Int Adv Econ Res (2011) 17:288–299
DOI 10.1007/s11294-011-9302-7

PIGS or Lambs? The European Sovereign Debt Crisis and the Role of Rating Agencies

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Published online: 11 June 2011

Abstract This paper asks whether rating agencies played a passive role or were an active driving force during Europe's sovereign debt crisis. We address this by estimating relationships between sovereign debt ratings and macroeconomic and structural variables. We then use these equations to decompose actual ratings into systematic and arbitrary components that are not explained by previously observed procedures of rating agencies. Finally, we check whether systematic, as well as arbitrary, parts of credit ratings affect credit spreads. We find that both do affect credit spreads, which opens the possibility that arbitrary rating downgrades trigger processes of self-fulfilling prophecies that may drive even relatively healthy countries towards default.

Keywords Rating agencies · Sovereign debt · Credit risk · Eurozone · Panel data · Debt crisis

JEL G24 · H63 · F34

Introduction

Important lessons learned from the recent global financial crisis are that the judgment of private rating agencies can have a huge impact on macroeconomic outcomes—and that it can be utterly mistaken.[1] Given these past failings concerning

[1]See for example Crotty (2009) or Goodhart (2008).

We are grateful to Andreas Kleiner, Simon Knaus and Giovanni Mellace for many helpful comments and suggestions.

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structured products on US mortgage loans, it would be surprising if market participants again rely on the same rating agencies when assessing the default risks of governments in the current European sovereign debt crisis. It could even be cataclysmic if these sovereign debt ratings were driving government bond yields irrespective of the development of the underlying economic fundamentals. This would put the fate of entire nations into the hands of private agencies because bad ratings, which are not in line with economic fundamentals, could be justified *ex post via* self-fulfilling prophecies. Then, even innocent lambs could be turned into, and treated like, pigs.

Given the importance of these issues for the stability of the European Monetary Union (EMU) we elaborate on the role of rating agencies in the current sovereign debt crisis, focusing on the so-called PIGS countries, i.e., Portugal, Ireland, Greece and Spain. The question whether rating agencies played a passive role or were an active driving force during Europe's debt crisis is addressed in three steps. First, we try to develop an understanding of how sovereign debt ratings are formed. We do this by estimating relationships between ratings and macroeconomic and structural variables. Second, we use these equations to decompose actual ratings into a systematic and an arbitrary part, the latter being defined as what is left unexplained by previously observed procedures of rating agencies. Finally, we quantify the effect of the systematic and the arbitrary part of a country's sovereign debt rating on its government bond yields to assess the endogenous and the discretionary impact of rating agencies on market outcomes during the European debt crisis with special concern for the PIGS countries. As our results suggest, the PIGS countries were not only rated worse during the crisis than all other countries in our sample of 26 OECD countries, but this markdown also resulted in significantly higher interest rates on government bonds, which themselves aggravated the European debt crisis.

Our paper contributes to several strands in the literature. First, it adds to the broad literature following Cantor and Packer (1996) that tries to explain sovereign debt ratings, which is summarized by Mellios and Paget-Blanc (2006). Most closely related to our study is the work of Ferri et al. (1999), Mulder and Perrelli (2001) and El-Shagi (2010) who discuss the role of rating agencies during the Asian Crisis at the end of the 1990s. By employing ordered regressions to explain sovereign debt ratings, our analysis is also related to Hu et al. (2002), Block and Vaaler (2004) and Afonso et al. (2007, 2009). It seems that no study exists which analyzes the role of rating agencies during the current European sovereign debt crisis using such methods. Our paper also adds to the literature that finds a significant impact of ratings on government bond spreads. Following the work of Kamin and von Kleist (1999) and Eichengreen and Mody (2000), who identified such a relationship for developing countries in the 1990s, Gomez-Puig (2006) finds a negative relationship between bond spreads and ratings for EMU members between 1996 and 2001. This is consistent with the results that Manganelli and Wolswijk (2009) obtained for EMU countries between 1999 and 2008. More recent papers suggest this relation also holds in the face of the current economic crisis, see for example Attinasi et al. (2009) or Sgherri and Zoli (2009). We do not only contribute to this literature by explaining government bond spreads with more recent sovereign debt ratings, but also by conducting Granger causality tests on the causal relation between both variables, which has rarely been done before.

