available or are less reliable for several eastern European countries, namely Romania, Lithuania, Latvia, Estonia or Slovenia. On the other hand, with CDS data there is a lower weight of rating announcements in the Euro Area and a bigger weight of the other EU27 countries (excluding Cyprus, Estonia and Luxembourg.).

Table 2 shows the average sovereign yield spread over Germany and the average CDS spread for the different rating notations. We can see that, on average, AAA countries have a spread of 0.2 percentage points over German 10 year bonds. As the rating deteriorates, the spread goes up. The countries rated AA- and A+ pay 1 percentage point more than Germany to issue sovereign debt. For the A-rating, the spread is around 2 percentage points. Closer to "junk" grade, spreads are between three and five percentage points.

[Table 2]

Figures 1 and 2 depict respectively the sovereign yield spread and the CDS spread, ten days before and up to ten days after the rating announcements. This simple illustrative exercise shows that sovereign yields tend to accompany more downgrade announcements,

[3] The respective country indices are described in the Data Annex.
[4] A full summary of rating announcements is provided in Appendix 1. We also report, per country, the data for the sovereign yield, CDS spreads and rating developments.

and the magnitude of the changes in the spreads is higher in those cases. Regarding CDS spreads, there seems to be some downward movement before rating upgrades, while in the case of outlook announcements this is less anticipated.

[Figure 1]

[Figure 2]

4. Empirical analysis

This section studies the relation between rating announcements and sovereign yield and CDS spreads along several main dimensions:

i) analyzes the reaction of rating announcements on yields and CDS spreads, and looks notably at whether: a) the effect is anticipated, b) the effect is different between the Economic and Monetary Union (EMU) and non-EMU countries, c) the reaction of yields and CDS markets has increased after the onset of the 2008 financial crisis;

ii) assesses whether sovereign ratings lead or cause changes in the yields and CDS spreads beyond and above other observable yields determinants;

iii) gauges whether sovereign yields and CDS spreads in a given country react to rating announcements of other countries, and whether there are asymmetries in the transmission of these spillover effects;

iv) examines whether downgrades and upgrades carry more information to the market, beyond the information contained in the rating notation.

4.1. Event study

To analyze how sovereign yields (and CDS) spreads respond to sovereign credit ratings and to credit outlook announcements we apply a standard event study methodology. In particular, we measure the response of the yield and CDS spreads over a two-day period (-1, 1), where the rating event is considered to occur at time zero. The use of a narrow window of two days, compared to, say, ten or thirty days, allows reducing contamination problems, which may bias the results of the analysis.

The standard event study approach usually links rating events to abnormal differences between model generated and actual movements in the yields (and CDS). Since the model-generated movements should be computed for the periods where no rating event takes place, and not enough observations are available for this purpose, we have to base the event study on the observed bond yields (and CDS) spreads between country specific bonds and German bonds (see Campbell et al., 1997 for a detailed discussion). In addition,

given that sovereign spreads are generally highly correlated across countries (Longstaff et al. 2011), we attempt to control for changes in the EU market conditions by computing an adjusted measure of sovereign yields (and CDS) spreads. Such measure is the difference between the sovereign's yield (and CDS) spread and the country average of the spreads (implying an equally weighted portfolio created of all the EU countries in the sample, de-meaning the country spread).

Table 3 reports the average change between *t-1* and *t+1* in the adjusted measure of sovereign yields (in decimal points) spreads and CDS (in basis points) spreads during the occurrence of a rating event at time *t*. A positive (negative) rating event for a given agency takes place when there is an upgrade (downgrade) of the credit rating or an upward (downward) revision in the sovereign's credit outlook. The results in the table show that while there is a significant reaction of sovereign yield spreads and particularly CDS spreads to negative events, the reaction to positive events is much more muted.

This result is consistent with previous studies in the literature, which generally conclude that only negative credit rating announcements have significant impacts on yields and CDS spreads (Reisen and von Maltzan, 1999; Norden and Weber, 2004; Hull et al. 2004; Kraussl, 2005). Interestingly, there are studies suggesting that responses to positive and negative information are asymmetric, and that negative news have a much greater impact on individuals' attitudes than do positive news. Put in another way, agents care more strongly about utility losses than they do about gains of equal magnitudes (see, for instance, Bowman et al., 1999, and Soroka, 2006).

[Table 3]

Considering all announcements among the different rating agencies, the results suggest that while a negative event increases the yields (CDS) sovereign spreads by 0.08 (0.13 percentage points), a positive event reduces the CDS sovereign spreads by around 0.01 percentage points. The magnitude of the effect of a negative event is considerable given that the average response of both yields and CDS spreads over a two-day window in absolute value is around 0.04 percentage points. The results are also robust when we exclude, for a given event over a 30 days window, lagged announcements from other agencies. Analyzing the market's reaction to announcements of different agencies, the results in the table suggest that while sovereign yields spreads react significantly only to negative S&P's announcements (and marginally to positive announcements from Moody's), sovereign CDS spreads increase in the presence of negative Moody's and

Fitch's announcements, and decrease when positive S&P announcements occur. This difference in the response is likely to be due to differences in the timing of the announcements across the agencies, with S&P's downgrades announcements in the majority of the cases preceding Fitch's and Moody's downgrades.[5] Finally, while the reaction in the sovereign yields spreads seems to take place mostly during the second day of the two-day period, the reaction in the CDS spreads mostly occurs during the first day.

We repeat the event study analysis by disaggregating negative (positive) events between periods of rating downgrades (upgrades) and periods of negative (positive) outlook revisions. The results reported in Table 4 suggest that for negative events both sovereign yields and CDS spreads respond very similarly to rating downgrades and negative outlook revisions. In contrast, among positive rating events, the results suggest that sovereign CDS spreads are more responsive to positive outlook revisions than the yield spreads.

[Table 4]

We have also tested whether the effect of rating announcements on sovereign yields and CDS spreads is different between EMU and non-EMU countries.[6] To this purpose we repeated the event study analysis for both EMU and non-EMU countries, re-calculating for each group the adjusted measure of sovereign yield and CDS spreads by using the equally weighted portfolio yield spreads and CDS spreads in each of the two samples.

Table 5 reports the results for the overall sample and the two country groups. While one could expect, a priori, that given the recent sovereign debt pressure faced by EMU countries, the reaction of both sovereign yields and CDS spreads to ratings announcements would be larger in EMU countries, when looking at the table we can observe that the response is qualitatively similar between EMU and non-EMU countries. In particular, and considering all rating announcements from the three rating agencies, while a negative event increases yields (CDS) spreads by 0.09 (0.11) percent in EMU countries, the increase in yields (CDS) spreads in non-EMU countries is about 0.08 (0.13) percent. A possible explanation of this similarity in the response is that during our period of analysis several

[5] Looking at downgrades across agencies over a window of 30 days it appears that, for the same event, S&P's announcements precede Fitch's announcements, which are followed by Moody's downgrades. This observation, however, has to be qualified by the fact that is not always possible to distinguish between different but contiguous downgrades events.

[6] In our sample, we have 14 EMU countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain, the number of non-EMU countries being ten.

downgrades for non-EMU countries have occurred in periods when these countries have faced marked financial and sovereign fragility.

Sovereign yields respond weakly (and negatively) to positive events in EMU countries but this is not the case in non-EMU countries. Overall, the difference in the results is never statistically significant. For the case of the non-EMU countries, when positive rating events take place, the CDS spreads only react to S&P announcements.

[Table 5]

The results presented so far drawing on a standard event study analysis, may suffer from a specification problem and therefore they may be biased. Indeed, the event study approach, based on the test of the means fails to account for the pattern of bond yields (CDS) spreads that might bias the estimated reaction of bond yields (CDS) spreads to current rating changes. To correct for this problem, we assess how sovereign yields (and CDS) spreads respond to sovereign credit ratings and to credit outlook announcements by estimating a country fixed effect panel regression of (adjusted measures) of sovereign yields (and CDS) spreads on rating dummies (*D*):

$$S_{it} = \alpha_i + \rho S_{it-1} + \beta D_{it} + \varepsilon_{it}, \qquad (2)$$

where *S* refers to the adjusted measures of sovereign yields (and CDS), α_i are country fixed effects and *D* is a dummy that takes value equal to 1 when the credit rating (or outlook) changes (as explained in (1.1) and (1.2)). This method has also the advantage of quantifying the impact of ratings announcements on sovereign bond yields and CDS spreads compared to their normal movement in the time series.

The estimations results reported in Table 6 are qualitatively similar to those reported in Table 4, and confirm the finding that mostly negative credit rating announcements have significant positive impacts on yields and CDS spreads. For instance, considering all announcements from the different rating agencies, the results show that a negative rating event increases the yields (CDS) sovereign spreads by 0.08 (0.05 percentage points).[7] On the other hand, positive rating announcements of S&P and Moody's reduce CDS spreads.

[Table 6]

[7] In this context, it usually argued that the CDS market is more liquid that the bond market, therefore, the former would incorporate a lower liquidity premium (see, for instance, Zhu, 2006).

Finally, we test whether the effect of rating announcements has changed over time. In this case, we are interested in analyzing whether the reaction of sovereign markets to rating announcements has become stronger during the recent period of financial turbulence. To this purpose, we re-estimate equation (2) after and before the 15th of September of 2008 (the day in which Lemhan Brothers filed for bankruptcy protection).

One should be careful in interpreting this exercise because of the sample composition. For instance, while there are 111 positive events for the yield spreads before the bankruptcy of Lemhan Brothers (56 for CDS spreads), there are only four positive events afterwards (six for CDS). With respect to negative events, the difference is not as dramatic, with 33 events before that date for yields (22 for CDS) and 68 after (77 for CDS).

The results reported in Table 7 suggest that while the reaction of sovereign yields spreads has remained broadly unchanged, the reaction of CDS spreads to negative rating events has increased considerably after the beginning of the crisis.

[Table 7]

The difference in reaction between sovereign yields and CDS to rating announcements is consistent with the fact that financial sovereign markets have become particularly exposed to "bad" news, and that CDS have significantly increased more than yields after the collapse of Lehman Brothers. Indeed, while average sovereign yields spreads have increased by 81 basis points (from 66 to 147 basis points), average sovereign CDS spreads have raised by 127 basis points (from 18 to 145 basis points). The difference between the yield and CDS spreads might also be related to the fear of collapse of AIG, given than it was a very large institution in the CDS market, where it held a very asymmetric position.

4.2. Testing anticipation

The results presented so far have shown that both sovereign yields and CDS spreads mostly react to (negative) rating announcements. The question that arises is whether both sovereign yields and CDS have already absorbed the information contained in changes in the ratings well before their announcements. To test for this hypothesis we re-estimate equation (2) considering the adjusted measure of sovereign yields (and CDS) spreads over two different 30 and 60 days windows: [-30,-1] and [-60,-1]. To avoid contamination, rating events that were preceded by other events in the same country in the previous 30 days (for the period [-30,-1]), or 60 days (for the period [-60,-1]) are eliminated.

Table 8 reports the estimates relative to S&P announcements (when Moody's and Fitch's announcements are analyzed the results are qualitatively unchanged).[8] Looking at the table, it is evident that information contained in both downward and upward outlook revisions is not anticipated by sovereign yield and CDS markets. In contrast, while sovereign yield markets do not anticipate rating announcements, there is (weak) evidence that CDS markets seem to anticipate the information contained in rating downgrades. Such mostly lack of anticipation may also imply that in some cases rating events go for some reason astray of the underlying macro and fiscal fundamentals perceived by markets' participants (on this issue see also Afonso and Gomes, 2011).

[Table 8]

The absence of statistical significance regarding the anticipation effects of positive announcements can be explained by two factors. First, our previous analysis has found strong empirical evidence that both sovereign yields and CDS spreads react mostly to negative announcements. Second, while there is a high incentive for governments to leak good news to rating agencies (Gande and Parsley, 2005), this incentive is null in the case of bad news.

4.3. Causality

The results of the previous section suggest that the information contained in both downward and upward rating events is not anticipated well before (30-60 days) their announcements. At the same time, it could be still the case that over a shorter period (1-2 weeks), past values of changes in the rating are significant determinants of changes in yields and CDS spreads. The same argument could be valid also for the inverse relationship. Indeed, while rating agencies do not always directly acknowledge the fact that a large movement in CDS prices (and, therefore, in the CDS implied rating) is an important factor in determining the timing and scope of rating actions, they are not immune to "pressure" coming from markets' views on what the rating should be.

For further exploring the nexus of causality between rating changes and yield (or CDS) spreads over the short-term, we employ Granger causality tests in a panel framework. Therefore, in order to have a meaningful number of (non-zero) observations for changes in ratings we construct a measure of average rating across agencies (R) as:

[8] The results are available from the authours upon request.

$$R_{it} = (1/3)[(SP_{it} + F_{it} + M_{it}) + \\ +0.5(posSP_{it} + posF_{it} + posM_{it}) - 0.5(negSP_{it} + negF_{it} + negM_{it})] \quad (3)$$

where *SP*, *F*, and *M*, take the values between 1 and 17 as explained in Table 1.

