Bank and sovereign credit ratings during the European debt crisis

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Abstract

The paper analyses the behaviour of European sovereign and bank ratings assigned by the larger credit rating agencies (Moody's, S&P and Fitch) during the current debt crisis. We find that sovereign rating downgrades and negative watch signals have strong effects on bank rating downgrades. The impact is stronger for multiple-notch sovereign rating downgrades, and more pronounced in PIIGS countries. We find significant differences in rating policies across the three credit rating agencies, and show evidence of interdependence in bank rating actions. S&P credit actions tend to be the more independent ones, while Moody's appears to be more cautious, although it is by far the most likely to assign multiple-notch downgrades.

JEL classification: G15; G24.

Keywords: Credit rating agencies; Sovereign rating; Bank rating; Rating policy; European sovereign debt crisis.

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1. Introduction

Credit ratings are heavily used in financial markets and regulation, and the current European debt crisis triggered increased scrutiny of the relative performance of credit rating agencies (CRAs). The credibility of a CRA is enhanced in the eyes of market participants by prompt actions (or leadership) following any change in an issuer's creditworthiness. Developed countries have long been accustomed with stable and high investment grade ratings. The fact that the recent debt crisis originated in developed European countries seriously challenges the previously common belief that their debts were relatively safe investments, with indebted European countries, including Portugal, Italy, Ireland, Greece and Spain (PIIGS), causing widespread concerns in the global economy.

Policy makers and regulators also emphasise the close interconnection between financial institutions and sovereigns during the financial crisis (e.g. Bank of England 2011; IMF, 2011; ESMA 2013). The deterioration in European sovereign creditworthiness had an adverse impact on European banks' funding costs and market access, including for banks in France, Germany and the UK. Blundell-Wignall (2012) finds that banks are heavily exposed to the sovereign debt of their own country. For example, the exposure of Greek banks to Greek sovereign debt represented 212% of their Tier 1 capital, while in Italy, Portugal and Spain, the equivalent figures were 161%, 130% and 152%, respectively, as of December 2011. There are many potential channels through which sovereign risks affect bank risks, including direct losses on sovereign debt holdings, lower collateral values for wholesale and central bank funding, reduced benefits that banks derive from government guarantees, and lower bank ratings (e.g. Ferreira and Gama, 2007; Williams et al., 2013).

The aim of this paper is to conduct a thorough analysis of the behaviour of, and the interactions between, sovereign and bank ratings for 21 European developed countries and 84 banks located in these countries with ratings assigned by the larger CRAs, namely Moody's,

S&P and Fitch, during the current financial crisis (October 2006 – December 2012). Specifically, we investigate to what extent sovereign rating actions in European countries affect the credit ratings of banks in the same country during the crisis. We also examine the presence of inter-CRA lead-lag relationships among European bank ratings. In particular, we consider whether bank rating changes by one CRA appear to be affected by prior actions by another CRA, and whether any one CRA demonstrates a lead in bank rating actions in European developed countries. Each element of analysis seeks to establish whether different rating policies have been applied across the CRAs.

The current financial crisis highlights the need to utilize an appropriate credit risk management framework. Estimates of rating migration probabilities are at the core of several risk management tools, e.g. J.P. Morgan's Credit Metrics. Assessing the factors leading to credit rating migration is a topical theme in recent credit ratings literature. Prior rating changes are demonstrated to carry predictive power for the direction of future rating migrations by the same CRA (rating momentum). Downgrade (but not upgrade) momentum is supported by Lando and Skødeberg (2002) for corporate ratings, and by Fuertes and Kalotychou (2007) and Alsakka and ap Gwilym (2009) for sovereign ratings. Leads and lags in ratings offer a view on a similar effect, but at the inter-CRA level. The rating lead-lag analysis is also crucial in the context that CRAs have a clear interest in maintaining a strong reputation in financial markets through providing high quality and timely credit signals, given the unequal market reactions to different CRAs' rating signals (e.g. Brooks et al., 2004; Hill and Faff, 2010; Alsakka and ap Gwilym, 2012).

This is the first paper to analyse the lead-lag relationship in bank credit ratings. The focus of prior studies related to lead-lag analysis is on corporate and sovereign ratings (see Section 2.3). CRAs apply different approaches and consider different inputs to evaluate the creditworthiness of banks compared with other corporate or sovereign issuers (see Section

2.1). The paper provides evidence that estimation of bank rating migrations can potentially be improved by taking into account the previous bank rating actions of other CRAs. A bank that has been downgraded by one CRA has a significantly increased probability to experience a harsher (more than one-notch) downgrade from a competing CRA. S&P appears to be the first movers in European bank rating downgrades during the crisis.

The paper also emphasises that the estimation of bank rating migrations can be considerably enhanced by considering prior sovereign watch and rating signals. This is related to the notion of the sovereign rating 'ceiling', whereby the sovereign rating generally represents the highest achievable rating for non-sovereigns within that country (see Section 2.2 for more details). The CRAs use watch and outlook as indicators of possible future rating changes, in order to retain rating stability whilst providing more information for market participants.[1] Watch signals are formal rating reviews that are likely to result in some rating action, and are found to provide important economic and monitoring functions (e.g. Boot et al., 2006; Bannier and Hirsch, 2010). They also offer important information content for equity, bond, CDS and foreign exchange markets (e.g. Norden and Weber, 2004; Gande and Parsley, 2005; Ferreira and Gama, 2007; Ismailescu and Kazemi, 2010; Alsakka and ap Gwilym, 2012).

To the best of our knowledge, this is the first paper that examines the effect of sovereign credit signals on bank ratings in developed European countries. Sovereign rating downgrades and negative watch signals significantly impact bank rating downgrades. Nevertheless the implementation of the sovereign ceiling policy is not identical across CRAs, whereby S&P appears to be the most likely CRA to migrate bank ratings simultaneously with the sovereign rating. Multiple-notch sovereign rating downgrades have a stronger effect on the probabilities of bank rating downgrades than one-notch rating downgrades and negative

[1] Outlook reflects a CRA's medium-term (one to two years) view on the development of a credit rating, while watch is a stronger indication focused on a typical ex-ante target horizon of three months.

watch signals. The effects of sovereign rating actions on bank ratings are relatively stronger in the case of the PIIGS countries.

The remainder of the paper is organised as follows. Section 2 reviews the relevant literature, Section 3 discusses the sovereign and bank credit rating data, and Section 4 explains the methodology. Section 5 presents the empirical results and Section 6 concludes the paper.

2. Key themes associated with the empirical analysis

2.1. Bank Ratings

The literature on the dynamics of bank ratings is relatively limited, and there is no prior research which examines how bank ratings by one CRA are affected by prior actions by another CRA. In addition, Williams et al. (2013) is the only prior study to document how bank ratings are directly affected by sovereign rating signals. They focus on banks in 54 emerging markets, and find that sovereign rating upgrades (downgrades) have strong effects on bank rating upgrades (downgrades), but the impact of sovereign watch signals on bank rating actions is much weaker and often insignificant.

Caporale et al. (2011) find that country-specific factors (in the form of heterogeneous intercepts) affect EU countries' bank ratings. Bellotti et al. (2011) and Caporale et al. (2012) show that bank ratings reflect banks' financial position and country of origin, whereby a bank in a less stable/developed/rich economy appears to have a lower rating. Using a sample of leading banks from East Asia during 1999–2005, Distinguin et al. (2012) show that market indicators are significant in predicting rating upgrades (not downgrades) for large banks, while market indicators perform relatively better than accounting indicators for predicting rating downgrades for small banks. Shen et al. (2012) show that larger bank assets and higher sovereign credit ratings boost bank credit ratings. Shen et al. (2012) also find that the impact

of financial ratios on bank ratings is greater in low information asymmetry countries (such as industrial or high-income countries) than high information asymmetry countries (such as emerging market countries). Hau et al. (2012) examine the quality of credit ratings assigned to banks in Europe and the United States by the three largest CRAs over 1990–2011, and find that bank characteristics significantly affect bank rating quality. A traditional banking model with a large loan share increases the accuracy of the credit rating, while CRAs tend to assign more favourable ratings to large banks and those banks that provide CRAs with a large quantity of securities rating business. Hau et al. (2012) also show that multiple bank ratings correlate with less favourable ratings, contrary to the assertion that rating competition fosters rating inflation through 'ratings shopping' (e.g. Skreta and Veldkamp, 2009).

Poon and Firth (2005), Poon et al. (2009) and Bannier et al. (2010) investigate bank ratings, but their focus is on whether unsolicited ratings are downward biased. These studies indicate that solicited bank ratings tend to be significantly higher than unsolicited ratings. Morgan (2002) analyses ratings assigned by Moody's and S&P across different US industries, and finds that the proportion of split ratings is much higher in the banking and insurance sectors, suggesting that banks are more opaque than other corporates, thus making it more challenging to quantify the risks arising from the nature of banks' assets and capital structure. Similarly, Iannotta (2006) uses split ratings to test whether banks are relatively more opaque than other industries. For European data on firms rated by Moody's and S&P, he finds that the probability of a split rating increases by more than 20% when the issuer is a bank, compared to other industries.

2.2. Sovereign ratings

Sovereign ratings represent assessments of the ability and willingness of governments to meet their financial obligations. Sovereign ratings have a strong influence on borrowing

costs and they are the most important stimulus for enhancing the capability of governments and private sectors to access global capital markets, attracting international capital and investment (Kim and Wu, 2008). Sovereign ratings represent a ceiling for the ratings assigned to provincial governments, corporates and financial institutions. Moody's, S&P and Fitch have recently eliminated their sovereign ceiling rule. Although the ceiling effect is no longer absolute, there remains a "sovereign ceiling lite". Borensztein et al. (2007) find that S&P sovereign ratings significantly impact corporate ratings in emerging markets. Prati et al. (2012) emphasise the highly significant effect of sovereign ratings on firms' credit ratings in 26 industrial and emerging countries.