The paper is structured as follows. The next section provides information on the employed data. Then we try to determine how sovereign debt ratings are built, followed by a look at how ratings and their components affect sovereign credit spreads. In the final section we offer concluding remarks.

The Data

Our empirical analysis uses annual data for 26 OECD countries for the period 1999 to 2010.[2] Eight OECD members were omitted because no data was available or membership started after 1999. We chose the specific period because sovereign ratings for the observed countries are not always available before this, and because we wanted to avoid the structural break due to the introduction of the Euro in 11 countries of our sample. The following variables are included, with descriptive statistics shown in Table 1[3]:

- *Rating*: Three major agencies provide sovereign ratings: Moody's, Fitch and Standard & Poor's. We use the end-of-year, long-term sovereign debt rating of Fitch, Inc.[4] For non-ordered regressions we translate the ratings into an equidistant numerical scale from 1 for D and 21 for AAA as, for example, in Afonso et al. (2007).
- *GDP growth*: Data on real GDP growth is from the OECD Economic Outlook No. 88 Annex Table 1.
- *GDP per capita*: Real GDP per capita measured in thousand current international dollars is from the IMF World Economic Outlook database.
- *Government surplus*: This variable measures general government financial balances as a percentage of nominal GDP including one-off factors such as sales of mobile phone licenses. The source is Annex Table 27 of the OECD Economic Outlook No. 88.
- *Government primary surplus (adj)*: This variable measures the general government underlying primary balance as a percentage of GDP. It equals Government surplus less net interest payments and is adjusted for one-off factors. The source is Annex Table 30 of the OECD Economic Outlook No. 88.
- *Government debt*: General government gross debt as a percentage of nominal GDP is taken from the IMF World Economic Outlook database.
- *Government bond yield*: Daily 10-year government bond yields are from Thomson Reuters Datastream. We use annual averages (avg) and end-of-year values (eoy).[5]

[2] Our sample includes Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Poland, Portugal, South Korea, Spain, Sweden, Switzerland, United Kingdom, and the USA.

[3] Data for 2010 are mostly estimates provided by the OECD Economic Outlook or the IMF World Economic Outlook database.

[4] Since the data needed for our analysis were not available for all three agencies we settled for Fitch as a representative. Given the high correlation between the ratings of Fitch and Standard & Poor's we do not expect this choice to bear on our main results.

[5] Due to the high volatility of daily data we used December averages instead of the December 31st value for the end-of-year values.

Table 1 Individual sample descriptive statistics

	Mean	Median	Std. Dev.	Maximum	Minimum	Obs.
Rating (eoy)	19.21	20.00	2.45	21.00	11.00	321
GDP growth	2.62	2.65	1.98	10.19	−3.80	324
GDP per capita	31.07	29.73	11.11	82.09	9.62	324
Gov. surplus	−1.25	−1.45	5.04	19.26	−32.30	324
Gov. prim. surplus (adj)	0.05	0.44	2.91	6.88	−8.31	324
Gov. debt	58.52	53.16	35.10	225.85	6.07	324
Gov. bond yield (avg)	4.66	4.50	1.62	11.80	0.50	290
Gov. bond yield (eoy)	4.56	4.40	1.66	12.10	0.60	297
Credit spread (eoy)	0.70	0.30	1.68	9.10	−3.70	297
Inflation	2.46	2.28	1.83	12.41	−1.71	324

- *Credit spread*: The credit spread is calculated as the difference between the end-of-year 10-year government bond yield of a country and of Germany.
- *Inflation*: The source is the IMF World Economic Outlook database.

PIGS or Lambs? Understanding Sovereign Debt Ratings

The main purpose of this section is to identify robust explanations of how agencies may generate their ratings. We need these as benchmarks, since rating agencies remain understandably secretive about their true procedures. These benchmarks allow us to conclude whether ratings arbitrarily and significantly went off course when the European sovereign debt crisis erupted.