We perform causality tests by estimating separate regressions of the changes of spreads and ratings:

$$\Delta S_{it} = \sum_{i=1}^{k} \gamma_0^i \Delta S_{it-i} + \sum_{i=1}^{k} \gamma_1^i \Delta R_{it-i} + \sum_{i=1}^{k} \gamma_2^i \Delta Z_{it-i} + \varepsilon_{it}, \quad (4)$$

$$\Delta R_{it} = \sum_{i=1}^{k} \lambda_0^i \Delta S_{it-i} + \sum_{i=1}^{k} \lambda_1^i \Delta R_{it-i} + \sum_{i=1}^{k} \lambda_2^i \Delta Z_{it-i} + \omega_{it}, \quad (5)$$

$$\Delta Z_{it} = \sum_{i=1}^{k} \delta_0^i \Delta S_{it-i} + \sum_{i=1}^{k} \delta_1^i \Delta R_{it-i} + \sum_{i=1}^{k} \delta_2^i \Delta Z_{it-i} + \mu_{it}, \quad (6)$$

where *Z* is a vector of variables that influence sovereign yields (and CDS) spreads and the credit rating. Ideally, the vector Z should include all the determinants of sovereign yields and CDS spreads and rating changes. Previous results in the literature (for instance, Afonso et al. 2011) suggest considering as these determinants macroeconomic variables such as GDP per capita, GDP growth, domestic and foreign debt, public deficit, and financial variables. However, given that daily observations are only available for high frequency financial variables we restrict our vector Z to stock market returns (daily log returns of the equity indexes). Equations (4)-(6) are estimated both for the yield spreads and for the CDS spreads.[9]

Hence, we test if ratings cause the spreads, by regressing the daily change in spreads, on its own lags and lags of the daily change in rating, and test the joint significance of all coefficients of ratings. [10] Although we include lags of the dependent variable, we estimate each equation with country fixed effects. First, we have a very large number of time observations, so the bias should be close to zero. Furthermore, estimating the equation with GMM would imply that taking the differences of the differences of the variables, which would amplify the noise in the regression. To test the joint significance of the coefficients, we use the likelihood ratio test.

[Table 9]

[9] Naturally, we are aware that it is difficult to distinguish between changes in fundamentals affecting both the spreads and the ratings at the same time at high frequency, and a joint effect cannot be completely discarded.

[10] Given that the focus of the analysis is to explore the nexus of causality between rating changes and yields (or CDS) spreads over the short-term, the number of lags used in equations (4)–(6) has been alternatively restricted to 5 (corresponding to one week) and 10 (corresponding to two weeks).

As in Reisen and von Maltzan (1999), we find two-way causality between sovereign credit ratings and government bond yield spreads (Table 9). Past values of changes in yield (CDS) spreads are significant determinants of the change in effective rating and vice-versa. We also reject the null that the stock market does not cause both the yield (CDS) spreads and the rating. On the other hand, in one set of regressions, we could not reject the null that the yield spreads and the rating do not cause the stock market returns. However, when we use the CDS spread, we do reject the null. Our estimates indicate that, while deriving information already available on the market, the ratings influence spreads beyond those fundamentals. In addition, all agencies respond to their competitors in terms of their rating actions, whether within one or two weeks, which suggests that there is no overall leadership by one agency (see Appendix 1 for the causality results per rating agency).

4.4. Contagion

The results of the previous section have provided strong empirical evidence that both sovereign yields and CDS spreads in a given country react to rating announcements concerning that country, and that bivariate causality exists. Another question that arises is whether sovereign yields spreads and CDS spreads in a given country also react to rating announcements for the other countries. In other words, we want to answer the question of whether spillover effects exist.

To test for this hypothesis we regress the change of sovereign yields (CDS) spreads[11] of a non-event country ($\Delta S_{it}^{non-event}$) on the average change in the rating in event countries:

$$\Delta S_{it}^{non-event} = \alpha_i + \beta\, \overline{\Delta R_{it}^{event}} + \varepsilon_{it}\,, \qquad (7)$$

where R is the average rating across agencies defined in the Granger causality section (equation (3)) and $\overline{\Delta R}$ is the average change of R across event countries.

In addition, we test whether spillover effects depend on the difference in credit rating qualities between non-event and event countries ($R_{it}^{non-event} - \overline{R_{it}^{event}}$):[12]

[11] The analysis of the spillover effect is carried out using the sovereign yields (CDS) spreads change instead of the adjusted measure. The reason to do so is that the use of the adjusted measure will tend to understate spillover effects (Jorion and Zhand, 2007; Ismilescu and Kazemi, 2010).

[12] It has to be recognized that equation (8) suffers from high collinearity between the interaction and the average change in the rating variables, which inflate the standard errors associated to the estimates. Alternatively it would be possible to estimate (8) excluding one of the non-interaction terms, however, this would lead to bias estimates and to a misleading interpretation of the results.

$$\Delta S_{it}^{non-event} = \alpha_i + \beta \overline{\Delta R_{it}^{event}} + \delta(R_{it}^{non-event} - \overline{R_{it}^{event}}) + \gamma \overline{\Delta R_{it}^{event}}(R_{it}^{non-event} - \overline{R_{it}^{event}}) + \varepsilon_{it}\,. \quad (8)$$

Alternatively, we estimate equations (7) and (8) with: i) country fixed-effects; ii) country fixed effects and a time trend; iii) country fixed effects and time fixed effects. The results reported in Table 10 provide evidence of significant spillover effects for sovereign yields markets. In particular, from the results of the first column of each empirical approach, it is possible to observe that one (unconditional) increase in the average rating, *R*, in country-events decreases sovereign yields by 0.1 percent in non-event countries. In contrast, spillover effects are mostly not significant for sovereign CDS spreads. A possible explanation for this different statistical significance of the result between CDS and yields spread is that while local investors have long enjoyed participation in sovereign debt market, they have had relatively limited participation in sovereign CDS markets, which makes them less informative and reactive (Ranciere, 2002; Isamilescu and Kazemi, 2010).

[Table 10]

Our results also show that the spillover effects for the yield spreads are asymmetric and are a function of the difference in credit rating qualities. For instance, we find that rating announcements in event countries affect more significantly sovereign yields in non-event countries when the rating of the event country is lower than in non-event countries. In other words, non-event countries with a better credit rating will experience a significantly larger change in its sovereign yields spreads from spillover effects than a lower credit quality rating. This result is consistent with previous finding in the literature (Gande and Parsley, 2005; Isamilescu and Kazemi, 2010). Overall, these results suggest that given that differences in rating reflect, among other factors, differences in fiscal positions, we can also interpret this as evidence of some spillover effects from countries with weaker fiscal positions to countries with stronger fiscal positions.

Finally, we test whether spillover effects are different between EMU and non-EMU countries. To this purpose, we re-estimated equation (7) for EMU and non-EMU countries separately. The results for the overall sample and the two country groups, reported in Table 11, allow us to conclude that spillover effects are larger and statistically significant for EMU countries.

[Table 11]

4.5. Persistence

Some economists have argued that financial markets tend to react excessively to changes in sovereign ratings, particularly to downgrades. Although we cannot give a definite answer to this question, we can ask if markets respond to announcements of downgrades and upgrades themselves, somewhat beyond the information contained in the rating notation. We are able to shed light on this persistence issue, by estimating equation (9)

$$\begin{aligned} S_{it} &= \alpha_i + \beta R_{it} + \gamma R_{it}^2 + \\ &\delta^{<1m} D_{it}^{<1m} + \delta^{<1-3m} D_{it}^{<1-3m} + \delta^{<3-6m} D_{it}^{<3-6m} + \delta^{<6-12m} D_{it}^{<6-12m} + \\ &\theta^{<1m} U_{it}^{<1m} + \theta^{<1-3m} U_{it}^{<1-3m} + \theta^{<3-6m} U_{it}^{<3-6m} + \theta^{<6-12m} U_{it}^{<6-12m} \end{aligned}, \qquad (9)$$

were we regress the sovereign yield and CDS spreads on country dummies, on the average effective rating and its square. Additionally, we include a dummy if the country has been downgraded by any rating agency over the past month ($D_{it}^{<1m}$), between the last 1 and 3 months ($D_{it}^{<1-3m}$), between the last 3 and 6 months ($D_{it}^{<3-6m}$) and between the last 6 and 12 months ($D_{it}^{<6-12m}$). We also include analogous dummies for the rating upgrades.

Given that we are controlling for the level of rating, the interpretation of the coefficients on the dummies becomes quite interesting. If a country has been downgraded less than a month ago, it has a higher yield by $\delta^{<1m}$ compared to all other countries with the same level of rating but that have not been downgraded recently. We also include horizons up to one year to assess how long this penalty lasts.

We report in Table 12 the results for the estimation of equation (9). Countries that have been downgraded within a month have half of a percentage point higher yield spreads, compared with other countries with similar rating. This effect is present up until 6 months after the downgrade and it disappears afterwards. For the rating upgrades, the effect is symmetric on the sign but asymmetric on the magnitude. After an upgrade, countries benefit of lower yields of around 0.1 percentage points, relative to countries with a similar rating.

[Table 12]

The results for the CDS go in the same direction. Controlling for the level of rating, a country that has been downgraded less than 6 months ago, faces around 100 basis points

higher CDS spreads. On the other hand, if the country has been upgraded it benefits from lower spreads (around 44 basis points) for at least one year.

In Appendix 1 we show the results disaggregated by rating agency. In general, they are in line with the aggregate results. Perhaps the most interesting finding is the stronger response of financial markets to announcements by Moody's. After a downgrade, the yield spread is around 1.5 percentage points higher for six months (150 to 200 basis points for the CDS). Since Moody's has fewer announcements than S&P and Fitch (as we mentioned before in section three) financial markets seem to respond more when such less frequent announcements take place.[13]

5. Conclusion

In this paper, we have assessed to what extent sovereign credit rating announcements impinge on the behaviour of sovereign yield spreads and CDS, a more liquid market, for the EU countries. Therefore, we have carried out an event study analysis for a panel of EU sovereign bond yields and CDS spreads with daily data from January 1995 until October 2010. The so-called events are the sovereign credit rating announcements and the changes in the credit rating outlook from the three major rating agencies (Standard & Poor's, Moody's and Fitch).

Our main results can be summarised as follows: i) we find a significant response of government rating bond yield spreads to changes in both the credit rating notations and in the outlook (with some differences across rating agency); ii) the response results are particularly important for the case of negative announcements, while the reaction of spreads to positive rating events is more mitigated; iii) sovereign yield spreads respond negatively (and weakly) to positive events in the EMU countries, but not in the non-EMU country sub-sample, while the response to negative events is this case is quantitatively similar across country-sub-sample; iv) the reaction of CDS spreads to negative rating events has increased after the 15th of September 2008 Lehman Brothers bankruptcy; v) rating and outlook announcements are essentially not anticipated in the previous 1 or 2 months but; vi) there is evidence of bi-directional causality between sovereign ratings and spreads in a 1-2 week window; vii) we find evidence of rating announcement spillover effects, particularly from lower rated countries to higher rated countries; viii) finally, countries that have been downgraded less than 6 months ago face higher spreads than

[13] Regarding the upgrades, the negative effect on yields is only visible for Fitch. For S&P and Moody's the effect is actually positive, but with a small magnitude.

countries with the same rating but that have not been downgraded within the last six months implying a persistence effect.

The abovementioned conclusions shed some additional light on the behaviour of capital markets vis-à-vis sovereign credit rating developments. The fact that negative rating events take markets mostly by surprise, can either imply that fundamentals are not fully discounted on a more permanent basis by markets participants or that rating events have, to some extent, gone astray of such underpinnings in some events. On the other hand, our analysis also shows that the reaction of EU spreads to credit rating events is clear and quick (within one to two days), which implies that good macroeconomic fundamentals and sound fiscal positions are key to prevent, first, rating downgrades, and then, the upward movement in yields and spreads. Finally, the existence of an asymmetric responsiveness of sovereign spreads vis-à-vis rating developments may also impinge importantly in economic and financial outcomes, with implications for policymaking.

Finally, we have addressed a very particular question on how rating announcements received by the financial markets. One question that we do not address it to what extent are rating announcements based on fundamentals or whether some of them can be exogenous (for instance, a mistake by an agency). The reaction of the market might be very different in these two cases. In our framework, we are not isolating the effect of a truly exogenous shock to ratings, but we capture the two effects simultaneously. Distinguishing between the two channels would be a future valuable, although difficult contribution.