Prior literature demonstrates that sovereign rating news does affect financial markets. Negative rating events impact own-country equity and bond markets while upgrades have limited or insignificant impact (e.g. Brooks et al., 2004; Hill and Faff, 2010). Sovereign rating downgrades incorporate valuable information for the sovereign bond spreads and the aggregate stock market returns of other countries, particularly during crisis periods, while upgrades have an insignificant impact (e.g. Kaminsky and Schmukler, 2002; Gande and Parsley, 2005; Ferreira and Gama, 2007). Arezki et al. (2011) examine the spillover effects of sovereign rating news on CDS spreads and stock market indices for selected European countries during 2007-2010. They find that rating downgrades lead to significant spillovers. Afonso et al. (2012) find evidence of significant spillover effects of sovereign rating news from the three major CRAs for the bond markets of 24 European countries during 1995-2010. Alsakka and ap Gwilym (2012) show that CRAs' sovereign signals affect the own-country exchange rate and identify strong spillover effects to other countries' exchange rates in Europe and Central Asia, particularly during the crisis period.

2.3. Lead-lag analysis of ratings

CRAs have varying experience in different countries, and they differ in the methodologies used in judging the creditworthiness of different types of issuers (banks versus corporate versus sovereign). These factors could affect both the time frame and the manner in which CRAs react to any new information by adjusting the credit rating of a given issuer. CRAs would rationally treat a rating adjustment by another CRA as a trigger for reviewing their own ratings, and it could be viewed as cost-effective to follow up a competitor's rating action. Issuers experiencing permanent credit quality improvements seek these to be reflected in ratings as quickly as possible in order to benefit from reduced borrowing costs and/or enhanced capital inflows. Investors value timely information about any change in credit risk affecting their invested funds. A CRA's credibility is enhanced by prompt rating actions following any permanent change in an issuer's creditworthiness. Rating leadership can be considered as a sign of the predictive ability of a given CRA (Güttler and Wahrenburg, 2007; Alsakka and ap Gwilym, 2010).

Prior literature on lead-lag analysis of ratings is very limited, and only exists for corporate and sovereign issuers. Johnson (2004) shows that S&P lags Egan-Jones (a small CRA active since 1995) in downgrading corporates. Güttler and Wahrenburg (2007) analyse the lead-lag relationship in ratings of near-to-default corporates rated by Moody's and S&P during the period 1997-2004. They find that given a rating change by Moody's (S&P), the subsequent rating adjustment by S&P (Moody's) is of significantly greater magnitude in the short-term (1-180 days). Alsakka and ap Gwilym (2010) investigate lead-lag relationships in sovereign credit signals, and they find that S&P demonstrates the least dependence on other CRAs, while Fitch demonstrates the most links with other CRAs' sovereign actions, and Moody's tends to be the first mover for positive credit signals.

2.4. Recent regulatory developments affecting the credit rating industry

An over-reliance on ratings by a large number of market participants can constitute a large systemic risk and trigger negative market developments. Yet, the CRAs refer to their ratings as mere "opinions", making CRAs safe from civil responsibility and lawsuits that may arise from any losses suffered by investors. The CRAs have been anti-regulation on the basis that their independence is critical to their credibility in the financial markets. Thus, market discipline was their preferred means to be monitored.

CRAs were partly blamed for the current financial crisis and the subsequent effects on the global economy. In the context of the US subprime crisis, the CRAs were widely viewed as guilty of assigning excessively high structured finance ratings. In contrast, the criticism of CRAs during the European sovereign debt crisis was more focused on the perception that erroneous downgrades of European sovereigns led to higher borrowing costs and worsened the crisis. Efforts have been made to address several factors including low transparency in the credit rating industry, the oligopolistic market structure, the CRAs' business models and conflicts of interest, and most importantly the over-reliance on credit ratings, especially the mechanistic reactions induced by the regulatory certification role, hardwiring and cliff effects (e.g. Cantor et al., 2007; Sufi, 2009).

In Europe, the most fundamental reform is the formal European Union (EU) regulation on CRAs that entered into force in December 2009, requiring all CRAs operating in EU to register and be subject to legally binding rules based on the IOSCO Code of Conduct Fundamentals for CRAs. The responsibility for ongoing oversight of CRAs was handed to the European Securities and Markets Authority (ESMA) in July 2011. Ratings issued outside the EU can be used for regulatory purposes by regulated entities in the EU by means of ratings being either endorsed or certified through ESMA. ESMA could play an important role in financial stability by seeking to address the issues of CRA integrity and

transparency and investor protection. The recent annual report on ESMA supervision of CRAs in the EU (ESMA, 2013) identifies progress by CRAs in their activities to meet the regulatory requirements on integrity, transparency and improved disclosure of methodologies. However, ESMA believes that improvements are still necessary in the areas of conflict of interest, consistent application and comprehensive presentation of rating methodologies, the monitoring of ratings, and the reliability of IT infrastructures. ESMA (2013) examines the bank rating methodologies of S&P, Moody's and Fitch, due to the strong linkages between bank and sovereign ratings. ESMA (2013) finds shortcomings in the processes of disclosure and implementation of changes in bank rating methodologies, the systematic application of methodologies and the review process of methodologies.

Further, the Basel Committee also reviewed the role of external ratings in its capital adequacy regulations, mainly to incorporate the IOSCO Code in the eligibility criteria. Many other G-20 countries have introduced or are in the process of introducing new regulatory oversight for CRAs. Regulatory changes are ongoing, implying continuing scrutiny of the relative performance of CRAs.

3. Data Sample

The data sample consists of end-of-month long-term foreign currency ratings and watch status for sovereigns and banks in 21 European countries. The source of the bank ratings data is the InteractiveData Credit Ratings International database, while sovereign ratings and watch status are obtained from the CRAs' publications. All sovereigns studied here are rated by all three CRAs during the entire sample period. The bank sample is based on selecting those European banks which are included in the 2011 EU stress test, which are rated by at least one of the three largest CRAs (Moody's, S&P and Fitch) during the period from October 2006 to December 2012 (the start date is chosen as consistent with Arezki et al., 2011). 91 banks from 21 European countries were included in the 2011 EU stress test.

These banks represent more than 60% of the entire EU banking sector in terms of total assets, including the major EU cross-border banking groups and a group of large credit institutions in Europe. The banks' sample has been built by selecting banks in each EU state in descending order of size, so as to cover at least 50% of the national banking sector.[2] Data on 84 banks are included in the analysis here.[3] Table 1 presents the sovereigns and banks included in the data sample.

Following Williams et al. (2013) and others, actual rating changes are identified according to a 20-point numerical rating scale (Aaa/AAA = 20, Aa1/AA+ = 19, Aa2/AA = 18 … Caa3/CCC- = 2, Ca/CC, C/SD-D = 1) by notches on the basis of monthly intervals. Table 2 summarises the dataset. There are 3925 observations for 62 banks from 17 European countries rated by S&P, 4683 observations for 75 banks from 20 countries rated by Moody's, and 4845 observations for 78 banks from 18 countries rated by Fitch. This gives a total of 13,453 end-of-month bank ratings' observations. During the sample period, the average sovereign rating of the 21 European countries in the sample is AA/Aa2 (numerical-rating of '18'), whereas the average rating of the European banks rated by S&P and Fitch is A (numerical rating of '15'), and by Moody's is A1 (numerical rating of '16'). Clearly, the average bank ratings tend to be lower than the average sovereign ratings by at least 2 notches.

The sovereign rating ceiling rule is no longer applied by the three CRAs, as is evident in our sample. We observe 88.7% (8.8%) of banks' observations by S&P, 83.5% (12.4%) by Moody's and 90.5% (8.2%) by Fitch rated below (at) the sovereign ceiling. Moody's is the most likely to assign higher ratings to banks than the sovereign rating of the European

[2] More details on the European Banking Authority (EBA) 2011 EU-wide stress test are available at: www.eba.europa.eu.

[3] The identity of one bank is not revealed by the European Banking Authority. Six banks are not rated by any of the three global CRAs. We use bank debt ratings, not deposit ratings.

country where the banks are located (4.1%), while Fitch is the least likely to rate a bank higher than the sovereign (1.3%).

There are 165 (26) bank rating downgrades (upgrades) by S&P, 235 (46) by Moody's, and 163 (8) by Fitch. There are also 45 (4) sovereign rating downgrades (upgrades) by S&P, 43 (4) by Moody's, and 36 (4) by Fitch, for the 21 sovereigns included in our sample.[4] These statistics reflect the strong downgrade trend in European countries as a consequence of the sovereign debt crisis. Moody's is notable in its greater willingness to use downgrades of greater than one-notch. Moody's ratings tend to be more stable, but can be adjusted strongly when the action is taken. Approximately a quarter of bank rating downgrades by S&P and Fitch are of more than one-notch, compared to 46% by Moody's. Similarly, 35.6% and 47.2% of sovereign rating downgrades by S&P and Fitch are of more than one-notch, compared to 51.2% by Moody's. In addition, there exists a strong link (within a two-month time window) between sovereign and bank rating downgrades, whereby 81 of the 165 bank rating downgrades by S&P are linked to sovereign rating downgrades, 80 of the 235 bank downgrades by Moody's are linked to sovereign downgrades, and 84 of the 163 bank downgrades by Fitch are linked to sovereign downgrades. However, none of the bank rating upgrades is linked to sovereign rating upgrades.

Table 2 also summarises the sovereign watch actions, and identifies 28 negative cases of watch status by S&P, 23 by Moody's, and 13 by Fitch. We only find 2 positive cases of watch status by Moody's, and those sovereigns placed on positive watch by Moody's were subsequently upgraded within three months. In the case of downgrades, 28, 23 and 13

[4] The sovereign rating upgrades during October 2006 to December 2012 include Cyprus (April 2008), Poland (March 2007) and Greece (May 2012, December 2012) by S&P; Cyprus (July 2007, January 2008) and Malta (July 2007, January 2008) by Moody's; and Cyprus (July 2007), Greece (March 2012), Malta (July 2007) and Poland (January 2007) by Fitch.

negative watch sovereign actions led to 21, 20 and 10 rating downgrades within 4 months by S&P, Moody's and Fitch, respectively.