This section, therefore, proceeds in two steps. First, we set up and estimate a benchmark model that relates ratings to variables that are considered relevant for the default probability of a sovereign state. Then we test the consistency of the PIGS ratings during the European sovereign debt crisis with this estimated benchmark model.

The Benchmark Model

Whether a country has to default or not is ultimately determined by economic fundamentals.[6] In our benchmark model the rating $R_{i,t}$ of country i in year t is described by:

$$R_{i,t} = \alpha + \beta' X_{i,t} + \varepsilon_{i,t} \quad (1)$$

where: α denotes the intercept; β is a vector of coefficients; $X_{i,t}$ is a vector of economic fundamentals, including a dummy variable for members of the euro area; and $\varepsilon_{i,t}$ reflects an error term. The variables contained in the $X_{i,t}$ vector are chosen from the broad set of variables provided by the literature on sovereign debt ratings

[6] Note that this must not be confused with the question whether a country actually *declares* default or not, see Eaton et al. (1986).

by using economic reasoning underlying the theory of public debt. The first column of Table 2 shows the estimation results obtained from a pooled OLS regression.

Seven out of eight variables turn out to be statistically significant at the 99 percent confidence level and have the expected sign. It is not surprising that according to our results agencies rate members of the Eurozone 0.85 notches higher than non-members.

Table 2 Explaining sovereign debt ratings

	Dependent variable: Rating (eoy)			
	(I)	(II)	(III)	(IV)$^{+}$
Intercept	19.60 *** (0.00)	19.59 *** (0.00)	21.71 *** (0.00)	–
Crisis	–	−1.00 *** (0.00)	0.66 *** (0.00)	−1.43 *** (0.00)
PIGS	–	0.03 (0.91)	–	0.21 (0.70)
PIGS×Crisis	–	−2.30 *** (0.00)	−1.31 *** (0.00)	−3.41 *** (0.00)
Euro zone	0.87 *** (0.00)	1.01 *** (0.00)	–	2.39 *** (0.00)
GDP growth	−0.04 (0.48)	−0.17 *** (0.01)	0.08 ** (0.03)	−0.31 *** (0.01)
GDP per capita	0.12 *** (0.00)	0.13 *** (0.00)	0.01 (0.54)	0.27 *** (0.00)
Gov. surplus	0.08 *** (0.00)	0.04 * (0.10)	0.15 *** (0.00)	0.37 *** (0.00)
Gov. prim. surplus (adj.)	0.10 *** (0.01)	0.07 * (0.08)	−0.20 *** (0.00)	−0.30 *** (0.00)
Gov. debt	−0.02 *** (0.00)	−0.02 *** (0.00)	−0.03 *** (0.00)	−0.03 *** (0.00)
Lagged gov. bond yield (avg)	−0.46 *** (0.00)	−0.38 *** (0.00)	−0.10 ** (0.04)	−0.45 *** (0.01)
Inflation	−0.31 *** (0.00)	−0.39 *** (0.00)	−0.07 ** (0.03)	−0.66 *** (0.00)
Country fixed effects	N	N	Y	N
$\overline{R}^2$	0.67	0.68	0.96	–
Predicted evaluation (correctly classified)	0.27	0.28	0.78	0.56
Predicted evaluation (at most 1 notch difference)	0.76	0.80	1.00	0.85
Observations	262	262	262	262

P-values in parentheses. *, **, *** denote significance at the 10%, 5%, 1% level

Data for 26 OECD countries between 1999 and 2010 from OECD, IMF, Thomson Reuters and Fitch Ratings

Ratings are transformed into an equidistant numerical scale from 1 (D) to 21 (AAA) in Regression (I) to (III)

$^{+}$ Results for regression (IV) are obtained by using an ordered dependent variable logit model

This premium might be attributed to the belief that the Stability and Growth Pact may have a positive impact on the budget discipline of Eurozone members.