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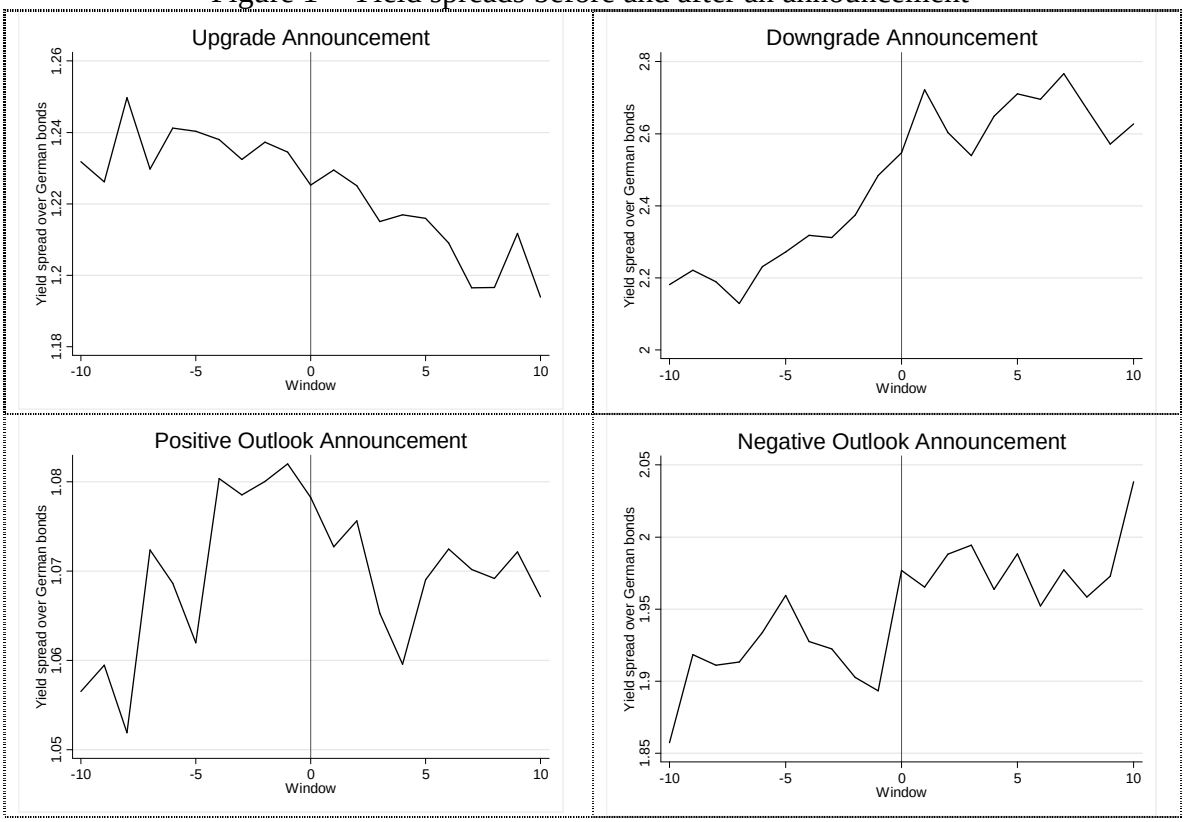
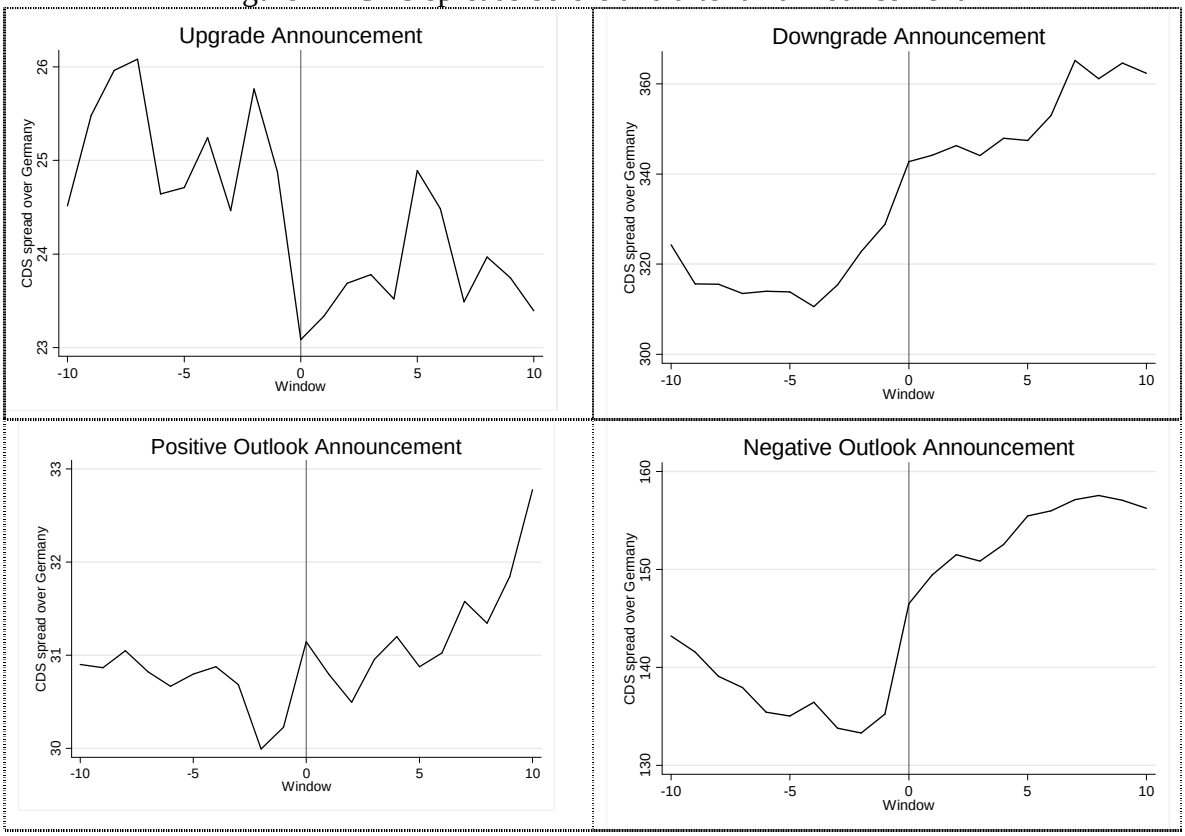
Figure 1 – Yield spreads before and after an announcement



Note: based on 73 upgrades, 31 downgrades, 37 positive outlook and 28 negative outlook announcements for the 3 agencies. The number of days is in the horizontal axis.

Figure 2 – CDS spreads before and after an announcement



Note: based on 36 upgrades, 63 downgrades, 23 positive outlook and 44 negative outlook announcements for the 3 agencies. The number of days is in the horizontal axis.

Table 1 – S&P, Moody's and Fitch rating systems

Characterization of debt and issuer (source: Moody's)		Rating			Linear transformation
		S&P	Moody's	Fitch	
Highest quality	Investment grade	AAA	Aaa	AAA	17
High quality		AA+	Aa1	AA+	16
		AA	Aa2	AA	15
		AA-	Aa3	AA-	14
Strong payment capacity		A+	A1	A+	13
		A	A2	A	12
		A-	A3	A-	11
Adequate payment capacity		BBB+	Baa1	BBB+	10
		BBB	Baa2	BBB	9
		BBB-	Baa3	BBB-	8
Likely to fulfil obligations, ongoing uncertainty	Speculative grade	BB+	Ba1	BB+	7
		BB	Ba2	BB	6
		BB-	Ba3	BB-	5
High credit risk		B+	B1	B+	4
		B	B2	B	3
		B-	B3	B-	2
Very high credit risk		CCC+	Caa1	CCC+	1
		CCC	Caa2	CCC	
		CCC-	Caa3	CCC-	
Near default with possibility of recovery		CC	Ca	CC	
				C	
Default		SD	C	DDD	
		D		DD	
				D	

Table 2 – Average sovereign yield and CDS spreads

Rating	Average yield spread over Germany (%)			Average CDS spread over Germany (bp)		
	S&P	Moody's	Fitch	S&P	Moody's	Fitch
AAA	0.18	0.21	0.19	11.1	15.0	12.9
AA+	0.34	0.42	0.51	25.0	30.5	45.2
AA	0.58	0.57	0.31	49.2	35.3	17.3
AA-	1.09	0.63	1.09	17.7	9.5	72.1
A+	0.95	1.35	1.05	49.9	38.3	53.6
A	0.83	1.92	0.76	55.3	84.1	33.1
A-	1.76	2.10	2.15	60.8	149.5	69.8
BBB+	2.75	3.70	2.71	96.8	302.8	102.5
BBB	4.06	5.84	3.14	246.8	-	164.7
BBB-	5.05	2.39	4.59	144.7	225.6	248.1
<BB+	3.79	3.63	2.49	371.7	107.0	373.5

Note: Yields spreads are expressed in decimal points; CDS in basis points. Mean with associated t-statistics reported in brackets. For some brackets just a few observations exist, for instance, for the CDS in category <BB+ (Moody's) there were only 3 countries: Greece (78 days, CDS 834bp); Bulgaria (385 days, CDS 39bp) and Romania (542 days, CDS 50bp).

Table 3 – Spread changes of event countries during rating events- Full sample

Spread	Rating agency	Negative events			Positive events		
		[-1,1]	[-1,0]	[0,1]	[-1,1]	[-1,0]	[0,1]
Yields	S&P	0.115***	0.034	0.082**	-0.003	-0.007	0.005
		(4.07)	(1.29)	(2.62)	(-0.21)	(-1.04)	(0.55)
	Moody' s	0.117	0.091	0.026	-0.027	0.002	-0.030*
		(1.38)	(1.58)	(0.44)	(-1.59)	(0.13)	(-1.71)
	Fitch	0.002	0.002	0.029	0.006	0.002	0.010
		(0.02)	(0.03)	(0.99)	(0.52)	(0.03)	(0.88)
	All	0.081**	0.036	0.054**	-0.007	-0.004	-0.004
		(2.23)	(1.14)	(2.51)	(-0.92)	(-0.56)	(-0.51)
CDS	S&P	5.842	7.486	-1.64	-1.94*	-1.019	-0.73
		(0.95)	(1.34)	(-0.57)	(-1.92)	(-1.73)	(-0.78)
	Moody' s	23.633***	10.142	13.491*	0.727	-0.283	-0.055
		(2.79)	(1.53)	(1.88)	(0.78)	(-0.56)	(-0.16)
	Fitch	13.768**	10.735***	3.033	-0.145	0.034	-0.179
		(2.11)	(2.62)	(0.81)	(-0.15)	(0.06)	(-0.45)
	All	12.523***	9.629***	3.254	-0.872*	-0.524	-0.347
		(3.12)	(2.93)	(1.34)	(-1.62)	(-1.56)	(-0.91)

Note: Positive (negative) events refer to upgrades (downgrades) of the letter credit rating or upward (downward) revisions in the sovereign's credit outlook. Yields spreads are expressed in decimal points; CDS in basis points. Mean with associated t-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively. For instance, [-1,1] means the change of the spread between *t-1* and *t+1*.

Table 4 – Spread changes of event countries during rating events, full sample

		Negative events			Positive events		
Spread	Rating agency	Rating downgrades			Rating upgrades		
		[-1,1]	[-1,0]	[0,1]	[-1,1]	[-1,0]	[0,1]
Yields	S&P	0.114***	0.054***	0.061**	0.017	-0.001	0.017
		(4.09)	(4.57)	(2.64)	(1.19)	(-0.02)	(1.55)
	Moody' s	0.117	0.084	0.033	-0.033**	-0.016**	-0.017
		(1.21)	(1.40)	(0.74)	(-2.16)	(-2.28)	(-1.11)
	Fitch	0.107**	0.115*	0.046	0.005	0.026	-0.022
		(2.49)	(1.81)	(1.30)	(0.15)	(1.39)	(-1.15)
	All	0.112***	0.080***	0.050***	-0.003	0.002	-0.005
		(4.314)	(3.29)	(2.87)	(-0.27)	(0.27)	(-0.58)
CDS	S&P	6.170***	6.922**	-0.753	-0.153	-1.019	0.867***
		(3.70)	(2.11)	(-0.25)	(-0.33)	(-1.73)	(3.20)
	Moody' s	19.889**	4.234	15.654*	0.726	0.541	0.186
		(2.60)	(1.71)	(2.18)	(0.79)	(0.93)	(0.34)
	Fitch	12.437	10.756	1.681	3.010	2.000	1.010
		(1.24)	(1.27)	(0.80)	(0.92)	(0.95)	(0.83)
	All	11.255***	7.767***	3.489	0.917	0.315	0.602
		(2.80)	(2.30)	(1.56)	(1.12)	(0.55)	(1.69)
Spread	Rating agency	Negative outlook revisions			Positive outlook revisions		
		[-1,1]	[-1,0]	[0,1]	[-1,1]	[-1,0]	[0,1]
Yields	S&P	0.117**	0.016	0.101	-0.016	-0.013	-0.003
		(2.40)	(0.32)	(1.80)*	(-0.80)	(-1.16)	(-0.23)
	Moody' s	0.174	0.130	0.043	-0.024	0.013	-0.037
		(1.29)	(1.43)	(0.46)	(-0.91)	(0.51)	(-1.41)
	Fitch	-0.087	-0.101	0.014	0.006	-0.017	0.023
		(-0.55)	(-0.72)	(0.32)	(0.63)	(-1.47)	(1.62)
	All	0.068	0.007	0.062	-0.010	-0.007	-0.003
		(1.06)	(0.12)	(1.67)*	(-0.91)	(-0.71)	(-0.29)
CDS	S&P	5.620	7.869	-2.249	-2.967*	-1.332	-1.635
		(0.55)	(0.86)	(-0.50)	(-1.95)	(-1.52)	(-1.16)
	Moody' s	26.084**	14.164	11.920	-1.853**	-1.053	-0.800
		(2.11)	(1.41)	(1.16)	(-2.95)	(-1.39)	(-1.63)
	Fitch	14.735	10.719***	4.016	-1.197**	-0.621*	-0.576*
		(1.68)*	(2.88)	(0.63)	(-2.08)	(-1.71)	(-1.80)
	All	13.616**	10.427**	3.189	-	-	-1.025*
		(2.22)	(2.18)	(0.84)	2.009***	0.984***	(-1.85)
					(-3.17)	(-2.52)	

Note: Mean with associated t-statistics reported in brackets. Yields spreads are expressed in decimal points; CDS in basis points. Mean with associated t-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively. For instance, [-1,1] means the change of the spread between *t-1* and *t+1*.