Figure 1 presents the recent rating history for sovereigns and banks in the five countries which have attracted the most attention during the European sovereign debt crisis, namely Portugal, Ireland, Italy, Greece and Spain (PIIGS). These plots illustrate differences of both opinion and timing of rating actions across CRAs. The CRAs often disagree on their sovereign ratings and bank ratings in these five countries, whereby S&P (Moody's) mostly assigns the lowest (highest) ratings, with the exception of the last few months of the sample. S&P tends to be the first mover in taking negative actions related to these countries until the last few months of the sample. In particular, Moody's was the first to downgrade Portugal and Ireland sovereigns' ratings to speculative status in July 2011, while other CRAs are still rating Ireland as investment grade (in December 2012).[5] The end-of-sample differences of opinion largely rest on evaluations of these countries' prospects for effective spending cuts, increased tax revenues/compliance, economic growth and support for the banking systems. The plots in Figure 1 also reflect the close connections between the actions of sovereign ratings and bank ratings in PIIGS countries, whereby bank ratings are often downgraded shortly after the downgrades of their countries' sovereign ratings. The average bank ratings in PIIGS are always at or below the level of the sovereign ratings, with the exception of Greece during June 2011-December 2012, particularly by Moody's.

Table 3 summarises the credit signals related to PIIGS countries. The sovereign rating downgrades related to PIIGS countries represent around 60% of those related to the 21 European countries (26/45 by S&P, 24/43 by Moody's and 24/36 by Fitch). Approximately, 70% of bank rating downgrades by S&P and Fitch in the 21 countries are for banks in PIIGS

[5] Another recent similar example is Moody's downgrade of the UK to Aa1 in February 2013, followed by Fitch in April 2013, while it maintains its AAA rating by S&P.

countries, and 51% of bank rating downgrades by Moody's in the 21 countries are for banks in PIIGS countries (121/165 by S&P, 120/235 by Moody's and 114/163 by Fitch).

To analyze whether there is interdependence across CRAs, rating changes for banks that are rated by at least two CRAs during the sample period are the focus of attention. Table 4 presents the distribution of bank rating changes (the dependent variable for the lead-lag analysis) by each pair of CRAs.[6] The inferences from Table 4 are consistent with those discussed above based on Table 2.

4. Methodology

The ordered probit model is employed, which is a widely accepted approach in the credit ratings literature because it accounts for the discrete, ordinal nature of credit ratings and rating changes. Equation (1) captures the effect of sovereign rating changes on bank ratings. The model estimates the upgrade, downgrade and no rating change probabilities for the bank credit ratings. The rating changes are identified by notches (0, 1, and 2 or more) using the 20-point rating scale. The specification of the model is defined as follows:

$$y^{*}_{i,a,t} = \beta\, SDN\_1n_{i,a} + \gamma\, SDN\_2n_{i,a} + \lambda\, NW_{i,a} + \vartheta\, Srat_{i,a,t} + \varphi\, Co_{t} + \zeta\, Y_{t} + \varepsilon_{i,a,t}; \quad \varepsilon_{i,a,t} \sim N(0,1) \tag{1}$$

$y^{*}_{i,a,t}$ is an unobserved latent variable linked to the observed ordinal response categories $y_{i,a,t}$ by the measurement model:

[6] Table 2 provides a complete picture of the dataset of events. Table 2 considers sovereign and bank ratings of 84 European banks in 21 countries with ratings assigned by at least one CRA, which are used for examining the relationship between sovereign and bank rating changes (based on Equation 1 later). Table 4 presents specific details for European banks rated by each pair of CRAs, i.e. controlling for the differing sets of banks rated by each CRA. These sub-samples are used for examining the lead-lag relationship (based on Equations 2 and 3 later).

$$y_{i,a,t} = \begin{bmatrix} 0 \text{ if } y^*_{i,a,t} \le \mu_1 \text{ (no bank rating change)} \\ 1 \text{ if } \mu_1 < y^*_{i,a,t} \le \mu_2 \text{ (bank rating upgrade / downgrade of 1 notch)} \\ 2 \text{ if } \mu_2 < y^*_{i,a,t} \text{ (bank rating upgrade / downgrade of 2 or more notches)} \end{bmatrix}$$

Where μ_m represent thresholds to be estimated using the maximum likelihood estimation (MLE), along with parameters β, γ, λ, ϑ, φ and ζ subject to the constraint that $\mu_1 < \mu_2$.

$y_{i,a,t}$ is an ordinal variable; $BUP_{i,a,t}$ or $BDN_{i,a,t}$. $BUP_{i,a,t}$ ($BDN_{i,a,t}$) = 1, 2 if a bank from country *i* is upgraded (downgraded) by 1, 2 or more notches, respectively, by CRA *a* (Moody's, S&P or Fitch) in month *t*; 0 otherwise.

$SDN\_1n_{i,a}$ is a dummy variable taking the value of 1 if sovereign *i* is downgraded by one-notch by CRA *a* up to 2 months prior to month *t* (i.e. time *t* and time *t*-1), 0 otherwise.

$SDN\_2n_{i,a}$ is a dummy variable taking the value of 1 if sovereign *i* is downgraded by more than one-notch by CRA *a* up to 2 months prior to month *t*, 0 otherwise.[7]

$NW_{i,a}$ is a dummy variable taking the value of 1 if sovereign *i* is placed on negative watch by CRA *a* up to 3 months prior to month *t*, 0 otherwise.[8]

$Srat_{i,a,t} = 1, 2, ..., 19, 20$. This is the numerical rating of sovereign *i* by CRA *a* in month *t*. This is a control variable to account for the economic/financial/political situation in the country at the time of the bank rating action.

Co_t: a full set of country dummies.

Y_t: a full set of year dummies.

We follow recent literature which estimates models for rating upgrades and downgrades separately, as they are driven by different factors (e.g. Williams et al., 2013). The dependent variables (bank upgrade / bank downgrade) are always related to the

[7] We only identify 4 sovereign rating upgrades by each CRA (see Table 2), therefore the impact of sovereign rating upgrades is not considered in Eq. (1), as it would have caused significant bias to the estimated coefficients and standard errors due to insufficient observations.

[8] Since there are only 2 cases of positive watch status (see Table 2), the impact of positive watch is not considered in Eq. (1).

independent variables (sovereign rating information) through the same CRA and country. A single estimation of the bank upgrade model is performed using data from all CRAs due to the limited total number of bank rating upgrades, especially for Fitch (see Table 2). The bank downgrade model is estimated using data pooled from all CRAs and also using data from each CRA separately in order to highlight inter-CRA differentials.

Given the close interconnection between bank and sovereign risks, we expect sovereign rating actions to significantly affect bank ratings. Therefore, we expect positive coefficients for sovereign downgrades, since they are expected to induce bank downgrades. We also expect positive coefficients for the negative watch variable, because if the sovereign has recently been on negative watch status, we expect the sovereign to subsequently be downgraded, which in turn will induce bank downgrades within the time horizons addressed. Further, we calculate the marginal effects (MEs) to estimate the economic significance of each independent variable (Livingston et al., 2008). The marginal effects show the impact of a sovereign rating action (rating change, watch) by CRA *a* for country *i* on the probability of bank rating changes of 0, 1, or 2 or more notches by CRA *a* on banks from country *i*.

Potential lead–lag relationships in bank rating actions are assessed for each pair of CRAs, using a Granger-like method with ordered probit regression (e.g. Güttler and Wahrenburg, 2007). We accomplish a relative comparison of the probability of a bank rating change by CRA *A* conditional on a previous rating change by CRA *B.* The restriction to a relative comparison arises from the fact that rating signal adjustments are not random events (see Alsakka and ap Gwilym, 2010). We estimate the following models with CRA *A* as potential follower and CRA *B* as potential leader in Eq. 2, and vice versa in Eq. 3:

$$\Delta BR^{*A}_{k,t} = \sum_{h=1}^{3} \beta_h^2 D\_BDN^{B}_{k,h} + \varphi Co_t + \zeta Y_t + \varepsilon_{k,t} \; ; \varepsilon_{k,t} \sim N(0, 1) \qquad (2)$$

$$\Delta BR^{*B}_{k,t} = \sum_{h=1}^{3} \beta_h^2 D\_BDN^{A}_{k,h} + \varphi Co_t + \zeta Y_t + \varepsilon_{k,t} \; ; \varepsilon_{k,t} \sim N(0, 1) \qquad (3)$$

$\Delta BR^{*}_{k,t}$ is an unobserved latent variable linked to the observed ordinal response categories $\Delta BR_{k,t}$ ($\Delta BR^{M}_{k,t}$, $\Delta BR^{SP}_{k,t}$ or $\Delta BR^{F}_{k,t}$), which refer to a bank rating change by CRA *A* in Eq. (2) or CRA *B* in Eq. (3) (Moody's, S&P or Fitch), for bank *k* at month *t*. Three different classes of rating changes are employed: ≤ -2, -1, and ≥1, i.e., downgrade by more than one-notch, downgrade by one-notch, upgrade by one-notch or more. $\Delta BR^{*}_{k,t}$ is linked to the observed response categories $\Delta BR_{k,t}$ (that take a finite number of discrete values equal to: -2, -1, or 1) by the measurement model:

$$\Delta BR_{k,t} = \begin{bmatrix} -2\ (i.e.\ bank\ rating\ downgrade\ by\ more\ than\ one\ notch)\ if\ \Delta BR^{*}_{k,t} \le \mu_1 \\ -1\ (i.e.\ bank\ rating\ downgrade\ by\ one\ notch)\ if\ \mu_1 < \Delta BR^{*}_{k,t} \le \mu_2 \\ 1\ (i.e.\ bank\ rating\ upgrade)\ if\ \mu_2 < \Delta BR^{*}_{k,t} \end{bmatrix}$$

where μ_1 and μ_2 represent thresholds to be estimated using maximum likelihood estimation (MLE), along with the parameters β, φ and ζ, subject to the constraint that $\mu_1 < \mu_2$.