To check the robustness of our results we also included several additional variables suggested in the literature, such as real effective exchange rates and other trade related measures. But since these variables only come into play when sovereign debts are issued in foreign currency, they turned out insignificant in our sample of industrialized countries. Also, the corruption index has no explanatory power since almost all OECD countries are ranked similarly high with little variation over time. In contrast, the composite index of government effectiveness issued by the World Bank and used by Afonso et al. (2009) has a significant impact on sovereign debt ratings. We decided not to incorporate this in our model, however, since it is highly correlated with income per capita and, thus, contains little additional information.[7] We also did not include measures for a country's default history, as no country in our sample declared default after World War II.

PIGS and the Crisis – a Modified Model

The benchmark model tells us nothing about whether the PIGS countries were singled out for special treatment during the crisis. To answer this question we modify Eq. 1 such that:

$$R_{i,t} = \alpha + \beta' X_{i,t} + \gamma C_{i,t} + \delta P_{i,t} + \lambda\left(P_{i,t} \times C_{i,t}\right) + \varepsilon_{i,t} \tag{2}$$

where: $C_{i,t}$ is a dummy variable for the years 2009 and 2010, when the sovereign debt crisis unfolded; $P_{i,t}$ is a dummy variable for the PIGS countries Portugal, Ireland, Greece and Spain; and $P_{i,t} \times C_{i,t}$ is an interaction term of the crisis and the PIGS dummy. The second column of Table 2 displays the results for this modified model by using pooled OLS. Almost all previous variables remain significant at the same or a slightly lower confidence level, whereas income growth now has a statistically significant negative impact on sovereign debt ratings. This seems at odds with common economic reasoning according to which higher income growth *ceteris paribus* leads to a lower debt ratio in the future. Given our sample of relatively homogenous countries, this negative regression parameter for income growth might be the result of some catch-up effect. According to the convergence property inherent in neoclassical growth theory, within a group of homogenous countries we would expect poor countries to feature higher income growth than richer ones. Since we find positive effect of income levels on sovereign ratings, this might explain the negative impact of income growth.[8]

Apart from that, two other results are noteworthy. First, the statistical significance of the crisis dummy, $C_{i,t}$, deserves particular attention. According to our estimates, the partial effect of the economic turmoil in 2009 and 2010 leads to a general rating decline of one notch. This is surprising, given that ratings do not reflect objective default probabilities but the relative creditworthiness of a country compared to others (see Mellios and Paget-Blanc 2006). This means that others (i.e., developing

[7] In fact, high values of government effectiveness seem to be a result rather than a cause of high income levels, since this index comprises elements like the quality of infrastructure, public schooling or public health care.

[8] Afonso et al. (2009) also find a negative effect of income growth on sovereign debt ratings.

countries not contained in our sample) must have been rated better during the crisis to keep the average rating constant. Additionally, agencies claim their ratings to be unaffected by changes in the business cycle (see Afonso et al. 2009), which makes the significant negative coefficient of the crisis dummy even more puzzling.

Second, it is remarkable that the interaction term turns out to be highly significant but the PIGS dummy is not. This means that even though there was no consequence of it being part of the PIGS group before the start of the European sovereign debt crisis, tables have turned over the last 2 years. When using the systematic from the benchmark model, the rating for a PIGS country in 2009 and 2010 is 2.30 notches lower than that of a hypothetical country, which is not part of that group but has the same economic fundamentals. This result is similar to that of Ferri et al. (1999) who find that, given their economic fundamentals, some countries were downgraded excessively by rating agencies during the Asian Crisis of 1997–1998. Of course, following Mulder and Perrelli (2001) one might point out that we cannot judge at that point whether the change in the rating is a correct anticipation of what lies ahead. And certainly, these countries were not grouped together arbitrarily, as they all face serious home-grown economic challenges. However, given the sharp increase in this group, the threat they are currently facing might be aggravated in an unjustified manner.