Table 5 – Spread changes of event countries during rating events- period [-1, 1]

Spread	Rating agency	Negative events			Positive events		
		Full	EMU	Non-EMU	Full	EMU	Non-EMU
Yields	S&P	0.115***	0.104***	0.127***	-0.003	0.023	0.012
		(4.07)	(3.76)	(3.99)	(-0.21)	(0.90)	(0.59)
	Moody' s	0.117	0.125	0.084	-0.027	-	-0.021
		(1.38)	(1.50)	(1.07)	(-1.59)	0.035***	(-0.88)
						(-2.86)	
	Fitch	0.002	0.054	0.005	0.006	-0.022	0.027
		(0.02)	(1.09)	(0.04)	(0.52)	(-1.67)	(0.46)
	All	0.081**	0.094***	0.079*	-0.007	-0.011	-0.000
		(2.23)	(3.40)	(1.65)	(-0.92)	(-1.62)*	(-0.00)
CDS	S&P	5.842	8.011***	3.862	-1.94*	-0.127	-2.637*
		(0.95)	(3.246)	(0.46)	(-1.92)	(-0.43)	(-1.94)
	Moody' s	23.633	24.101***	21.059**	0.727	0.381	-0.245
		(2.79)***	(2.69)	(2.24)	(0.78)	(0.52)	(-0.30)
	Fitch	13.768**	6.590	19.221**	-0.145	0.996	0.015
		(2.11)	(0.89)	(2.48)	(-0.15)	(0.71)	(0.01)
	All	12.523***	11.142***	13.100***	-0.872	0.388	-1.057
		(3.12)	(3.23)	(2.62)	(-1.62)*	(0.78)	(-1.44)

Note: Positive (negative) events refer to upgrades (downgrades) of the letter credit rating or upward (downward) revisions in the sovereign's credit outlook. Yields spreads are expressed in decimal points; CDS in basis points. Mean with associated t-statistics reported in brackets. Mean with associated t-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively. [-1,1] means the change of the spread between *t-1* and *t+1*.

Table 6 – Regression spread changes of event countries during rating events, full sample

Spread	Rating agency	Negative events			Positive events		
		[-1,1]	[-1,0]	[0,1]	[-1,1]	[-1,0]	[0,1]
Yields	S&P	0.112***	0.055*	0.098***	-0.001	-0.007	0.001
		(3.87)	(1.78)	(3.32)	(-0.14)	(-0.83)	(0.14)
	Moody' s	0.111	0.102**	0.069	-0.027	-0.008	-0.029
		(1.67)*	(2.25)	(1.26)	(-1.83)*	(-0.99)	(-1.86)*
	Fitch	-0.001	0.036	0.016	0.006	-0.002	0.008
		(-0.0)	(2.72)***	(0.26)	(0.64)	(-0.16)	(0.75)
	All	0.077*	0.059***	0.067**	-0.007	-0.006	-0.006
		(1.83)	(3.32)	(2.36)	(-1.22)	(-2.13)**	(-1.15)
CDS	S&P	-0.664	6.791*	-2.979	-0.851*	-1.148***	-0.586
		(-0.23)	(1.88)	(-1.50)	(-1.71)	(-2.82)	(-0.60)
	Moody' s	14.892**	9.225	11.779**	-0.240	-0.354**	-0.085
		(2.29)	(1.51)	(2.13)	(-0.73)	(-2.40)	(-0.33)
	Fitch	5.129	9.966**	1.213	0.019	0.044	-0.239
		(1.02)	(2.29)	(0.38)	(0.06)	(0.07)	(-1.11)
	All	4.765**	8.541***	1.672	-0.381	-0.517	-0.325
		(2.20)	(3.06)	(1.01)	(-1.17)	(-1.58)	(-0.84)

Note: Positive (negative) events refer to upgrades (downgrades) of the letter credit rating or upward (downward) revisions in the sovereign's credit outlook. Yields spreads are expressed in decimal points; CDS in basis points. Mean with associated t-statistics reported in brackets. T-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively. For instance, [-1,1] means the change of the spread between *t-1* and *t+1*.

Table 7 – Regression spread changes of event countries during rating events, full sample

Spread	Rating agency	Negative events			Positive events		
		Overall Period	Before 15 Sept 2008	After 15 Sept 2008	Overall Period	Before 15 Sept 2008	After 15 Sept 2008
Yields	ALL	0.077*	0.054*	0.049	-0.007	-0.007	0.004
		(1.83)	(1.81)	(1.10)	(-1.22)	(-1.21)	(0.11)
CDS	ALL	4.765**	0.235	5.732*	-0.381	-1.025**	0.780
		(2.20)	(0.45)	(1.96)	(-1.17)	(-2.28)	(0.23)

Note: Positive (negative) events refer to upgrades (downgrades) of the letter credit rating or upward (downward) revisions in the sovereign's credit outlook. Yields spreads are expressed in decimal points; CDS in basis points. Mean with associated t-statistics reported in brackets. T-statistics reported in brackets. ***,**,* means significance at 1%, 5%, 10%, respectively. Lehman Brothers filed for bankruptcy protection on 15 September 2008.

Table 8 – Regression of spread changes against dummy during rating events, anticipation effects, S&P

	Negative events		Positive events	
Spread	Rating downgrades		Rating upgrades	
	[-30,-1]	[-60,-1]	[-30,-1]	[-60,-1]
Yields	0.023	0.048	-0.018	-0.10
	(0.41)	(0.61)	(-0.75)	(-0.51)
CDS	7.107	4.854 *	-0.399	-0.493
	(1.81)	(1.96)	(-0.83)	(-0.42)
	Negative outlook revisions		Positive outlook revisions	
	[-30,-1]	[-60,-1]	[-30,-1]	[-60,-1]
Yields	0.184	0.200	-0.001	0.029
	(1.11)	(1.79)	(-0.03)	(0.74)
CDS	1.108	1.960	-0.302	-0.245
	(0.20)	(0.42)	(-0.19)	(-0.13)

Note: Yields spreads are expressed in decimal points; CDS in basis points. Mean with associated t-statistics reported in brackets. T-statistics reported in the table. ***,**, * means significance at 1%, 5%, 10%, respectively. For instance, [-30,-1] is the change of the spread between *t-30* and *t-1*.

Table 9 –Granger Causality Tests

Rating		Yield spread		Stock Market Return	
Yield does not cause Rating	LR= 46.44 (0.000)	Rating does not cause Yield	LR= 300.59 (0.000)	Yield does not cause Stock market	LR= 222.2 (0.000)
Stock market does not cause Rating	LR= 13.17 (0.022)	Stock market does not cause Yield	LR= 118.04 (0.000)	Rating does not cause Stock market	LR= 2.67 (0.750)
Rating		CDS spread		Stock Market Return	
CDS does not cause Rating	LR= 91.62 (0.000)	Rating does not cause CDS	LR= 99.71 (0.000)	CDS does not cause Stock market	LR= 206.17 (0.000)
Stock market does not cause Rating	LR= 19.30 (0.002)	Stock market does not cause CDS	LR= 14.85 (0.011)	Rating does not cause Stock market	LR= 14.87 (0.000)

Note: Equations (4), (5) and (6) are estimated with country fixed effects. We use 5 lags of all variables. p-value of the test is reported in brackets. We should compare the test statistics with a Chi square with 5 degrees of freedom.

Table 10 – Contagion: effect on spreads of non-event countries

Coefficient	Country FE		Country FE +time trend		Country FE+ Time FE	
	Yields					
(β) Change in rating in event countries	-0.064 (-1.91)**	-0.020 (-0.54)	-0.100 (-3.23)***	-0.065 (-1.92)*	-0.100 (-1.77)*	0.273 (0.83)
(δ) Rating differences	-	0.000 (0.02)	-	-0.009 (-0.11)	-	-0.033 (-0.66)
(γ) Interaction	-	-0.011 (-2.41)**	-	-0.008 (-1.74)*	-	-0.025 (-2.13)**
	CDS					
(β) Change in rating in event countries	-0.2245 (-1.83)*	-0.060 (-0.83)	-0.138 (-1.43)	0.037 (0.31)	-0.123 (-0.48)	0.378 (1.02)
(δ) Rating differences	-	-0.013 (0.02)	-	-0.007 (-0.22)	-	-0.048 (-0.83)
(γ) Interaction	-	-0.088 (-1.58)	-	-0.086 (-1.58)	-	-0.072 (-1.52)

Note: Yields spreads are expressed in decimal points; CDS in basis points. Mean with associated t-statistics reported in brackets. T-statistics reported in the table. ***,**, * means significance at 1%, 5%, 10% respectively. FE – fixed effects.

Table 11 – Contagion: effect on spreads of non-event countries, EMU vs. non-EMU (country FE)

Coefficient	Overall	EMU	non-EMU
	Yields		
(β) Change in rating in event countries	-0.064 (-1.91)**	-0.064 (-2.35)**	-0.064 (-0.75)
	CDS		
(β) Change in rating in event countries	-0.2245 (-1.83)*	-0.382 (-1.92)**	-0.053 (-0.38)

Note: Yields spreads are expressed in decimal points; T-statistics reported in the table. ***,**, * means significance at 1%, 5%, 10% respectively. FE – fixed effects.

Table 12: Persistent effects of rating changes at different horizons

Coefficient	Yields Spreads		CDS Spreads	
(β) Rating	-1.233	(-68.87)***	-195.15	(-79.16)***
(γ) Rating^2	0.022	(33.15)***	5.86	(50.95)***
(δ) Downgrade				
<1 month	0.454	(17.46)***	113.7	(49.74)***
1-3 months	0.576	(28.09)***	111.7	(59.68)***
3-6 months	0.475	(25.90)***	75.3	(43.79)***
6-12 months	0.040	(2.71)***	-4.2	(-2.74)***
(θ) Upgrade				
<1 month	-0.093	(-5.38)***	-43.1	(-16.51)***
1-3 months	-0.110	(-8.59)***	-49.0	(-24.85)***
3-6 months	-0.118	(-10.91)***	-38.6	(-22.52)***
6-12 months	-0.072	(-8.59)***	-45.1	(-32.94)***

Note: Equation (9) is estimated with country fixed effects with 65288 observations for the yield spreads and 35097 observations for the CDS spreads. Yields spreads are expressed in decimal points; CDS in basis points. Mean with associated t-statistics reported in brackets. ***,**,* means significance at 1%,5%, 10%, respectively.

Data annex

Daily sovereign yield data come from Reuters. The respective tickers are: BE10YT_RR, DE10YT_RR, IE10YT_RR, GR10YT_RR, ES10YT_RR, FR10YT_RR, IT10YT_RR, NL10YT_RR, AT10YT_RR, PT10YT_RR, FI10YT_RR, MT10YT_RR, SI10YT_RR, SK10YT_RR, DK10YT_RR, GB10YT_RR, BG10YT_RR, CZ10YT_RR, HU10YT_RR, LT10YT_RR, LV10YT_RR, PL10YT_RR, RO10YT_RR, SE10YT_RR.

Daily 5-year Credit default swaps spreads, historical close, are provided by DataStream.