$D\_BDN_{k,h}$ is a dummy variable taking the value of 1 if bank *k* is downgraded by the potential leader CRA, in three predefined windows of time ***h***, with *h*=1 for 1 month, *h*=2 for 2 - 6 months, and *h*=3 for 7 - 12 months prior to the rating change for bank *k* at time (month) *t* by the potential follower CRA, zero otherwise.[9]

Co_t: a full set of country dummies.

Y_t: a full set of year dummies.

In addition, the marginal effects are calculated to estimate the impact of a bank rating change by the potential leader CRA (in the three predefined windows of time *h*) on the probability of bank rating changes by the potential follower CRA by ≤-2, -1 and ≥1 notches.

[9] There are no cases where bank *k* is upgraded by the potential leader CRA Fitch (S&P or Moody's) within 1 - 12 months prior to the rating change for bank *k* at month *t* by the potential follower CRA S&P or Moody's (Fitch), while there are only 6 cases for the sub-samples where Moody's is follower (leader) and S&P is leader (follower), and therefore dummies representing these specifications are absent from the specification of Equations (2) and (3).

5. Empirical results

5.1. The impact of sovereign rating actions on bank ratings

Table 5 presents the estimation results of Eq. (1) using pooled data from the three CRAs. We find that a bank is 7.42% (4.30%) more likely to be downgraded by one-notch (more than one-notch) if the sovereign is downgraded by one-notch in the last 2-months, and a bank is 12.81% (9.81%) more likely to be downgraded by one-notch (more than one-notch) if the sovereign is downgraded by more than one-notch recently. If a sovereign issuer was recently on negative watch then a bank has increased probabilities of being downgraded by one-notch (more than one-notch) of 2.11% (0.90%). The significant effect of sovereign watch signals is consistent with the previous empirical findings highlighting the economic function of watch events, and the significant impact of watch signals on bond, stock and foreign exchange markets (e.g. Gande and Parsley, 2005; Ferreira and Gama, 2007; Alsakka and ap Gwilym, 2012). The MEs should be considered in the context that bank rating downgrades of one-notch and more than one-notch represent 2.77% and 1.41% of the observations, while sovereign rating downgrades of one-notch (>one-notch) represent 1.46% (1.16%) of the observations, and sovereign negative watch signals represent 1.35% of the observations (see Table 2).

Table 6 presents the estimation results of Eq. (1) using bank downgrades from each CRA separately. We find that European banks are more likely to be downgraded following sovereign rating downgrades by all three CRAs. The impact on bank ratings is the strongest for sovereign rating downgrades of more than one-notch by S&P, whereby a bank has subsequent increased probabilities of a rating downgrade of one-notch and more than one-notch by S&P by 27.06% and 15.26%. Banks have higher probabilities to be downgraded by one-notch following sovereign rating downgrades by Fitch versus Moody's, while banks have higher probabilities to be downgraded by >one-notch following sovereign rating downgrades

by Moody's versus Fitch. For sovereigns receiving a one-notch (> one-notch) downgrade, a bank has increased probabilities of a rating downgrade of one-notch by Moody's by 7.29% (9.55%) and by Fitch by 10.04% (12.30%), and banks have increased probabilities of a rating downgrade of >one-notch by Moody's by 8.10% (12.15%) and by Fitch by 4.11% (5.59%). The higher probability of bank rating downgrade by more than one-notch in the case of Moody's compared to Fitch is in line with Moody's apparent policy of adjusting its rating by multiple notches when the action is taken (see Tables 2, 3 and 4). In general, the impact is stronger for sovereign rating downgrades of >one-notch than of one-notch. Sovereign negative watch signals by the three CRAs have a weaker impact on bank ratings' behaviour, whereby a bank has subsequent increased probabilities of a rating downgrade of one-notch and >one-notch by S&P by 2.42% and 0.40%, by Moody's by 2.84% and 2.39%, and by Fitch by 2.05% and 0.52%.

The MEs should be considered in the context that, in the examined sample, bank rating downgrades of one-notch (more than one-notch) represent 3.21% (0.99%) of the observations for S&P, 2.71% (2.31%) for Moody's and 2.48% (0.89%) for Fitch, while sovereign rating downgrades by one-notch (> one-notch) represent 1.84% (1.02%) of the observations for S&P, 1.33% (1.40%) for Moody's and 1.21% (1.08%) for Fitch, and sovereign negative watch signals represent 1.78% of the observations for S&P, 1.46% for Moody's and 0.83% for Fitch (see Table 2).

Further, the Pseudo–R^2 value is highest in the case of S&P (24.7%) compared to Fitch (21.1%) and Moody's (13.7%). The Pseudo–R^2 values confirm that S&P sovereign actions are the most influential on bank rating downgrades. However, and interestingly, Fitch sovereign rating actions appear to have a stronger impact than Moody's signals on bank rating downgrades in European countries. It should be pointed out that Fitch has dual headquarters (New York and London) and that it is majority-owned by Fimalac SA, which is

headquartered in Paris. Thus, some market participants may pay more attention to Fitch rating actions in Europe. Table 6 also reveals that banks from countries with better (poorer) sovereign ratings from Fitch are less (more) likely to be downgraded, suggesting that the impact of Fitch negative sovereign events on bank ratings is most marked for lower credit quality sovereigns. This finding resonates with events during the recent financial crisis, whereby the exposures of European banks in Greece, Portugal, Italy and Spain to the sovereign debt of their own country are substantial.

Table 7 presents the estimation results of Eq. (1) using data from each CRA separately for PIIGS countries. The results generally confirm the view from Table 6. We find that banks in PIIGS countries are more likely to be downgraded following sovereign rating downgrades and negative watch signals by the three CRAs. The marginal effects are stronger for sovereign downgrades of more than one-notch, where a bank has subsequent increased probabilities of a rating downgrade of one-notch (more than one-notch) by 27.12% (17.47%) by S&P, 7.22% (9.74%) by Moody's, and 12.53% (5.89%) by Fitch. The marginal effects are economically smaller for one-notch downgrades by S&P than for Fitch and Moody's. For sovereigns receiving a one-notch downgrade, a bank has increased probabilities of a rating downgrade of one-notch (>one-notch) by 4.15% (0.90%) by S&P versus 5.71% (7.05%) by Moody's and 7.83% (2.97%) by Fitch. Consistent with the results of Table 6, sovereign negative watch signals by Moody's and S&P for PIIGS countries have a weaker impact on bank ratings, whereby a bank has subsequent increased probabilities of a rating downgrade of one-notch and >one-notch by S&P by 2.61% and 0.51%, by Moody's by 2.35% and 2.29%, and by Fitch by 3.10% and 0.90%. As expected, the marginal effects are relatively stronger when we focus on the PIIGS countries (Table 7 versus Table 6).

5.2. The lead–lag relationship in bank rating changes

Table 8 presents the results of examining the lead-lag relationships in bank ratings. In general, we find evidence of interdependence in bank rating actions. A bank that has been downgraded by one CRA has a significantly increased probability to experience a harsher (more than one-notch) downgrade by another CRA.

Panel I of Table 8 considers Moody's and S&P. A bank that experiences a downgrade by S&P has a significantly increased probability to be downgraded by >one-notch by Moody's for every time window, while has decreased probabilities to be upgraded or downgraded by one-notch by Moody's. Downgrading a bank by S&P significantly raises the probability of downgrades of >one-notch by Moody's within one month (which has an implication for market reactions) to a much greater extent than vice versa (51.83% versus 14.56%). Similarly, downgrading a bank by S&P significantly raises the probability of downgrades of >one-notch by Moody's within 2-6 months to a greater extent than vice versa (12.63% versus 11.05%). The Pseudo-R^2 value is 34.9% when S&P is a leader to Moody's bank rating downgrades, while it is 32.4% when Moody's is a leader.

Panel II of Table 8 considers Moody's and Fitch. Downgrading a bank by Fitch significantly raises the probabilities of downgrades of more than one-notch by Moody's by 16.93% (17.07%) within 2-6 (7-12) months, while decreasing the probabilities of Moody's upgrades or downgrades by one-notch. Downgrading a bank by Moody's significantly raises the probability of downgrades of more-than-one-notch by Fitch by 23.14% within one month, while decreasing the probabilities of Fitch upgrades or downgrades by one-notch. Fitch downgrades are not linked to Moody's downgrades at other horizons. The Pseudo-R^2 value is 31.5% when Fitch is a leader to Moody's bank rating downgrades, while it is 22.8% when Moody's is a leader.

Panel III of Table 8 considers S&P and Fitch. Downgrading a bank by Fitch has no significant impact on the probabilities of bank ratings dynamics of S&P. In comparison, a bank that experiences a downgrade by S&P has significantly increased probabilities to be downgraded by more than one-notch by Fitch by 35.14% within one-month and 16.44% within 2-6 months.

Overall, the results suggest common information flows influences CRAs. A bank rating downgrade by a 'leader' CRA tends to be followed by a harsher bank rating downgrade by a lagging CRA. A given CRA announces a rating change normally as a consequence of information that leads it to re-assess the creditworthiness of a bank. However, a CRA's bank rating downgrade following another CRA rating downgrade can take some time. A bank rating downgrade by the lagging CRA may not occur until a steady accumulation of news that the leader CRA's bank downgrade already reflected at an earlier date. Yet bank rating downgrades by CRAs may independently follow important news relating to given bank, or they may independently react to similar common underlying information. These rating actions tend not to occur at the same time since the models used by different CRAs have different weights/thresholds for different inputs to trigger a bank rating downgrade. In general, S&P has the strongest evidence of being a first mover in European bank rating downgrades in the crisis period. Moody's appears to take longer before acting, but then may apply harsher downgrades.

6. Conclusions

The European sovereign debt crisis brought increased attention to the role of CRAs and to the links between sovereign and banking risks. The crisis represented a significant challenge to CRAs in deciding the timing and extent of downgrades to sovereign and bank ratings, e.g. establishing the influence of explicit and implicit government guarantees to

countries' banking sectors. The three large CRAs dealt with the issues differently, leading to differences in the timing of rating actions and a preponderance of split ratings. This paper is the first to assess the reaction of European bank ratings to sovereign credit signals. The evidence is based on 84 banks in 21 European developed countries, and ratings are from S&P, Moody's and Fitch for the period October 2006 to December 2012. The paper is also the first to analyse the lead-lag relationship in bank ratings across the largest CRAs.