We conducted several robustness checks that give evidence for structural validity of our estimates. White's heteroscedasticity-consistent standard errors and bootstrapped standard errors did not change our findings. Column 3 of Table 2 displays the results when we control for country fixed effects.[9] Here, the significance of the PIGS×Crisis interaction term still reaches the 99 percent confidence level but with a smaller absolute coefficient. Surprisingly, the regression parameter for the crisis dummy turns positive in this case, which might be due to the high variance within the estimated fixed effects. Thus, it seems like the downgrading of specific country ratings is accompanied by an upgrading (or maintaining) of others, which is not justified by economic fundamentals. Finally, taking into account the ordinal nature of sovereign debt ratings we follow the approach of Hu et al. (2002) or Block and Vaaler (2004) by performing an ordered logit regression (see Column 4 in Table 2). Again, the PIGS× Crisis interaction term is negative and significant at a 99 percent confidence level. The crisis dummy has a negative effect on the sovereign debt rating, as no fixed effects are considered in this case, and the PIGS dummy again is insignificant.

Overall, our modified model fits the data very well and appears robust. A total of 80 percent of predicted sovereign debt ratings differ by no more than one notch from their actual value. If fixed effects are used, 78 percent of all observations are correctly predicted. Results suggest that ratings of countries in the PIGS groups have been downgraded excessively during the crisis, unsupported by our identified explanation of sovereign credit ratings that applied before the crisis and for other countries.

The Impact of Ratings on Credit Spreads

We now decompose actual ratings into a predicted part that can be attributed to economic and structural variables and an unexplained or arbitrary remainder. Then

[9] A Hausman Test strongly indicates the use of fixed effects rather than random effects.

we estimate the influence of each part on the credit spread. As we shall see, markets do respond to the arbitrary part, which indicates that rating agencies may indeed exert a discretionary influence on the price that governments pay for credit.

The underlying assumption of this approach, namely the causal effect of ratings on credit spreads, has been frequently employed in the literature (e.g., see Cantor and Packer 1996). Nevertheless, we test for Granger causality between the two variables, focusing on the PIGS countries, in order to underscore the validity of this assumption before we proceed to the regressions on credit spreads.

Ratings and Credit Spreads: The Question of Causality

Since looking for causal effects in financial markets makes little sense with annual data, we work with weekly averages instead.[10] To perform a Granger causality test we first estimate a VAR using first differences of credit and rating spreads of each country.[11] First differences are sufficient to render ratings and credit spreads stationary as an Augmented Dickey-Fuller Test indicates. The number of lags in the VAR is determined by the Hannan-Quinn information criterion and is between five and eight. The Granger causality test allows for an evaluation of the null hypothesis that a variable is exogenous by computing the Chi-square (Wald) statistic for the joint significance of the other lagged endogenous variable. For the PIGS countries considered here, we can never reject the hypothesis that the credit spread is caused by the rating spread. However, in two out of the four cases we can reject that the rating spread is caused by the credit spread at reasonable confidence levels. These results support the common conjecture that ratings, indeed, are a relevant variable for explaining credit spreads.[12]

Note that we used lagged government bond yields to explain ratings in the previous section. Doing so is not only an econometric remedy against endogeneity but it is also a valid assumption from a theoretical point of view—the proper variable in the regressions of the previous section is the effective interest rate a country has to pay for all its current debt. This usually lags behind the current interest rate and is closer to the lagged annual average due to different maturities and different issue dates of a country's debt titles.

The Effect of Ratings and their Constituent Parts on Credit Spreads

In this section, we decompose actual country credit ratings into a systematic part and an arbitrary part. The systematic part is explained by our set of economic and

[10] We can do so since the underlying data series—government bond yields and sovereign debt ratings—are available on a daily basis.

[11] As mentioned before, the credit spread of a country denotes the difference between its government bond yield and that of Germany. The rating spread denotes the difference between Germany's rating and the respective country's rating. Since Germany obtains a AAA rating in all observations, the rating spread is the distance of the current rating to the maximum rating.