Daily equity indexes are provided by Datastream:

Germany - Equity/index - DAX 30 Performance Index - Historical close - Euro
France - Equity/index - France CAC 40 Index - Historical close - Euro
Athens Stock Exchange ATHEX Composite Index - Historical close - Euro
Standard & Poors/MIB Index - historic close - Euro
Portugal PSI-20 Index - historic close - Euro
Amsterdam Exchange (AEX) Index - historic close - Euro
Spain IBEX 35 Index - historic close - Euro
Belgium BEL 20 Index - historic close - Euro
Ireland Stock Exchange Overall (ISEQ) Index - historic close - Euro
Nordic Exchange OMX Helsinki (OMXH) Index - historic close - Euro
Austrian Traded Index (ATX) - Percentage change in the latest trade price or value from the historic close - Euro
Slovenian Stock Exchange (SBI) Index - Percentage change in the latest trade price or value from the historic close - Euro
Cyprus Stock Exchange General Index - Historical close - Euro
Malta Stock Exchange Index - Percentage change in the latest trade price or value from the historic close - Maltese lira
Slovakia SAX 16 Index - Percentage change in the latest trade price or value from the historic close - Euro
Bulgaria Stock Exchange SOFIX Index - Historical close, end of period - Bulgarian lev, provided by Bloomberg
Prague PX 50 Index - Historical close, end of period - Czech koruna
Nordic Exchange OMX Copenhagen (OMXC) 20 Index - Historical close, end of period - Danish krone
Nordic Exchange OMX Tallinn (OMXT) Index - Historical close, end of period - Estonian kroon
Nordic Exchange OMX Riga (OMXR) Index - Historical close, end of period - Latvian lats
Nordic Exchange OMX Vilnius (OMXV) Index - Historical close, end of period - Lithuanian litas
Budapest Stock Exchange BUX Index - Historical close, end of period - Hungarian forint
Warsaw Stock Exchange General Index - Historical close, end of period - Polish zloty
Romania BET Composite Index (Local Currency) - Historical close, end of period - Romanian leu
Nordic Exchange OMX Stockholm 30 (OMXS30) Index - Historical close, end of period - Swedish krona
Financial Times Stock Exchange (FTSE) 100 Index - Historical close, end of period - UK pound sterling

Appendix 1: additional results

Table A1.1 – Summary of rating announcements

	Announcements since 1995				Starting date and total announcements captured		
Country	Upgrade	Downgrade	Positive Outlook	Negative Outlook	Yields	CDS	Equity
Euro Area							
Austria	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)	2 Jan 1995 (0)	6 Jan 2004 (0)	1 Jan 2002 (0)
Belgium	2 (0,0,2)	1 (0,0,1)	1 (1,0,1)	0 (0,0,0)	10 May 1996 (4)	5 Jan 2004 (2)	1 Jan 2002 (3)
Finland	8 (3,2,3)	0 (0,0,0)	3 (3,0,0)	0 (0,0,0)	2 Jan 1995 (11)	14 May 2008 (0)	1 Jan 2002 (1)
France	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)	28 May 1996 (0)	16 Aug 2005 (0)	1 Jan 2002 (0)
Germany	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)	2 Jan 1995 (0)	8 Jan 2004 (0)	1 Jan 2002 (0)
Greece	12 (4,3,5)	11 (4,3,4)	7 (1,2,4)	6 (3,1,2)	2 Nov 1998 (33)	9 Jan 2004 (19)	1 Jan 2002 (23)
Ireland	6 (3,3,1)	7 (3,2,2)	1 (1,0,0)	3 (1,1,1)	2 Jan 1995 (17)	11 Aug 2003 (10)	1 Jan 2002 (10)
Italy	3 (0,2,1)	3 (2,0,2)	1 (0,1,0)	4 (3,0,1)	12 Jun 1996 (9)	20 Jan 2004 (4)	1 Jan 2002 (7)
Malta	4 (1,2,1)	2 (1,1,0)	2 (0,1,1)	3 (1,2,0)	4 Aug 1998 (3)	-	3 Jan 2002 (5)
Netherlands	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)	8 May 1996 (0)	7 Sep 2005 (0)	1 Jan 2002 (0)
Portugal	4 (1,2,1)	5 (3,1,1)	1 (1,0,0)	6 (3,1,2)	2 Jan 1995 (16)	26 Jan 2004 (11)	1 Jan 2002 (11)
Slovakia	18 (8,4,6)	2 (1,0,1)	9 (2,4,3)	3 (1,1,1)	17 Mar 2004 (9)	6 Jan 2004 (14)	1 Jan 2002 (20)
Slovenia	10 (3,3,4)	0 (0,0,0)	6 (1,3,2)	0 (0,0,0)	-	1 Jan 2003 (6)	1 Jan 2002 (13)
Spain	5 (2,1,2)	4 (2,1,1)	3(2,1,0)	3 (2,1,0)	3 Jul 1996 (15)	27 Apr 2005 (7)	1 Jan 2002 (10)
Non-euro area							
Bulgaria	17 (7,5,5)	2 (1,0,1)	5 (1,3,1)	3 (1,0,2)	3 Sep 2002 (12)	8 Sep 2004 (12)	2 Jan 2002 (21)
Czech Republic	7 (2,2,3)	2 (1,0,1)	4 (2,1,1)	0 (0,0,0)	14 Apr 2000 (9)	8 Sep 2004 (7)	1 Jan 2002 (9)
Denmark	3 (1,1,1)	0 (0,0,0)	3 (1,1,1)	0 (0,0,0)	2 Jan 1995 (6)	22 Mar 2006 (0)	1 Jan 2002 (1)
Estonia	8 (3,1,4)	3 (1,0,2)	8 (3,1,4)	3 (1,1,1)	-	8 Feb 2006 (10)	1 Jan 2002 (16)
Hungary	10 (4,3,3)	8 (3,3,2)	4 (1,1,2)	10 (4,2,4)	8 Jun 1999 (26)	8 Sep 2004 (16)	1 Jan 2002 (18)
Latvia	5 (2,1,2)	12 (5,3,4)	5 (2,1,2)	4 (1,1,2)	-	13 Jan 2006 (17)	1 Jan 2002 (24)
Lithuania	13 (4,4,5)	8 (3,2,3)	6 (2,3,2)	3 (1,1,1)	-	6 Jun 2005 (14)	1 Jan 2002 (27)
Poland	9 (4,2,3)	0 (0,0,0)	8 (4,1,3)	1 (1,0,0)	3 Aug 1999 (11)	8 Sep 2004 (5)	1 Jan 2002 (8)
Romania	16 (6,4,6)	8 (3,2,3)	8 (3,2,3)	5 (2,1,2)	-	8 Sep 2004 (13)	1 Jan 2002 (22)
Sweden	7 (1,3,3)	1(0,1,0)	3 (1,1,1)	2 (1,1,0)	1 Jan 1999 (9)	21 Nov 2007 (0)	1 Jan 2002 (4)
United Kingdom	0 (0,0,0)	0 (0,0,0)	0 (0,0,0)	1 (1,0,0)	27 Set 1996 (1)	8 Sep 2004 (1)	1 Jan 2002 (1)
Euro area, total	72 (25,21,26)	35 (16,8,12)	34 (11,13,10)	28 (14,7,7)	117	73	102
Non-euro area, total	95 (34,26,35)	44 (17,11,16)	54 (20,15,20)	32 (13,7,12)	74	94	150
Total	167 (59,47,61)	79 (33,19,28)	88 (31,28,30)	60 (27,14,19)	191	167	252

Note: the announcements since 1995 include in brackets the number for each agency (S&P, Moody´s, Fitch). For instance, Greece 12 (4,3,5) in the upgrade column means: 4, 3, and 5 upgrades respectively from S&P, Moody´s, and Fitch.

Table A1.2 – Granger causality tests, specific agency regressions

		5 Lags	10 Lags
Yield spread is not caused by	S&P	LR=482.65 (0.000)	LR=2023.28 (0.000)
	Moody´s	LR=85.33 (0.000)	LR=108.02 (0.000)
	Fitch	LR=27.31 (0.000)	LR=68.33 (0.000)
	Stock Returns	LR=112.80 (0.000)	LR=116.77 (0.000)
S&P is not caused by	Moody´s	LR=201.62 (0.000)	LR=242.97 (0.000)
	Fitch	LR=7.79 (0.168)	LR=45.99 (0.000)
	Stock Returns	LR=12.34 (0.031)	LR=17.22 (0.070)
	Yield spread	LR=106.22 (0.000)	LR=251.50 (0.000)
Moody's is not caused by	S&P	LR=38.40 (0.000)	LR=51.00 (0.000)
	Fitch	LR= 0.20 (0.999)	LR= 160.83 (0.000)
	Stock Returns	LR=19.65 (0.002)	LR=24.18 (0.001)
	Yield spread	LR=27.35 (0.000)	LR=44.83 (0.000)
Fitch is not caused by	S&P	LR=23.37 (0.003)	LR=104.55 (0.000)
	Moody´s	LR=16.85 (0.005)	LR=1.25 (0.999)
	Stock Returns	LR=6.95 (0.224)	LR=14.59 (0.148)
	Yield spread	LR=6.21 (0.287)	LR=4.79 (0.905)
Stock returns are not caused by	S&P	LR=14.99 (0.010)	LR=104.55 (0.000)
	Moody´s	LR=6.42 (0.2678)	LR=1.25 (0.999)
	Fitch	LR= 6.91 (0.228)	LR14.59 (0.148)
	Yield spread	LR=9.59 (0.088)	LR=4.79 (0.905)

Note: Each equation is estimated individually with country fixed effects and includes all variables in lag-differences. We use either 5 or 10 lags of all variables. The p-value of the test is reported in brackets. We should compare the test statistics with a Chi square with 5 and 10 degrees of freedom respectively. The specific rating variable per agency is now, for instance for Moody's, $R_{it} = M_{it} + 0.5\,posM_{it} - 0.5negM_{it}$.

Table A1.3: Persistent effects of rating changes on yield spreads at different horizons, by rating agency

Coefficient	S&P		Moody's		Fitch	
(β) Rating	-1.035	(-63.45)***	-0.403	(-26.34)***	-1.413	(-77.90)***
(γ) Rating^2	0.021	(34.34)***	-0.004	(-7.39)***	0.037	(55.16)***
(δ) Downgrade						
<1 month	0.315	(8.82)***	1.241	(26.60)***	0.291	(6.90)***
1-3 months	0.500	(19.08)***	1.542	(43.87)***	0.445	(14.60)***
3-6 months	0.477	(21.22)***	1.534	(45.23)***	0.987	(37.85)***
6-12 months	-0.056	(-3.12)***	0.399	(14.79)***	0.652	(30.02)***
(θ) Upgrade						
<1 month	0.192	(6.26)***	0.045	(1.49)	0.001	(0.02)
1-3 months	0.081	(3.81)***	0.048	(2.28)**	-0.098	(-4.85)***
3-6 months	0.136	(7.68)***	-0.002	(-0.12)	-0.208	(-12.45)***
6-12 months	0.129	(10.08)***	-0.149	(-12.09)***	-0.105	(-8.69)***

Note: Equation (9) is estimated with country fixed effects using 65288 observations. Yields spreads are expressed in decimal points. Mean with associated t-statistics reported in brackets. ***,**,* means significance at 1%,5%, 10%, respectively.

Table A1.4: Persistent effects of rating changes on CDS spreads at different horizons, by rating agency

Coefficient	S&P		Moody's		Fitch	
(β) Rating	-172.82	(-99.34)***	-70.64	(-26.18)***	-192.32	(-105.89)***
(γ) Rating^2	5.04	(66.18)***	0.83	(7.08)***	6.39	(76.39)***
(δ) Downgrade						
<1 month	97.51	(31.51)***	158.08	(32.69)***	142.08	(44.93)***
1-3 months	85.31	(36.69)***	199.14	(54.46)***	155.16	(65.96)***
3-6 months	70.27	(34.75)***	133.77	(37.89)***	155.76	(75.80)***
6-12 months	-2.42	(-1.45)	-15.63	(-4.84)***	26.65	(14.42)***
(θ) Upgrade						
<1 month	-32.45	(-7.80)***	-88.15	(-14.05)***	-25.94	(-6.91)***
1-3 months	-39.40	(-13.20)***	-87.99	(-19.55)***	-30.76	(-11.73)***
3-6 months	-50.89	(-20.70)***	-87.00	(-23.16)***	-30.43	(-13.83)***
6-12 months	-41.23	(-23.51)***	-98.26	(36.45)***	-27.92	(-17.71)***

Note: Equation (9) is estimated with country fixed effects using 35097 observations. CDS spreads are expressed in basis points. Mean with associated t-statistics reported in brackets. ***,**,* means significance at 1%,5%, 10%, respectively.