The descriptive statistics highlight that the average bank ratings appear to be lower than the average sovereign ratings by at least 2 notches, with more than 83% of the bank ratings' observations below the sovereign ceiling. A strong rating downgrade trend dominates our sample, and is driven by the sovereign debt crisis. We observe differences in opinion and timing of bank and sovereign rating actions across CRAs, with Moody's (S&P) broadly tending to be the most generous (harshest) CRA.

The empirical results show that European developed bank ratings are frequently constrained by the sovereign ceiling, highlighting the importance of sovereign ratings for banks in European developed markets, and how strongly CRAs apply the sovereign ceiling in the majority of cases. Significant differences are identified across the three CRAs in their policy regarding the attachment between sovereign and bank credit actions. We find that multiple-notch sovereign rating downgrades by S&P have the strongest impact on bank rating downgrades. We also reveal higher probability of bank rating downgrade by more than one-notch in the case of Moody's compared to Fitch, which is consistent with Moody's apparent policy of adjusting its rating decisively when the action is taken. Although negative sovereign watch actions by the three CRAs significantly affect bank rating downgrades, their impact is relatively weaker than sovereign rating downgrades. Banks in PIIGS countries appear to be more affected by the sovereign credit signals than those in other European countries, in line

with the fact that the exposures of European banks in Greece, Portugal, Italy and Spain to the sovereign debt of their own country were substantial.

Further, we find evidence of interdependence in bank rating actions across CRAs. A bank that has been downgraded by one CRA has a significantly increased probability to experience harsher (more than one-notch) downgrades by one of the competing CRAs. S&P has most evidence of acting as a first mover in bank rating downgrades in European developed markets. Moody's appears more cautious in downgrading but can then take decisive action, as evidenced by frequent use of multiple-notch downgrades. There are differences in rating policy with Moody's applying greater rating stability than the other two CRAs. Different users of ratings will have different preferences across the CRAs' policies (e.g. see Boot et al., 2006; Cantor et al., 2007).

We contribute to the bank rating literature by providing evidence suggesting that the probabilities of bank rating migrations can be estimated more precisely by considering previous bank rating actions by a competing CRA and also by taking into account sovereign credit signals for the home country of the banks. For European countries, we show a strong potential for rating leadership in the banking sector, whereby S&P appears to be the most independent actor. A possible reason for evidence of Fitch's relative independence is that the countries/banks of interest are located in the European area. Because Fitch has dual headquarters and a European owner, some market participants may pay more attention to Fitch rating actions in Europe. Our results should improve the perspectives of European commentators on the rating decisions of these CRAs. Other market participants, such as regulators, financial institutions, issuers, investors, and credit managers, will also be interested in this relationship among CRAs in several respects. CRAs will also be interested from a reputational perspective, particularly with the expectation of increased competition in the rating industry following the recent introduction of formal European Union regulations.

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Table 1- List of sovereigns and banks

No.	Bank name	Country	No.	Bank name	Country
1	Erste Bank Group (EBG)	Austria	43	Banque et Caisse d'Epargne de l'Etat	Luxembourg
2	Oesterreichische Volksbanken	Austria	44	Bank of Valletta	Malta
3	Raiffeisen Bank International AG	Austria	45	ING BANK NV	Netherlands
4	Dexia	Belgium	46	Rabobank Nederland	Netherlands
5	KBC Bank NV	Belgium	47	ABN Amro Bank NV	Netherlands
6	Bank of Cyprus Ltd	Cyprus	48	SNS Bank NV	Netherlands
7	Marfin Popular Bank Public Co Ltd	Cyprus	49	DnB Bank ASA	Norway
8	Danske Bank A/S	Denmark	50	Powszechna Kasa Oszczednosci Bank Polski SA	Poland
9	Jyske Bank A/S	Denmark	51	Banco BPI SA	Portugal
10	Nykredit Bank A/S	Denmark	52	Banco Comercial Portugues SA	Portugal
11	Sydbank A/S	Denmark	53	Caixa Geral de Depositos SA	Portugal
12	OP-Pohjola Group	Finland	54	Espirito Santo Financial Group SA	Portugal
13	BNP Paribas	France	55	Nova Kreditna Banka Maribor d.d.	Slovenia
14	BPCE	France	56	Nova Ljubljanska Banka d.d.	Slovenia
15	Credit Agricole	France	57	Banca March SA	Spain
16	Societe Generale	France	58	Banco Bilbao Vizcaya Argentaria SA	Spain
17	Bayerische Landesbank Girozentrale	Germany	59	Banco de Sabadell	Spain
18	Commerzbank AG	Germany	60	Banco Grupo Caja Tres SA	Spain
19	DekaBank Deutsche Girozentrale	Germany	61	Banco Pastor SA	Spain
20	Deutsche Bank AG	Germany	62	Banco Popular Espanol SA	Spain
21	DZ Bank Deutsche Zentral-Genossenschaftsbank AG	Germany	63	Banco Santander SA	Spain
22	HSH Nordbank	Germany	64	Bankinter SA	Spain
23	Hypo Real Estate Holding AG	Germany	65	Bilbao Bizkaia Kutxa (BBK)	Spain
24	Landesbank Baden-Wuerttemberg	Germany	66	Caixa de Aforros de Galicia, Vigo, Ourense e Pontevedra	Spain
25	Landesbank Berlin	Germany	67	Caixa d'Estalvis Unio de Caixes Manlleu, Sabadell Terrassa	Spain
26	Norddeutsche Landesbank Girozentrale	Germany	68	Caja de Ahorros de Vitoria y Alava	Spain
27	WestLB AG	Germany	69	Caja de Ahorros del Mediterraneo	Spain
28	WGZ Bank	Germany	70	Caja de Ahorros y Monte de Piedad de Zaragoza (IBERCAJA)	Spain
29	Agricultural Bank of Greece SA	Greece	71	Caja de Ahorros y Pensiones de Barcelona	Spain
30	Alpha Bank AE	Greece	72	Caja Espana de Inversiones, Salamanca y Soria	Spain
31	EFG Eurobank Ergasias SA	Greece	73	Grupo Banca Civica	Spain
32	National Bank of Greece SA	Greece	74	Monte de Piedad Y Caja de Ahorros de Ronda, Cadiz, Almeria, Malaga, Antequera Y Jaen	Spain
33	Piraeus Bank SA	Greece	75	Caixa D'Estalvis de Catalunya, Tarragona I Manresa	Spain
34	OTP Bank Nyrt	Hungary	76	BFA-Bankia	Spain
35	Allied Irish Banks plc	Ireland	77	Nordea Bank AB	Sweden
36	Bank of Ireland	Ireland	78	Skandinaviska Enskilda Banken	Sweden
37	Irish Life and Permanent	Ireland	79	Svenska Handelsbanken AB	Sweden
38	Banca Monte dei Paschi di Siena SpA	Italy	80	Swedbank AB	Sweden
39	Banco Popolare Societa Cooperativa SCRL	Italy	81	Barclays plc	UK
40	Intesa Sanpaolo SpA	Italy	82	HSBC Holdings plc	UK
41	Unione di Banche Italiane ScpA - UBI Banca	Italy	83	Lloyds Banking Group plc	UK
42	UniCredit SpA	Italy	84	Royal Bank of Scotland Group plc	UK

This table presents the banks and their country of origin which are included in our sample. The 84 banks are part of the 2011 EU stress test (see footnote 3).

Table 2

Descriptive statistics of the data sample

		S&P		Moody's		Fitch		Total	
Banks	Countries	17		20		18		21	
	Rated banks	62		75		78		84	
	Average numerical rating	15.0		15.7		15.1		15.3	
	Upgrade by 1-notch	26	0.66%	21	0.45%	7	0.14%	54	0.40%
	Upgrade by > 1-notch	0	0.00%	25	0.53%	1	0.02%	26	0.19%
	Downgrade by 1-notch	126	3.21%	127	2.71%	120	2.48%	373	2.77%
	Downgrade by > 1-notch	39	0.99%	108	2.31%	43	0.89%	190	1.41%
	B=S	343	8.8%	579	12.4%	397	8.2%	1319	9.8%
	B>S	99	2.5%	192	4.1%	61	1.3%	352	2.6%
	B<S	3483	88.7%	3912	83.5%	4387	90.5%	11,782	87.6%
	Observations	3925		4683		4845		13,453	
Sovereign actions	Average numerical rating	17.9		18.3		18.2		18.1	
	Upgrade by 1-notch	2	0.13%	4	0.25%	3	0.19%	9	0.19%
	Upgrade by > 1-notch	2	0.13%	0	0.00%	1	0.06%	3	0.06%
	Downgrade by 1-notch	29	1.84%	21	1.33%	19	1.21%	69	1.46%
	Downgrade by > 1-notch	16	1.02%	22	1.40%	17	1.08%	55	1.16%
	Positive Watch signals	0	0.00%	2	0.13%	0	0.00%	2	0.04%
	Negative Watch signals	28	1.78%	23	1.46%	13	0.83%	64	1.35%
	Observations	1575		1575		1575		4725	

The table presents summary statistics for the credit rating dataset, which consists of end of month bank and sovereign ratings and watch (only for the sovereigns) for 84 banks from 21 European advanced countries for October 2006 to December 2012. B=S, B < S, and B > S are defined as follows: Banks rated the same as the sovereign, banks rated worse than the sovereign, and banks rated better than the sovereign, respectively.