[12] Reisen and von Maltzan (1999) find similar results using Granger causality tests. However, they apply a slightly different method and use different data.

structural variables in a fashion that appears robust over time and across countries. The arbitrary part is what remains unexplained in this fashion. We then estimate the impact of these components on the credit spread and thereby the capital costs of a country.[13] We use the credit spread instead of the interest rate to control for the general, global interest rate that obviously varies over time and is not influenced by idiosyncratic country ratings. We estimate the following model:

$$S_{i,t} = \eta \hat{R}^{X}_{i,t} + \theta \hat{R}^{P\times C}_{i,t} + \kappa \hat{\varepsilon}_{i,t} + \mu_{i,t} \tag{3}$$

where: $S_{i,t}$ is the credit spread; $\mu_{i,t}$ is the error term; and $\hat{R}^{X}_{i,t}$, $\hat{R}^{P\times C}_{i,t}$ and $\hat{\varepsilon}_{i,t}$ are the decompositions of actual ratings, derived from the regressions given in Table 2. It holds that:

$$R_{i,t} = \hat{R}^{X}_{i,t} + \hat{R}^{P\times C}_{i,t} + \hat{\varepsilon}_{i,t} \tag{4}$$

with: $R_{i,t}$ as the observed rating, $\hat{R}^{X}_{i,t} = \hat{\alpha} + \hat{\beta}' X_{i,t} + \hat{\gamma} C_{i,t} + \hat{\delta} P_{i,t}$ as the rating part explained (mostly) by economic fundamentals, and $\hat{R}^{P\times C}_{i,t} = \hat{\lambda}\left(P_{i,t} \times C_{i,t}\right)$ as the economically unjustified rating markup for PIGS countries during the crisis.[14] The residual $\hat{\varepsilon}_{i,t}$ is also used as an explanatory variable reflecting arbitrary rating markups that are not part of the PIGS×Crisis markup.

Note that for each regression in Table 2 we get different estimates for the decompositions because the coefficients $\hat{\alpha}$, $\hat{\beta}$, $\hat{\gamma}$, $\hat{\delta}$, $\hat{\lambda}$ and the residual $\hat{\varepsilon}_{i,t}$ vary with the specific set-up or method used in each regression. Our analysis, therefore, considers each equation separately. An exception is the ordered dependent variable regression. We abstain from decomposing the resulting equation because residuals are not available and generalized residuals as in Becker and Kennedy (1992) cannot be directly compared with those derived from the other regressions. We also refrain from decomposing the fixed effects regression since bootstrapping cannot be applied (see below). When decomposing the rating according to Regression (I) $\hat{R}^{P\times C}_{i,t}$ cannot be computed and $\hat{R}^{X}_{i,t} = \hat{\alpha} + \hat{\beta}' X_{i,t}$ only contains economic variables because the respective dummy variables $P_{i,t}$, $C_{i,t}$ and $P_{i,t}\times C_{i,t}$ are omitted in this case. Results are given in Table 3. The first column shows a baseline estimation in which we regress the credit spread on the observed rating only. Regression (ii-I) uses the decomposed rating computed from Regression (I) in the previous section, (iii-II) and (iv-II) relate to Regression (II).

The results suggest that rating agencies may indeed influence interest rates with rating markups that cannot be attributed to economic fundamentals.[15] All estimates show that the rating markup for the PIGS countries during the crisis is significant and increases the credit spread for these countries.[16] Also, both the systematic part of the rating, as well as the remaining arbitrary markup or residual, turn out to be highly significant. In Regression (ii-I) the effect of the PIGS×Crisis

[13] Both ratings and credit spreads are now end of year values.

[14] Note that the rating markup for the PIGS countries during the crisis is always negative and actually represents a markdown.

[15] Or that rating agencies use a model that economic theory has not deciphered yet.

[16] Note the negative coefficients: A markdown or negative markup therefore leads to higher credit spreads.