Figure A1.1 – Sovereign yields by country

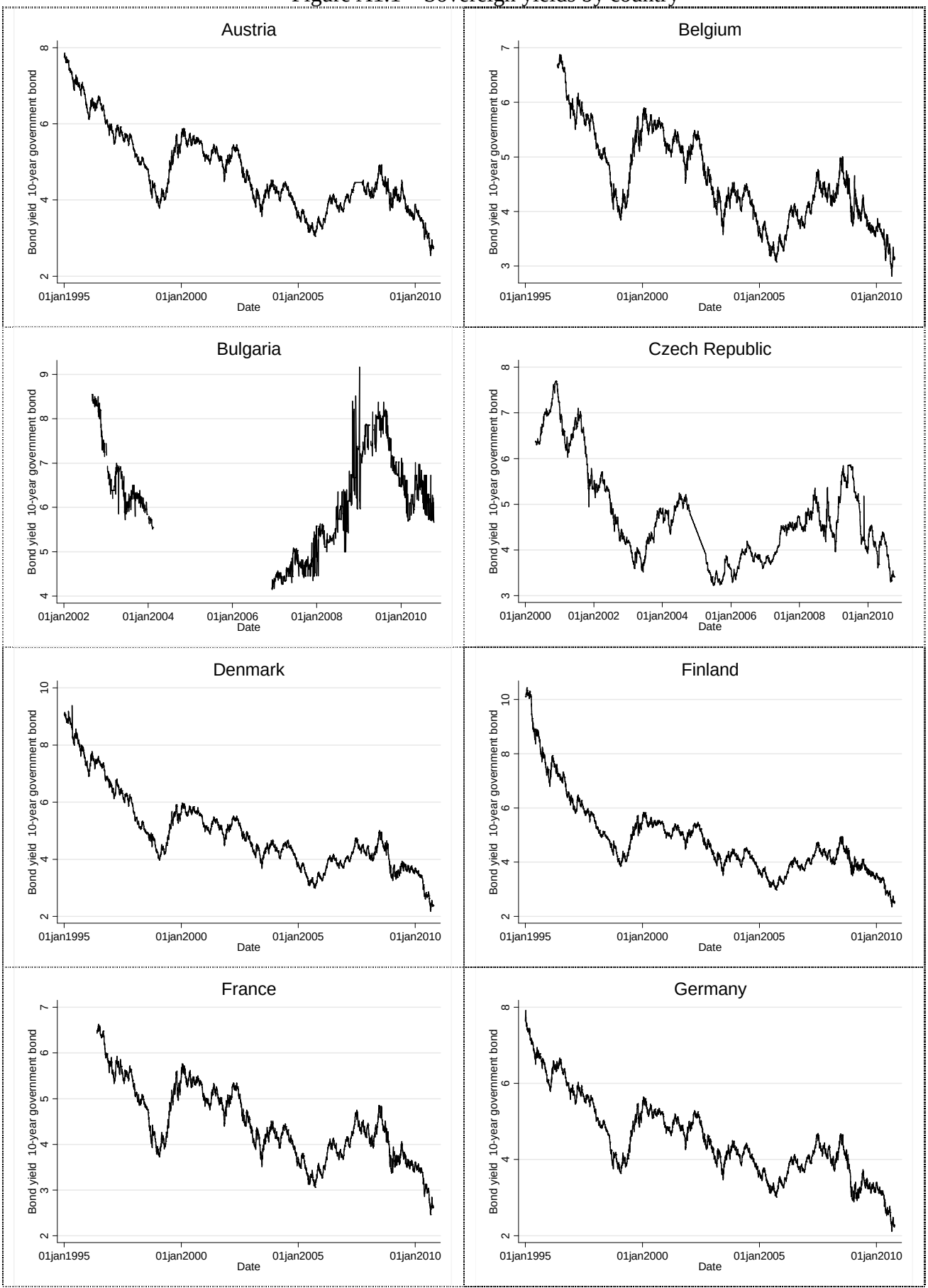


Figure A1.1 – Sovereign yields by country (cont)

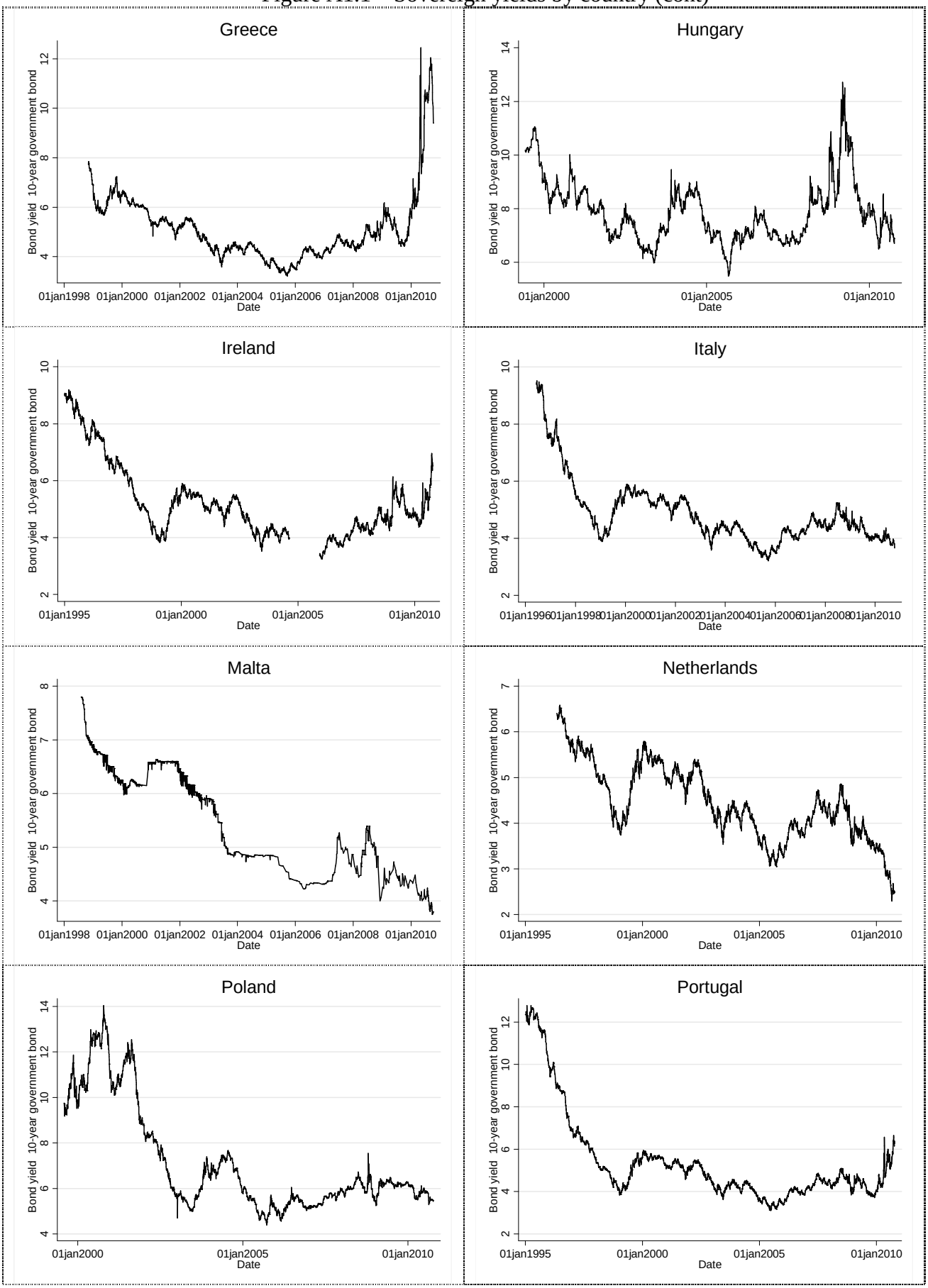


Figure A1.1 – Sovereign yields by country (cont)