Table 3

Descriptive statistics for PIIGS countries

		S&P	Moody's	Fitch
Portugal	Rated banks	4	4	4
	Bank Upgrade	3	4	0
	Bank Downgrades by one-notch	8	15	9
	Bank Downgrades by more than one-notch	10	9	6
	Sovereign Downgrades by one-notch	1	2	3
	Sovereign Downgrades by more than one-notch	3	3	2
	Sovereign negative watch signals	2	3	2
Italy	Rated banks	5	5	5
	Bank Upgrade	2	3	1
	Bank Downgrades by one-notch	13	9	13
	Bank Downgrades by more than one-notch	3	9	1
	Sovereign Downgrades by one-notch	2	1	2
	Sovereign Downgrades by more than one-notch	1	2	1
	Sovereign negative watch signals	1	1	1
Ireland	Rated banks	3	3	3
	Bank Upgrade	0	4	0
	Bank Downgrades by one-notch	16	7	2
	Bank Downgrades by more than one-notch	2	8	5
	Sovereign Downgrades by one-notch	5	3	2
	Sovereign Downgrades by more than one-notch	1	2	2
	Sovereign negative watch signals	3	2	2
Greece	Rated banks	4	5	5
	Bank Upgrade	2	2	3
	Bank Downgrades by one-notch	9	4	21
	Bank Downgrades by more than one-notch	12	17	15
	Sovereign Upgrades	2	0	1
	Sovereign Downgrades by one-notch	2	2	5
	Sovereign Downgrades by more than one-notch	5	4	3
	Sovereign negative watch signals	5	4	2
Spain	Rated banks	12	15	18
	Bank Upgrade	5	3	0
	Bank Downgrades by one-notch	39	20	34
	Bank Downgrades by more than one-notch	9	22	8
	Sovereign Downgrades by one-notch	3	2	1
	Sovereign Downgrades by more than one-notch	3	3	3
	Sovereign negative watch signals	1	4	1

The table presents summary statistics for PIIGS sub-sample, which consists of end-of-month bank and sovereign ratings and watch (only for the sovereigns) for October 2006 to December 2012.

Table 4

Distribution of the monthly bank rating changes by each pair of CRAs

	1 notch upgrade	>1 notch upgrade	Total upgrade	1 notch downgrade	>1 notch downgrade	Total downgrade	All changes	% of obs.
S&P and Moody's		***(61 banks with 4,200 observations)***						
S&P	24	0	24	122	36	158	182	4.33%
Moody's	20	19	39	109	88	197	236	5.62%
S&P and Fitch		***(57 banks with 4,094 observations)***						
S&P	26	0	26	120	37	157	183	4.47%
Fitch	7	0	7	96	32	128	135	3.30%
Moody's and Fitch		***(68 banks with 4,813 observations)***						
Moody's	18	23	41	110	101	211	252	5.24%
Fitch	7	0	7	103	36	139	146	3.03%
Column number	1	2	3	4	5	6	7	8

This Table provides an overview of bank monthly rating changes for 84 European banks rated by each pair of CRAs during October 2006 to December 2012.

Table 5

Estimation results of Eq. (1) for the whole sample

Explanatory variables	BUP					BDN				
	Coeff.	t-value	Marginal effects			Coeff.	t-value	Marginal effects (%)		
			0	1n	> 1n			0	1n	> 1n
SDN_1n	-0.12	-0.35				0.90	11.37***	-11.72	7.42	4.30
SDN_2n	NA	NA				1.32	16.44***	-22.62	12.81	9.81
NW	0.16	0.47				0.37	5.47***	-3.01	2.11	0.90
Srat	0.001	0.03				-0.02	-1.50			
Co/Y dummies	Yes					Yes				
	Pseudo R^2		12.1%	Obs.	12,962	Pseudo R^2		17.6%	Obs.	13,453

This Table reports the results of ordered probit estimation (Eq. (1)) with robust standard errors using data from three CRAs, Moody's, S&P, and Fitch, pooled together. The credit rating dataset consists of end of month bank and sovereign ratings and watch (only for the sovereigns) for 84 banks from 21 European advanced countries for October 2006 to December 2012. The dependent variable is *BUP* (*BDN*) (which equals 0, 1 or 2 if a European bank from country *i* is upgraded (downgraded) by CRA *a* by 0, 1, 2 or more notches, respectively, in month *t*; 0 otherwise). $SDN\_1n_{i,a}$ ($SDN\_2n_{i,a}$) is a dummy variable taking the value of 1 if sovereign *i* is downgraded by one-notch (more than one-notch) by CRA *a* up to 2 months prior to month *t*, 0 otherwise. $NW_{i,a}$ is a dummy variable taking the value of 1 if sovereign *i* is placed on negative watch by CRA *a*, up to 3 months prior to month *t*, 0 otherwise. $Srat_{i,t}$ is the sovereign rating. Full sets of country (*Co*) and year (*Y*) dummy variables are included. We also estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with significant (at 10% or better) coefficients. The estimates of the two threshold parameters are significant at the 1% level in all estimations, and are not shown here.

*** Significant at 1% level.

Table 6

Estimation results of Eq. (1)- Bank rating downgrades- for sub-samples by each CRAs

Explanatory variables	Coefficient	t-value	Marginal effects (%)		
			0	1n	> 1n
Panel I- S&P					
SDN_1n	0.56	3.45***	-5.10	4.30	0.80
SDN_2n	1.92	10.38***	-42.32	27.06	15.26
NW	0.38	2.70***	-2.82	2.42	0.40
Srat	0.01	0.44			
Co/Y dummies	Yes				
	Pseudo R^2	24.7%		Obs.	3925
Panel II- Moody's					
SDN_1n	0.94	6.64***	-15.39	7.29	8.10
SDN_2n	1.17	8.88***	-21.70	9.55	12.15
NW	0.47	4.14***	-5.23	2.84	2.39
Srat	-0.01	-0.25			
Co/Y dummies	Yes				
	Pseudo R^2	13.7%		Obs.	4683
Panel III- Fitch					
SDN_1n	1.12	8.50***	-14.15	10.04	4.11
SDN_2n	1.28	9.99***	-17.89	12.30	5.59
NW	0.39	2.92***	-2.57	2.05	0.52
Srat	-0.05	-2.64***	0.24	-0.20	-0.04
Co/Y dummies	Yes				
	Pseudo R^2	21.1%		Obs.	4845

This Table reports the results of ordered probit estimation (Eq. (1)) with robust standard errors using data from each CRAs, Moody's, S&P, and Fitch, separately. The credit rating dataset consists of end of month bank and sovereign ratings and watch (only for the sovereigns) for 62, 75, and 78 banks rated by S&P, Moody's and Fitch, respectively, from 21 European advanced countries for October 2006 to December 2012. The dependent variable is *BDN* which equals 0, 1 or 2 if a European bank from country *i* is downgraded by CRA *a* by 0, 1, 2 or more notches, respectively, in month *t*; 0 otherwise. $SDN\_1n_{i,a}$ ($SDN\_2n_{i,a}$) is a dummy variable taking the value of 1 if sovereign *i* is downgraded by one-notch (more than one-notch) by CRA *a* up to 2 months prior to month *t*, 0 otherwise. $NW_{i,a}$ is a dummy variable taking the value of 1 if sovereign *i* is placed on negative watch by CRA *a*, up to 3 months prior to month *t*, 0 otherwise. $Srat_{i,t}$ is the sovereign rating. Full sets of country (*Co*) and year (*Y*) dummy variables are included. We also estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with significant (at 10% or better) coefficients. The estimates of the two threshold parameters are significant at the 1% level in all estimations, and are not shown here.

*** Significant at 1% level.

Table 7

Estimation results of Eq. (1)- Bank rating downgrades in PIIGS countries

Explanatory variables	Coefficient	t-value	Marginal effects (%)		
			0	1n	> 1n
Panel I- S&P					
SDN_1n	0.49	2.87***	-5.05	4.15	0.90
SDN_2n	1.91	9.90***	-44.59	27.12	17.47
NW	0.35	2.25**	-3.12	2.61	0.51
Srat	0.06	1.98**	-0.44	0.38	0.06
Co/Y dummies	Yes				
	Pseudo R^2	29.0%		Obs.	1775
Panel II- Moody's					
SDN_1n	0.89	5.75***	-12.76	5.71	7.05
SDN_2n	1.08	7.65***	-16.96	7.22	9.74
NW	0.47	3.68***	-4.64	2.35	2.29
Srat	-0.03	-1.04			
Co/Y dummies	Yes				
	Pseudo R^2	20.2%		Obs.	1939
Panel III- Fitch					
SDN_1n	0.91	6.12***	-10.80	7.83	2.97
SDN_2n	1.25	9.38***	-18.42	12.53	5.89
NW	0.48	3.17***	-4.00	3.10	0.90
Srat	-0.03	-0.96			
Co/Y dummies	Yes				
	Pseudo R^2	23.8%		Obs.	2101

This Table reports the results of ordered probit estimation (Eq. (1)) with robust standard errors using sub-samples rating dataset that consists of end of month bank and sovereign ratings and watch (only for the sovereigns) for 28, 32, and 35 banks rated by S&P, Moody's and Fitch, respectively, in PIIGS countries for October 2006 to December 2012. For definitions of the dependent variable and independent variables, see Table 5. Full sets of country (*Co*) and year (*Y*) dummy variables are included. We also estimate and report the impact of each variable on the probability of a rating change (marginal effect), but only for variables with significant (at 10% or better) coefficients. The estimates of the two threshold parameters are significant at the 1% level in all estimations, and are not shown here.