Table 3 The influence of decomposed ratings on credit spreads

	Dependent variable: Credit Spread (eoy)			
	(i)	(ii-I)$^{+}$	(iii-II)$^{+}$	(iv-II)$^{+}$
Intercept	8.26 *** (0.00)	8.74 *** (0.00)	8.68 *** (0.00)	−3.15 *** (0.00)
Crisis	–	–	–	0.90 *** (0.00)
PIGS	–	–	–	−0.39 ** (0.02)
Euro zone	–	–	–	0.00 (0.98)
GDP growth	–	–	–	0.05 (0.26)
GDP per capita	–	–	–	0.00 (0.65)
Gov. surplus	–	–	–	−0.01 (0.78)
Gov. prim. surplus (adj)	–	–	–	0.01 (0.76)
Gov. debt	–	–	–	0.00 (0.38)
Lagged gov. bond yield (avg)	–	–	–	0.57 *** (0.00)
Inflation	–	–	–	0.29 *** (0.00)
Rating (eoy) R	−0.40 *** (0.00)	–	–	–
Rating: Economic fundamentals $\hat{R}^{x}$	–	−0.42 *** (0.00)	−0.42 *** (0.00)	–
Rating: PIGS×Crisis markup $R^{P\times C}$	–	–	−1.35 ** (0.03)	−1.62 ** (0.03)
Rating: Residual $\hat{\varepsilon}$	–	−0.33 *** (0.00)	−0.23 *** (0.00)	−0.23 *** (0.00)
$\overline{R}^2$	0.34	0.34	0.38	0.78
Observations	262	262	262	262

P-values in parentheses. *, **, *** denote significance at the 10%, 5%, 1% level

Data for 26 OECD countries between 1999 and 2010 from OECD, IMF, Thomson Reuters and Fitch Ratings

$^{+}$ Two-stage bootstrap with 1000 replications; p-values and significance levels according to percentile method

markup is captured by the residual which increases the respective coefficient slightly.

In (iv-II) we use the economic variables from Table 2 instead of $\hat{R}^{X}_{i,t}$ plus the arbitrary rating markups $\hat{R}^{P\times C}_{i,t}$ and $\hat{\varepsilon}_{i,t}$. The latter ones still influence the credit spread. Markets do not interpret economic variables in a way that would fully explain the credit spread markup of the PIGS countries during the recent crisis. They

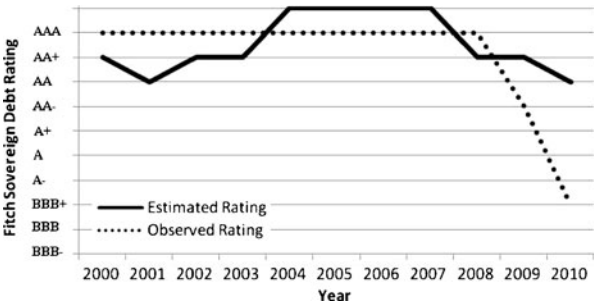

Fig. 1 Ireland's observed and predicted ratings according to Regression (I)

also use the arbitrary information $\hat{R}_{i,t}^{P\times C}$ and $\hat{\varepsilon}_{i,t}$ given by the rating agencies. It is noteworthy, however, that markets interpret economic variables differently than rating agencies (only the lagged interest rate and inflation have a significant influence on the current credit spread).[17] Since (ii-I), (iii-II) and (iv-II) build on generated regressors, we apply the bootstrapping method on these two-stage regressions to obtain robust statistics.[18]

Conclusion

Our econometric exercise produced a structural explanation of sovereign credit ratings that is robust with respect to the statistical methods employed. Based on these estimated equations, we decomposed actual ratings into a systematic and an arbitrary part. Figure 1 illustrates the procedure, using Ireland and the results of Regression (I) as an example.

The solid line displays Ireland's credit rating as predicted by economic and structural variables alone. This is the systematic part of the credit rating. The dashed line shows Ireland's actual credit rating. The vertical difference between the two lines is what we call the arbitrary component of the credit rating. The most striking feature is the sudden and substantial increase of this arbitrary part in 2009 and 2010.

We then provided evidence that risk premiums in capital markets, represented by credit spreads for government bonds, are affected not only by the systematic part of credit ratings, but by the arbitrary part as well. This has the serious implication that rating agencies do possess some power to drive countries with a significant debt ratio into trouble. With respect to the group of PIGS countries, they appear to have played, deliberately or not, just such an unfortunate role during the European sovereign debt crisis that unfolded in 2009.