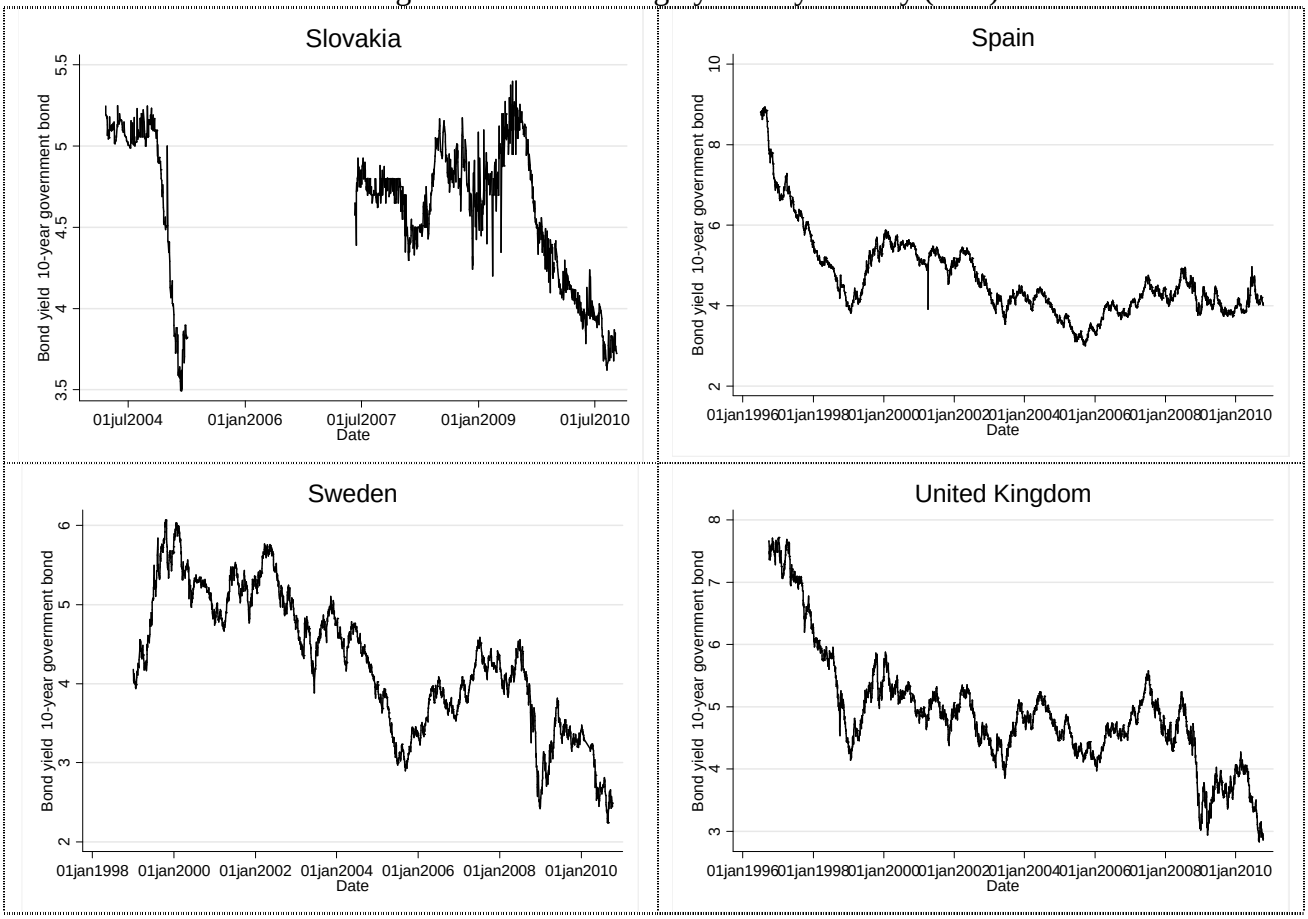


Figure A1.2 – CDS by country

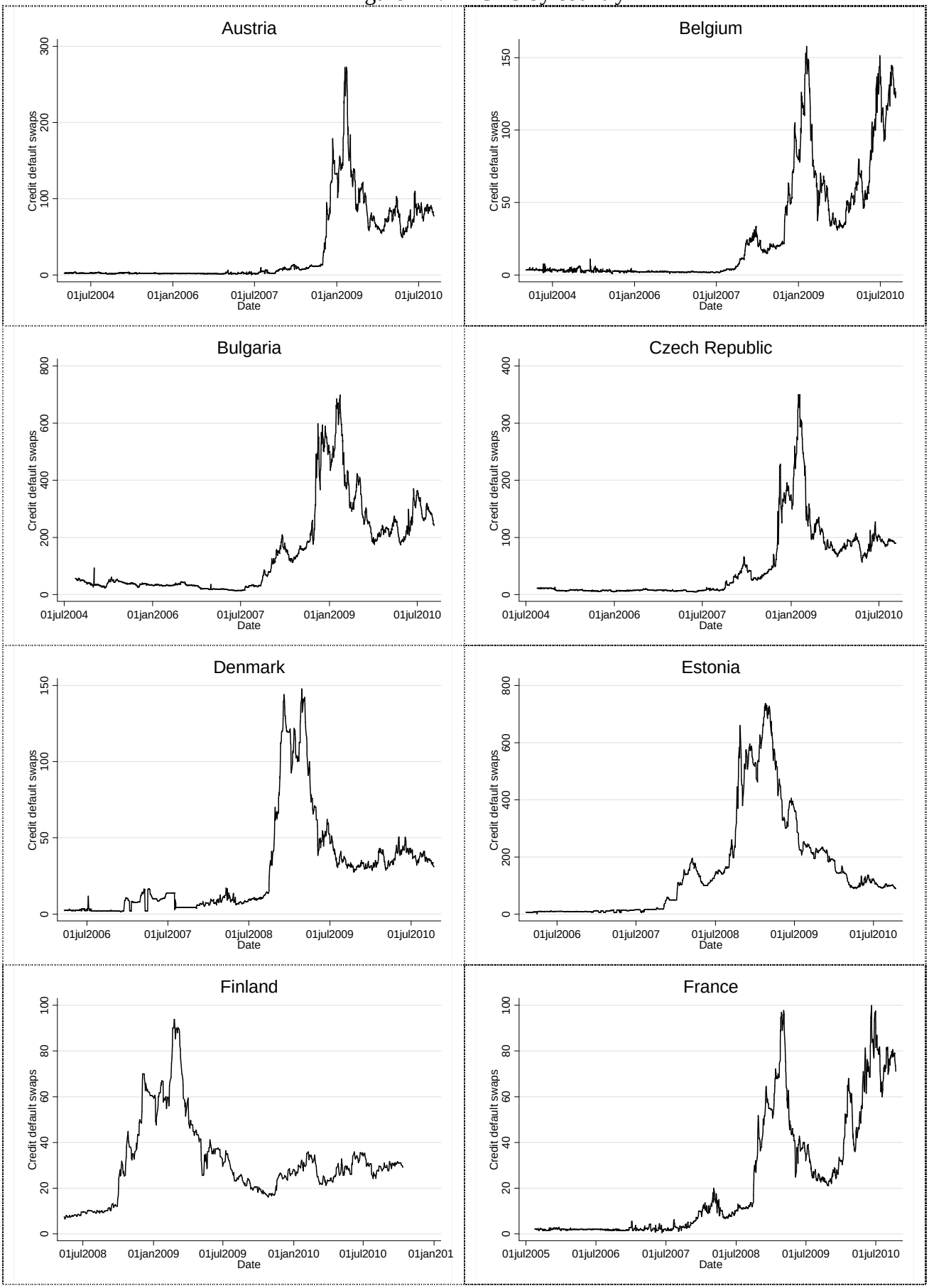


Figure A1.2 – CDS by country (cont.)

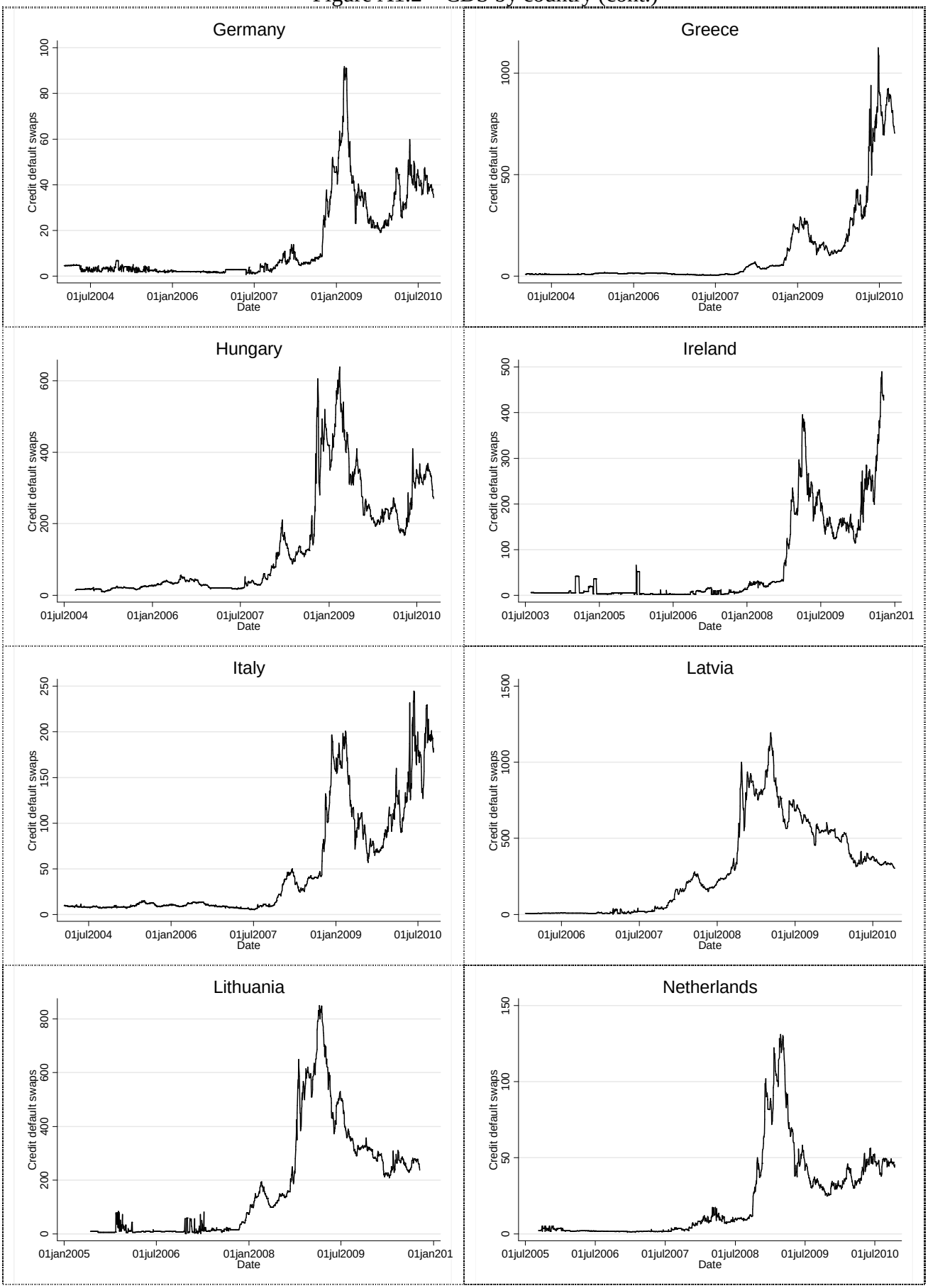


Figure A1.2 – CDS by country (cont.)

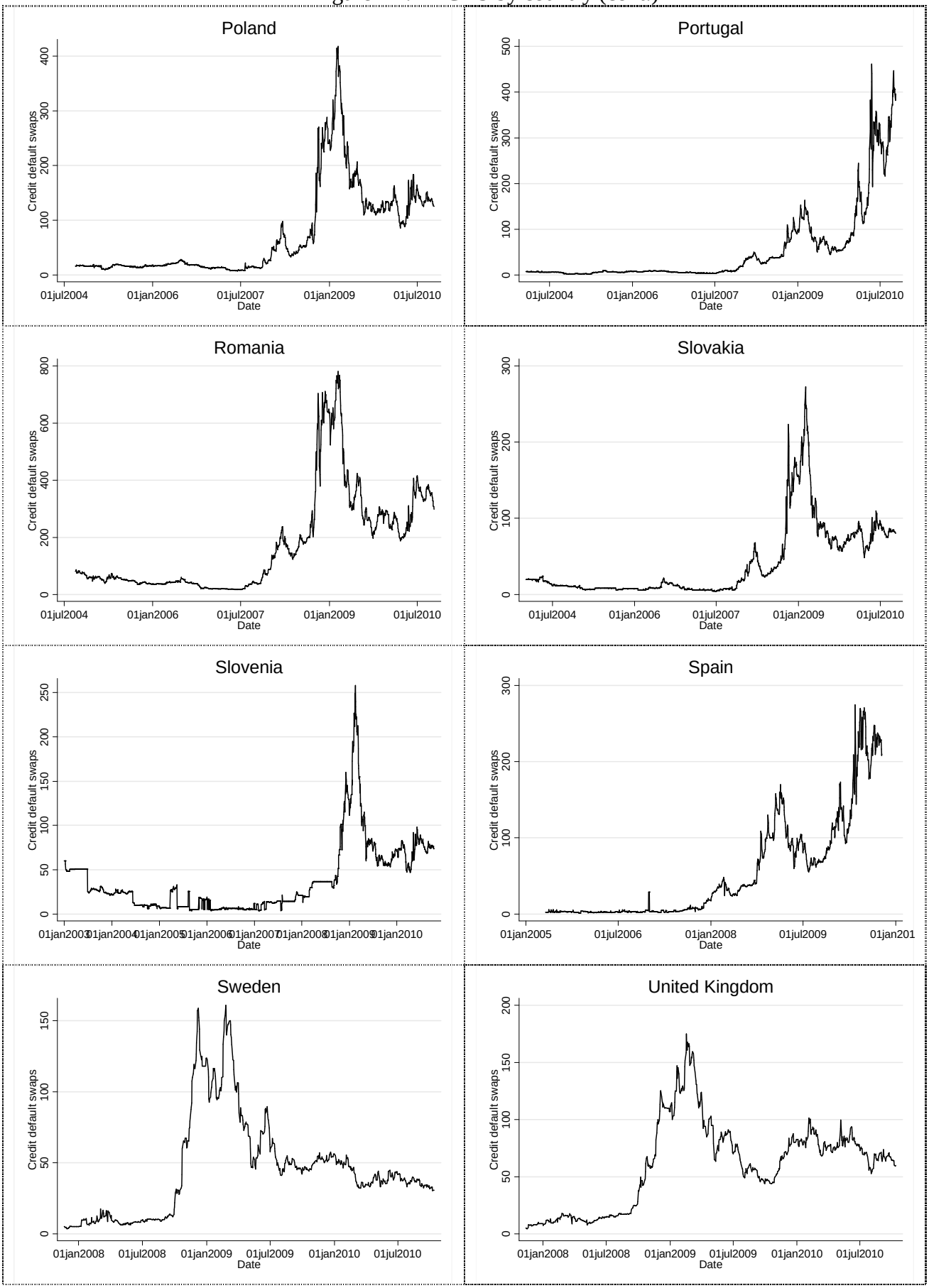


Figure A1.3 – Rating by country

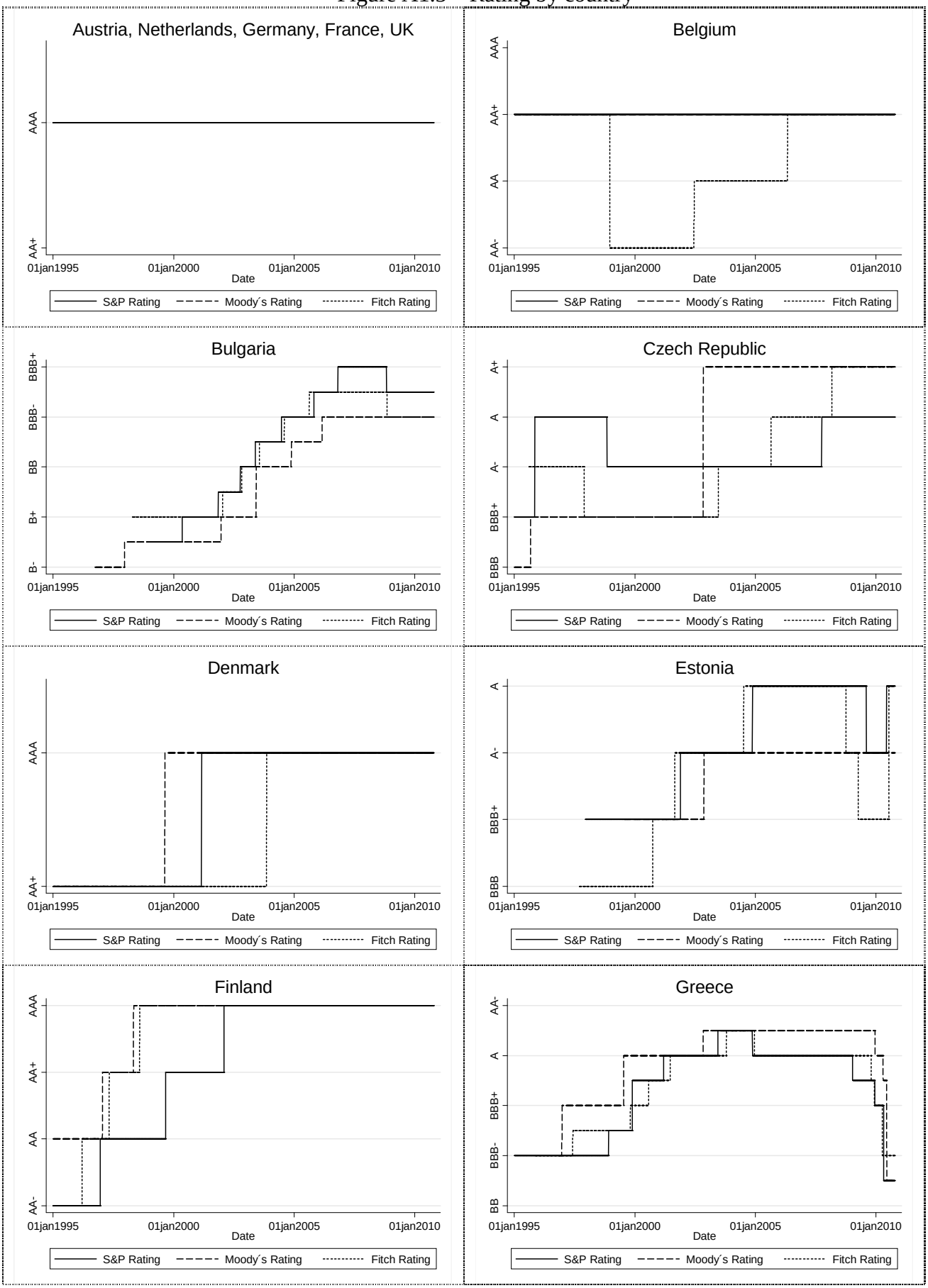


Figure A1.3 – Rating by country (cont.)