*** Significant at 1% level; ** Significant at 5% level.

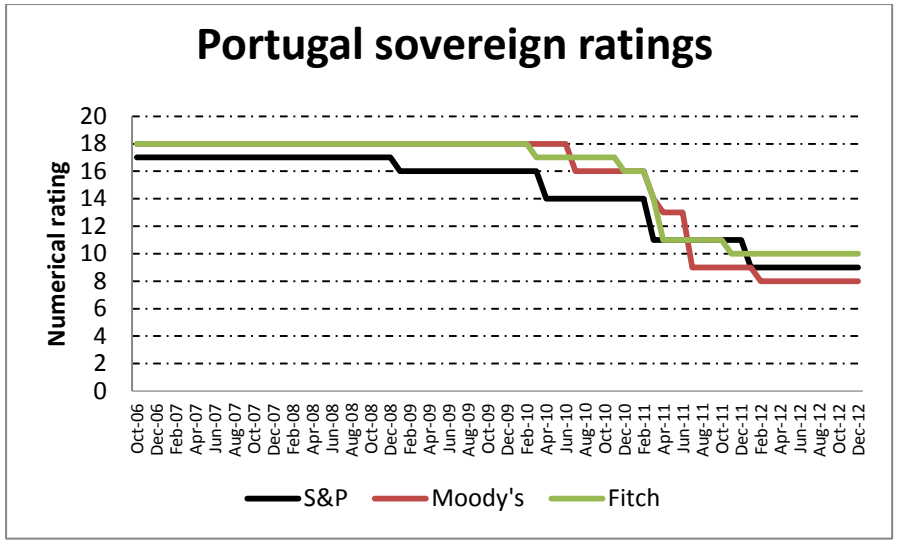
Table 8

Lead-lag relationship in bank ratings between each pair of CRAs, Equations (2) and (3)

	Coefficients	t-val	Marginal Effects (%)			
			Avr |Chg|	<=-2n	-1n	>=1n
Panel I: S&P and Moody's						
S&P as rating follower, Equation (2)						
D_BDN by Moody's h=1	-0.64	-1.94*	9.70	14.56	-11.65	-2.91
D_BDN by Moody's h=2	-0.59	-2.56***	7.37	11.05	-7.23	-3.82
D_BDN by Moody's h=3	-0.29	-1.16				
Co/Y dummies	Yes					
	Pseudo R^2	32.4%	No. of obs.	182		
Moody's as rating follower, Equation (3)						
D_BDN by S&P h=1	-1.41	-4.52***	34.55	51.83	-45.92	-5.91
D_BDN by S&P h=2	-0.37	-1.69*	8.42	12.63	-9.54	-3.09
D_BDN by S&P h=3	-0.59	-2.64***	14.24	21.20	-16.88	-4.32
Co/Y dummies	Yes					
	Pseudo R^2	34.9%	No. of obs.	236		
Panel II: Moody's and Fitch						
Moody's as rating follower, Equation (2)						
D_BDN by Fitch h=1	-0.55	-1.50				
D_BDN by Fitch h=2	-0.46	-2.18**	11.29	16.93	-12.60	-4.33
D_BDN by Fitch h=3	-0.46	-1.92*	11.38	17.07	-13.04	-4.03
Co/Y dummies	Yes					
	Pseudo R^2	31.5%	No. of obs.	252		
Fitch as rating follower, Equation (3)						
D_BDN by Moody's h=1	-0.71	-1.98**	15.43	23.14	-21.40	-1.74
D_BDN by Moody's h=2	-0.27	-1.20				
D_BDN by Moody's h=3	-0.06	-0.23				
Co/Y dummies	Yes					
	Pseudo R^2	22.8%	No. of obs.	146		
Panel III: S&P and Fitch						
S&P as rating follower, Equation (2)						
D_BDN by Fitch h=1	0.47	1.55				
D_BDN by Fitch h=2	0.26	1.13				
D_BDN by Fitch h=3	0.30	1.04				
Co/Y dummies	Yes					
	Pseudo R^2	24.5%	No. of obs.	183		
Fitch as rating follower, Equation (3)						
D_BDN by S&P h=1	-1.08	-3.45***	23.43	35.14	-33.61	-1.53
D_BDN by S&P h=2	-0.61	-2.44**	10.96	16.44	-15.00	-1.44
D_BDN by S&P h=3	-0.24	-0.76				
Co/Y dummies	Yes					
	Pseudo R^2	29.6%	No. of obs.	135		

This Table reports the results of ordered probit estimations of Eq. (2) and Eq. (3) using monthly bank ratings of 84 European banks in 21 countries jointly rated by S&P and Moody's in panel I, by Moody's and Fitch in panel II, and by S&P and Fitch in panel III during October 2006 to December 2012. The dependent variables are $\Delta BR_{k,t}$ referring to a bank rating change by the potential follower CRA for bank *k* at month *t*. Three different classes of rating changes are employed: ≤ -2, -1, and ≥1, i.e., downgrade by more than one-notch, downgrade by one-notch, upgrade by one-notch or more. The independent variables: $D\_BDN_{k,h}$,which are dummy variables taking the value of 1 if a bank *k* was downgraded by the potential leader CRA, in three predefined windows of time ***h,*** with *h*=1 for 1 month, *h*=2 for 2-6 months, and *h*=3 for 7-12 months prior to the rating change for bank *k* at month *t* by the potential follower CRA, zero otherwise. Full sets of country (*Co*) and year (*Y*) dummy variables are included. We apply Huber-White robust standard errors. We also estimate and report the impact of each variable on the probability of a bank rating change (marginal effect (ME)) , but only for variables with significant (at 10% or better) coefficients. The estimates of the two threshold parameters are significant at the 1% level in all estimations, and are not shown here.

*** Significant at 1% level; ** Significant at 5% level; *Significant at 10% level.


Portugal sovereign ratings
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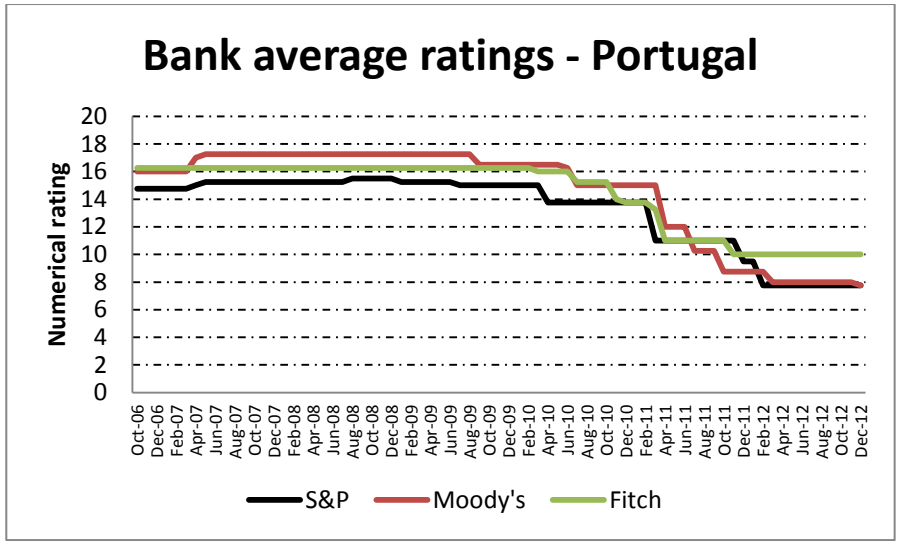
S&P
Moody's
Fitch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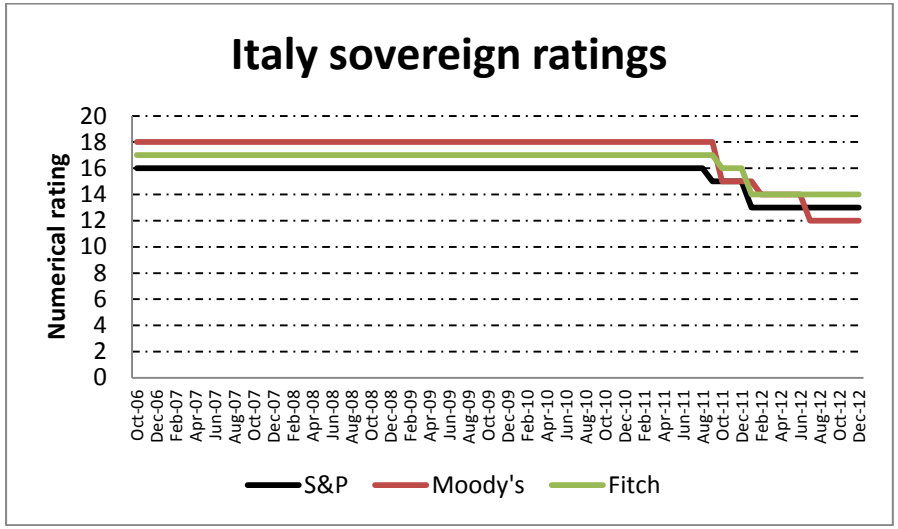
S&P
Moody's
Fitch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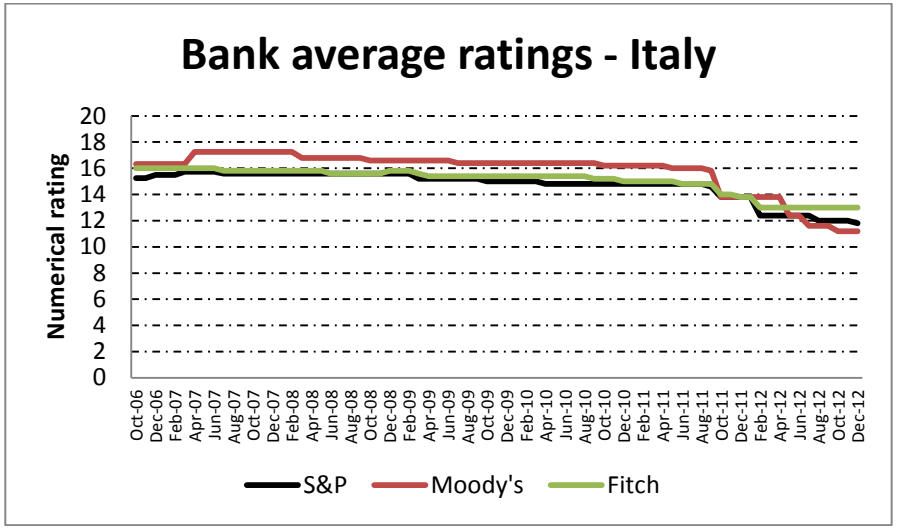
S&P
Moody's
Fitch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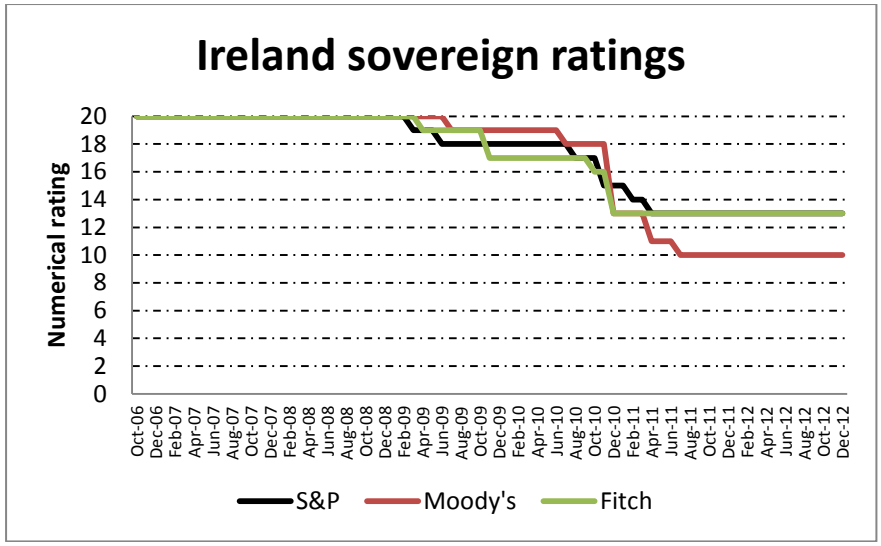
S&P
Moody's
Fitch