This result must be taken with a pinch of salt, of course, since it crucially depends on the employed benchmark. This benchmark, the structural equation we identified to explain the ratings of a major agency, may be close to what this agency actually

[17] Note that, as expected, the signs of the coefficients are opposite to the ones before, since higher credit spreads match with lower ratings. Also note that including $\hat{R}_{i,t}^{X}$ in this regression results in multicollinearity, as expected.

[18] Compared to standard OLS, coefficients are virtually identical and significance levels are very much the same. Only the significance level of the PIGS×Crisis markup drops slightly from 99% to 95% when bootstrapping is applied.

does, or it may not, even though it explains its decisions rather well. But given that Ferri et al. (1999) arrived at similar conclusions after the Asian crisis, and given the unimpressive role that rating agencies played in the run-up to the US subprime crisis, it would be naive and risky not to subject the issue raised in this paper to further and closer scrutiny.

References

Afonso, A., Gomes, P., & Rother, P. (2007). *What 'hides' behind sovereign debt ratings?* ECB Working Paper Series, No. 711, January.

Afonso, A., Gomes, P., & Rother, P. (2009). Ordered response models for sovereign debt ratings. *Applied Economics Letters, 16*(8), 769–773.

Attinasi, M.-G., Checherita, C., & Nickel, C. (2009). *What explains the surge in Euro area sovereign spreads during the financial crisis of 2007–09?* ECB Working Paper Series, No. 1131, December.

Becker, W. E., & Kennedy, P. E. (1992). A graphical exposition of the ordered probit. *Econometric Theory, 8*, 127–131.

Block, S., & Vaaler, P. M. (2004). The price of democracy: sovereign risk ratings, bond spreads and political business cycles in developing countries. *Journal of International Money and Finance, 23*, 917–946.

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

Crotty, J. (2009). Structural causes of the global financial crisis: a critical assessment of the 'new financial architecture'. *Cambridge Journal of Economics, 33*, 563–580.

Eaton, J., Gersovitz, M., & Stiglitz, J. E. (1986). The pure theory of country risk. *European Economic Review, 30*, 481–513.

Eichengreen, B., & Mody, A. (2000). What explains changing spreads on emerging-market debt? In: S. Edwards (Eds.) *Capital flows and the emerging economies: theory, evidence, and controversies* (pp. 107–136). University of Chicago Press.

El-Shagi, M. (2010). The role of rating agencies in financial crises: event studies from the asian flu. *Cambridge Journal of Economics, 34*, 671–685.

Ferri, G., Liu, L.-G., & Stiglitz, J. E. (1999). The procyclical role of rating agencies: evidence from the east asian crisis. *Economic Notes, 28*(3), 335–355.

Gomez-Puig, M. (2006). Size matters for liquidity: evidence from EMU sovereign yield spreads. *Economics Letters, 90*(2), 156–162.

Goodhart, C. A. E. (2008). The background to the 2007 financial crisis. *International Economics and Economic Policy, 4*(4), 331–346.

Hu, Y.-T., Kiesel, R., & Perraudin, W. (2002). The estimation of transition matrices for sovereign credit ratings. *Journal of Banking & Finance, 26*, 1383–1406.

Kamin, S. B., & von Kleist, K. (1999). *The evolution and determinants of emerging market credit spreads in the 1990s*. BIS Working Papers, No. 68, May.

Manganelli, S., & Wolswijk, G. (2009). What drives spreads in the euro area government bond market? *Economic Policy, 24*(4), 191–240.

Mellios, C., & Paget-Blanc, E. (2006). Which factors determine sovereign credit ratings? *European Journal of Finance, 12*(4), 361–377.

Mulder, C., & Perrelli, R. (2001). *Foreign currency credit ratings for emerging market economies*. IMF Working Paper, No. 191.

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

Sgherri, S., & Zoli, E. (2009). *Euro area sovereign risk during the crisis*. IMF Working Paper, No. 222.