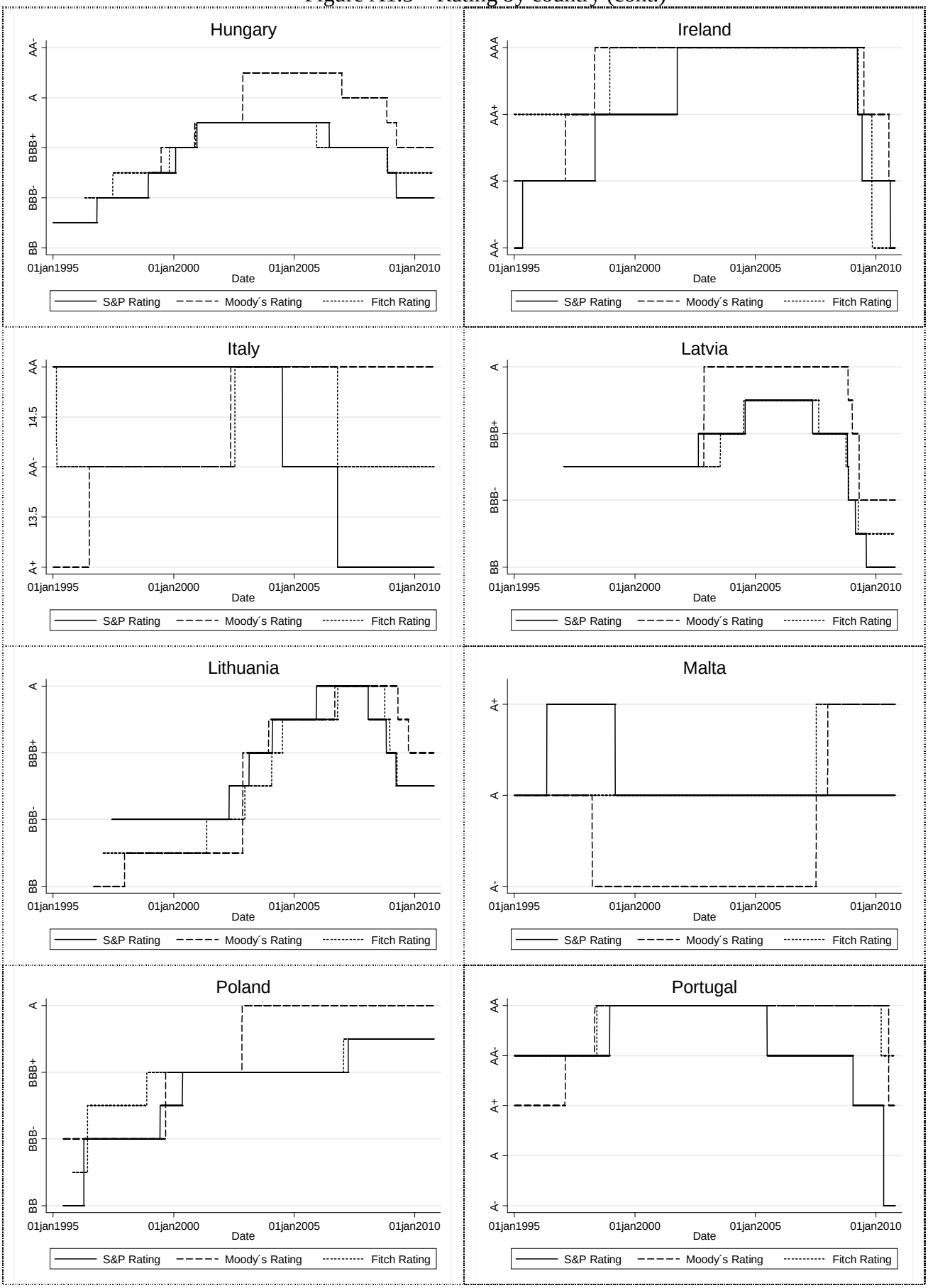
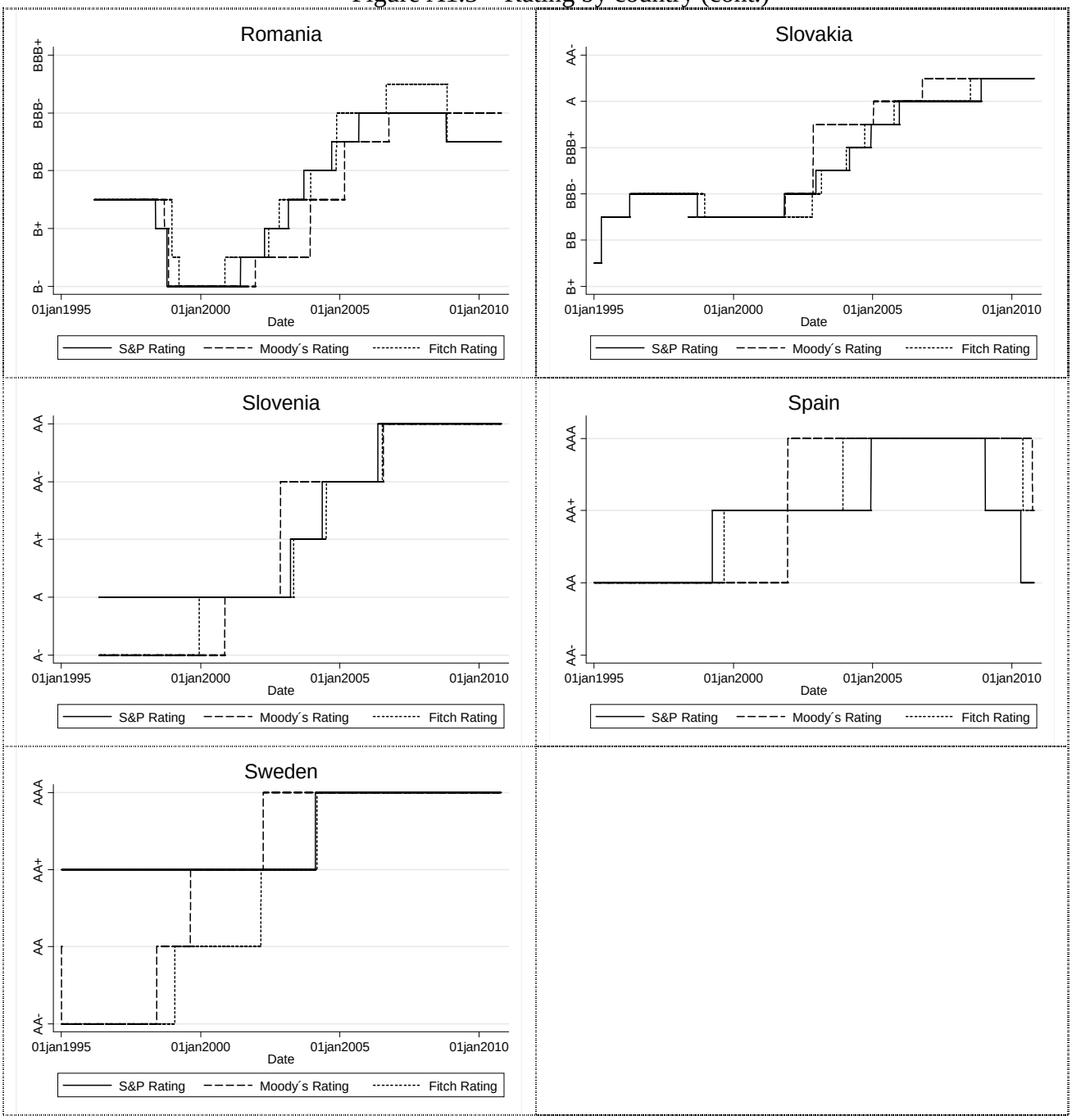
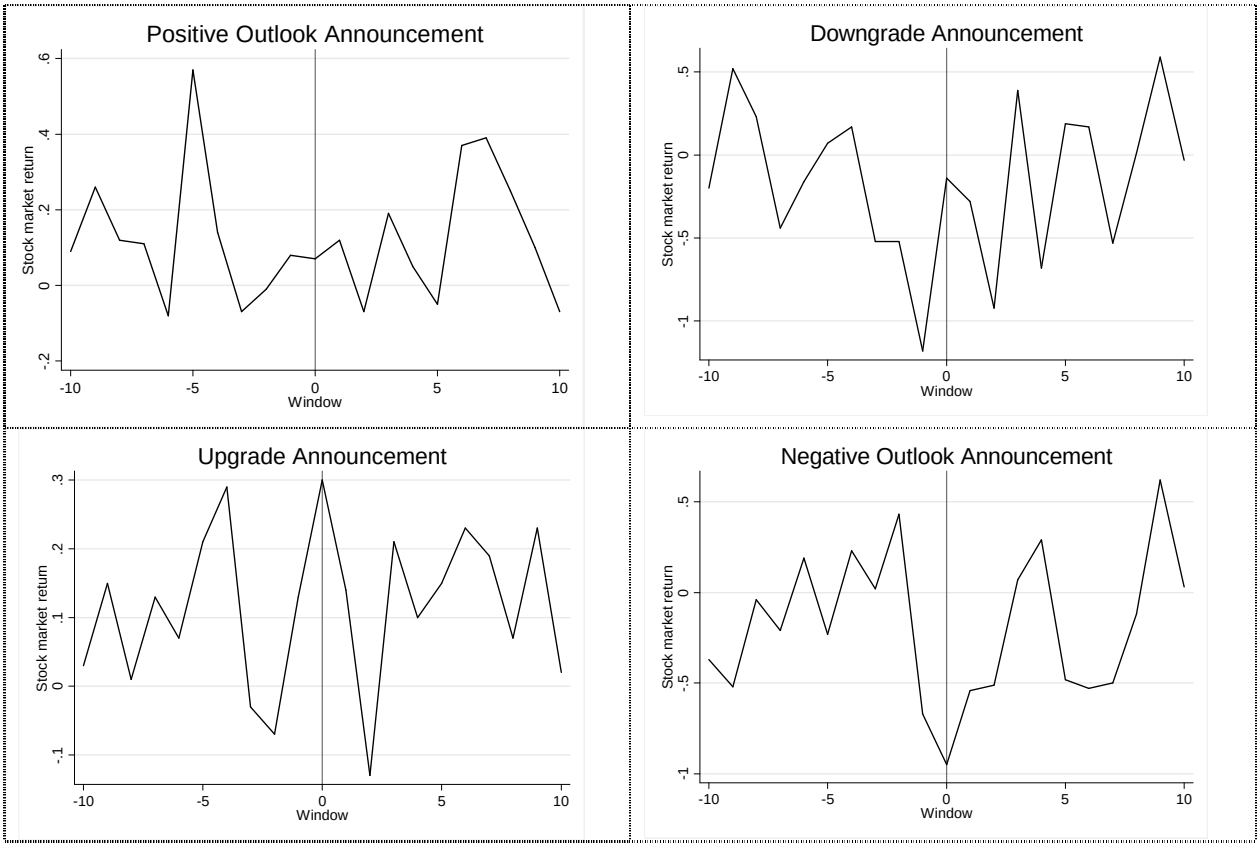


Figure A1.3 – Rating by country (cont.)



Appendix 2: effects of announcements on stock market returns

Figure A2.1 – Stock market returns before and after an announcement



Note: based on 95 upgrades, 63 downgrades, 47 positive outlook and 47 negative outlook announcements for the 3 agencies.