Ireland sovereign ratings
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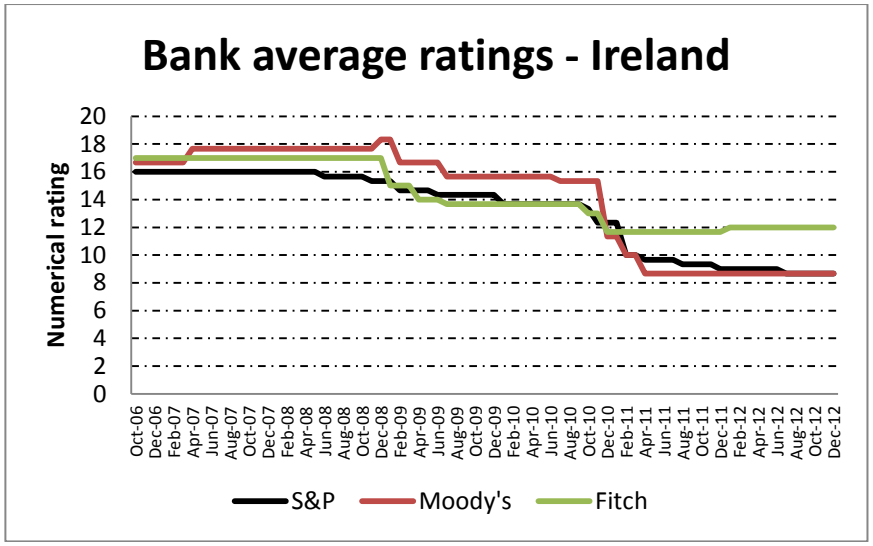
S&P
Moody's
Fitch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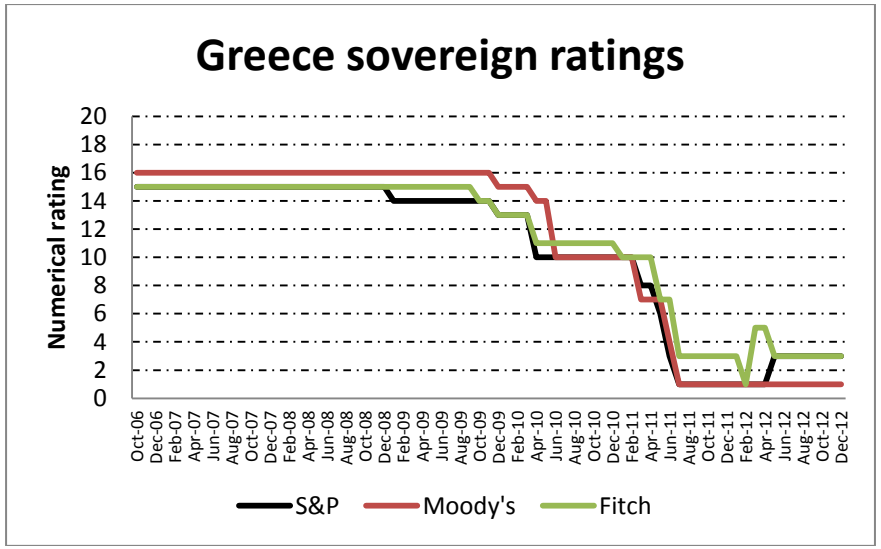
S&P
Moody's
Fitch


Greece sovereign ratings
Numerical rating
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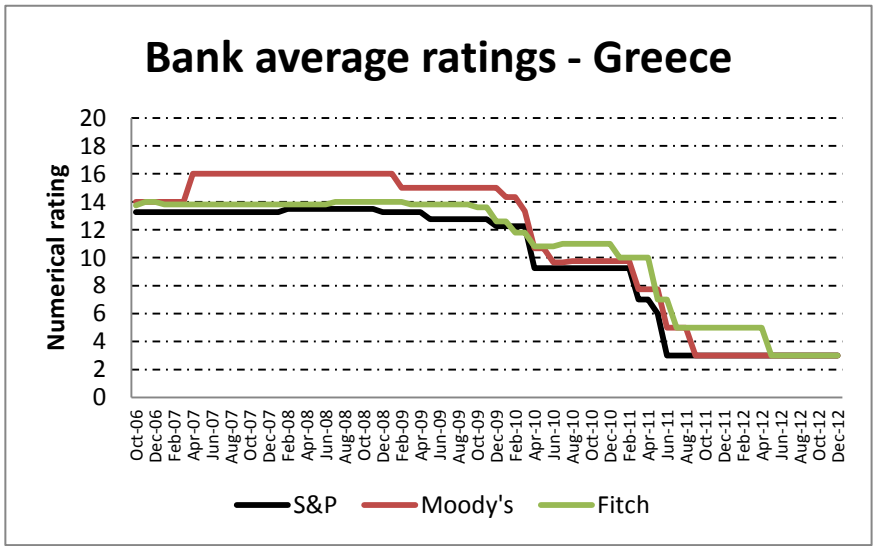
Oct-06 Dec-06 Feb-07 Apr-07 Jun-07 Aug-07 Oct-07 Dec-07 Feb-08 Apr-08 Jun-08 Aug-08 Oct-08 Dec-08 Feb-09 Apr-09 Jun-09 Aug-09 Oct-09 Dec-09 Feb-10 Apr-10 Jun-10 Aug-10 Oct-10 Dec-10 Feb-11 Apr-11 Jun-11 Aug-11 Oct-11 Dec-11 Feb-12 Apr-12 Jun-12 Aug-12 Oct-12 Dec-12
S&P
Moody's
Fitch


Bank average ratings - Greece
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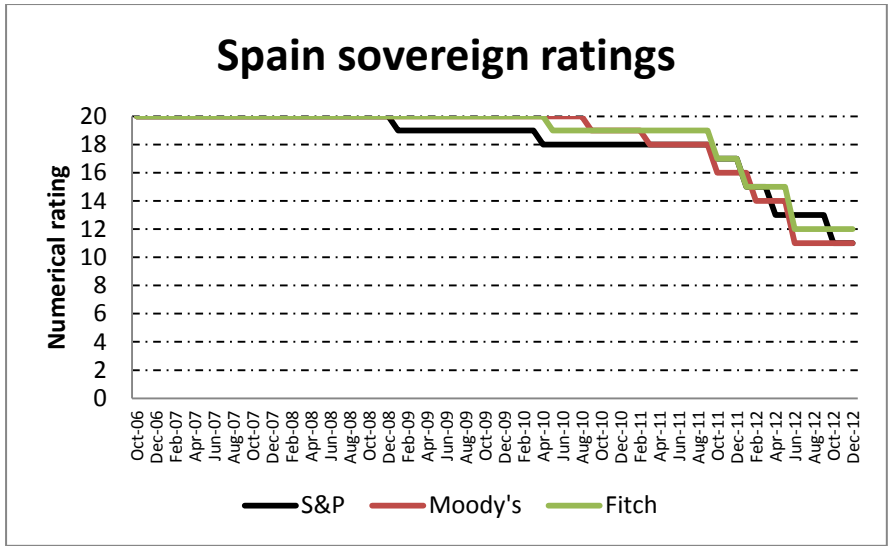
Fitch



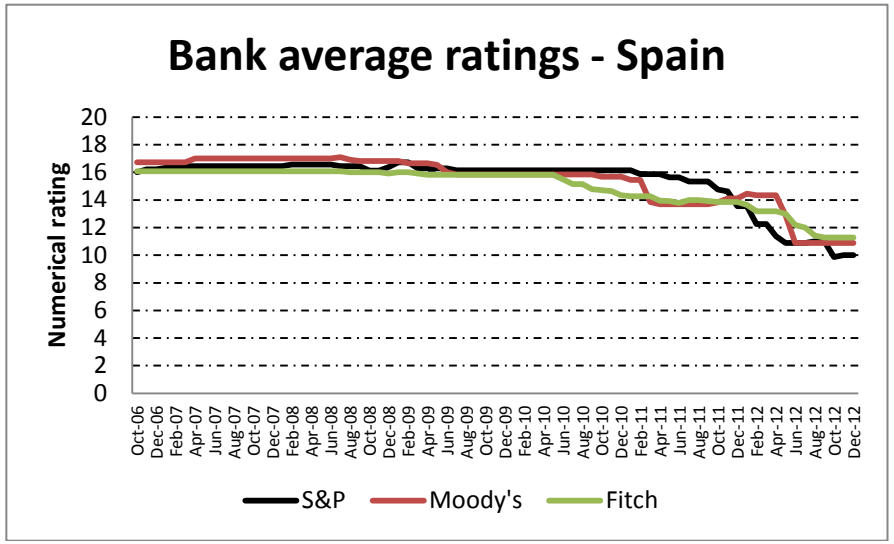


Fig. 1. The behaviour of bank and sovereign ratings of PIIGS countries during the crisis period (October 2006 to December 2012). The credit ratings scale is transformed into a 20-point numerical scale (Aaa/AAA = 20, Aa1/AA+ = 2, Aa2/AA = 3 … Caa3/CCC- = 2, Ca/CC, C/SD-D = 1).